Exploring Gender Disparities in the Learning Experiences of Students Studying Natural Sciences in Selected High Schools of Makonde District Zimbabwe

By

Welensky Mashavave

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Abstract

Globally, despite many good intentions and a plethora of initiatives, gender disparities in science education continue to be a major challenge. In the context of the student understanding and learning in Science, Technology, Engineering and Mathematics (STEM) policy, this study sought to investigate gender disparities and experiences in the learning of Natural Sciences at secondary school level in the Makonde District of Zimbabwe. Informed and guided by the pragmatism paradigm, the study used a fusion of quantitative and qualitative methodological approaches to study gender disparities using a sample of students (n= 590) and eight teachers from five schools in Makonde District, Zimbabwe. Quantitative data was collected using a Likert type questionnaire. Focus group discussions (FGDs), interviews and class observations were used to collect qualitative data. Quantitative data analyses were done using chi-square statistics, one-way analysis of variance (ANOVA) and factor analysis (FA). Qualitative content analysis (QCA) was used to analyze qualitative data obtained from four focus group discussions, eight teacher interviews and three lesson observations. The main findings of this study confirm the existence of gender disparities in Natural Sciences learning. It was also found that female and male students learning experiences were different from each other. Gender stereotyping and discrimination by male students were found to be rife in the classrooms. Female students perceived their classrooms to be gender biased. School administrations and teaching structures were found to be gender biased. Some recommendations are made for teacher pedagogical practices as well as policy selection criteria in Natural Sciences education.

Key Words

Gender disparity, natural sciences, learning experiences, gender stereotyping

Declaration

I declare that this thesis is my own unaided work. It is being submitted for the degree of Doctor of Philosophy in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other university.

Welensky Isaya Mashavave

15th day of October 2018

Dedication

I dedicate this thesis to the most important people in my life.

To my late wife and best friend, Ratidzai Madzingo Mashavave: for your love, academic insights and persuasive language and vision. May your dear soul rest in peace.

To my children Tafadzwa Diana, Munyaradzi Hlupo and Sithembiso Hlupo: for your love, support and understanding. Your encouragement kept me going even when the chips were down. The onus is now on you to challenge the set standard.

To my late parents Mr. H. and Mrs. D. Mashavave: for instilling in me the virtues of love, perseverance and resilience. You taught me never to be a “crying babe” and to be principled and defend what I believe in.

Publications and Presentations Emanating from this Research

Publication

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Conference papers

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CHAPTER 1

INTRODUCTION AND STUDY OVERVIEW

Introduction: whole-class participation

This study explored gender disparities in the learning experiences of students studying natural sciences in the Makonde District of Zimbabwe and how the disparities influenced the choice of natural science subjects. The study also investigated the reasons for low choice and performance in natural sciences by the female students. Gender discrimination experiences in the classes and the forms of gender stereotyping manifestations were also investigated. The study aimed at correlating such gender disparities and learning experiences and how they impact on the student's choice and performance of natural sciences. This study further explored whether the learning experiences of females were the same as that of the males in natural sciences. Before I discuss the study overview, let me start by introducing myself, my motivation and the district of study.

1.1 Introducing myself

My cultural beliefs and upbringing somehow dictate to me that I must start this thesis by introducing myself, discuss the motivation behind this study and the location of where the study was done and why? According to my culture (Shona-Karanga) one does not just start a conversation with anyone before a greeting followed by an introduction and then purpose of the visit. Introducing myself is a way of greeting you, the reader before any serious conversation (reading of the thesis) takes place. The purpose of sharing my background and context of the study is to enable the reader to comprehend and appreciate why I chose this topic, the research methodology, research design and my style of data interpretation. I am very much aware that there are conventional ways of presenting and analyzing data from different approaches, but I believe my style and approach adds a new-dimension in academic writing. I also identify with Mutua and Swadener (2004) in their proposition that research is not a neutral knowledge- creation exercise or a linear equation, but it is influenced by socio-cultural experiences and histories which repeatedly mold our thinking.

I was born in Shurugwi (Selukwe) in a village called Zura in the Midlands Province of Zimbabwe. My totem is Hungwe (fish eagle) of the Chasura lineage renowned for frank speaking and liberalized thinking. My father had two wives and we were fifteen children (9 girls and 6 boys). The family survived on peasant farming and some odd jobs in the nearby white commercial farms. Of all the girls, only two who were younger than me managed to go to school beyond grade seven levels. My father had a lot of cattle, but he saw no need to educate the girl child beyond grade seven. All of us the boys were encouraged to take schooling seriously and beyond grade seven. Resources were already available to the boy child and not to the girl child. This was the practiced norm by all the neighbouring villages. As I grew up I accepted these cultural practices as normal. The girl child's education was not meant for her to acquire life skills but just to have basic literacy (learn how to write and read) and then get married. She would then be able to read and reply letters from husbands working in towns, mines or farms far away from homes.

The traditional cultural norms, values, beliefs and expectations, to my surprise, were accepted by both males and females in my rural areas. After grade seven, I went to a co-education boarding school. My father was willing and happy to sell his cattle so that I could pursue higher education. This was the turning point in my cultural beliefs towards the females. The presence of girls at high school baffled the rural boys especially because some of the girls were equally competent in mathematics and natural sciences like the boys. I started thinking of my elder sisters, five of them were already married. Two of these girls were forcibly married (kuzvarigwa). They were just living ordinary lives bordering on the fringes of poverty. If they had gone further with their education, would they not be nurses or teachers? I had no answers because they had not been given the chances. Nursing and teaching were the easily known professions in my village. Female nurses worked at the district hospital and the female teachers at my local school. Surprisingly, the nurses and teachers that I knew came from faraway places like Gutu in Masvingo province and Matabeleland. I did my secondary education in Matabeleland South up to form 6 but did not get the needed points to successfully compete for the quota of African places allocated by the University of Zimbabwe, which was the only University in the country. I then proceeded to the then Gwelo Teachers College to train as a natural science teacher.

1.2 Why this study?

Gwelo Teachers College trained specialist teachers in the areas of natural sciences, mathematics, arts, commercial and technical subjects. Most of the female trainee teachers opted to do the rest of the other subjects except natural sciences and mathematics. The three natural science subjects (Biology, Chemistry and Physics) were compulsory in the first year of study. In the second year the group was spilt into physical sciences and biology. Our natural sciences year- group was made up of seventeen students (12 males and 5 females) in the first year. In the second year, the physical science group where I belonged had only one female student and 6 male students. The rest of the students in our year-group opted to do biology. The gender disparity in the uptake of natural sciences as a specialist area of teaching was apparent in the college subjects' enrollment and more so in the choice of physics and chemistry during my period of training as a science teacher. These observations were part of my experiences, but I had no explanations as to why it was like that.

After teacher training, I first worked at Mhangura Secondary School at Mhangura Mine known for Copper mining in the heart of Makonde District in Mashonaland West Province. There were many different cultures practiced and languages spoken at Mhangura Mine. The dominant language was Shona mainly the Zezuru and Korekore dialects. Chi Nyanja and Chichewa were spoken by people from Malawi and Zambia. IsiNdebele was spoken by few people and English was the official language of communication in schools and the work places where few whites held management positions and artisan skills. The school enrollment was dominated by more boys than girls. A striking feature of this community was the similarity among the different cultures in their marriages beliefs. Girls either married or were married off at the average ages of 12 and 13 years.

The few girls who were attending high school, most of them dropped out in Form 2 due to pregnancies or arranged marriages between parents. During this time, the school did not have any female teachers in natural sciences and mathematics. This was a reminder of my early childhood rural experiences. My sisters had been denied their right to education and treated like second class children by my parents. Here again, some twenty-four years later I was undergoing the same experiences at my work place. It was at this point that I realized that gender stereotyping was common to most cultures. Cultural beliefs on gender roles were not only a Karanga cultural practice but a national challenge worth researching.

The science curriculum of Mhangura high school was split at Form 3 into Physical Science, Biology and General Science. Only a few girls opted to read Physical Science and Biology. The majority did General Science. Mathematics was a compulsory subject to all the students. The management of the mine had a policy of recruiting most of its apprentices from the high school. The skills that were trained included electricians, boiler makers, motor mechanics, mining engineers and fitters and turners. Very few girls, if any, would opt to train as an apprentice. For the ten years that I worked at this school, I only remember one girl who trained as an electrician.

Careers linked to Science Technology Engineering and Mathematics (STEM) all over the world reward financially (Mackay & Parkinson, 2010). The benefits of economic and social development to a nation that grants its women education are enormous (Banning & Folkestad, 2012) Therefore, inclusion of women into the main stream pillars of the economy is necessary especially for a country like Zimbabwe where the population of females is greater than males (Zimbabwe National Statistics Agency, 2013) census. It all starts at home on how we view and treat each other based own our biological sex differences.

Throughout my teaching career spanning over 28 years in all the co-education schools that I taught natural sciences, the ratio of the subject uptake and performance was in favour of more boys than girls. As an examiner of Integrated Science in Zimbabwe for 18 years I observed that male candidates produced a higher pass rate than female candidates in most of the years, although candidature entry for the subject was almost the same. I have 2 girls and a boy and all of them did very well in the natural sciences at O-level but none of the girls opted to pursue the subjects at A-level. This was a like a thunderbolt from a clear sky bearing in mind that I taught natural sciences myself. To find out the answers to my numerous questions, I decided that when an opportunity avails itself, I would carry out a research on gender disparities in science education and the root causes. Therefore, this study was motivated by a combination of my growing up, teacher training, working and parenting experiences. These experiences culminated into a sense of obligation to make a new and significant contribution to human knowledge on gender and science education. The research had to be done in Makonde District where I have lived for more than 40 years.

1.3 The context of the Study

1.3.1 The District of Makonde

My intention in presenting this section and its context is to try and guide the outsider to this study a deeper understanding and appreciation of the home background of the participants, their experiences and perspectives. Makonde District derives its name from a local indigenous tree called mukonde (cactus tree). These are the dominant trees in the district. Local oral history says that the first Shona people to settle in this area loved the tree so much that they called themselves the Makonde people hence the name of the district.

1.3.2 The geography of Makonde

Makonde is one of the six districts in Mashonaland West Province affectionately called “Mash Best” by the locals. Mashonaland West Province is in the north central of Zimbabwe and is one of the two bread baskets of Zimbabwe. It has an area of 8564 square kilometers with 98.1% being rural and 1.9% urban (see Figure 1.1)

Makonde district is home to 153 540 people (Zimbabwe National Statistics Agency, 2013). Before the 2000 land redistribution or “land invasion”, as some call it, about three quarters of the land was farmed commercially by whites and most of the black population was confined to the dry and arid are of the district. The main town of the district is Chinhoyi which is also the provincial capital and has a population of 77 929 people (Zimbabwe National Statistics Agency, 2013).

The main driver of the economy of this district is farming, and the crops grown include maize, tobacco, cotton and soya beans. Copper used to be the main mineral produced at Mhangura mine before the mine closed in 1999 due to mismanagement and low cooper prizes in the world. Gold is also mined but mainly through panning by informal gold panners (makorokoza). Cattle ranching are also done. The district is also home to the famous Chinhoyi Caves (Chirorodziva) which is a major tourist attraction center. The district receives normal to above normal annual rains most of the time and hence farming thrives so well. Before the land reform programme of 2000, the district had a network of good roads but now most of these are dilapidated.

Figure 1. 1 Makonde District, Zimbabwe

1.3.3 The language situation

The language of communication in Makonde is Shona mainly the Korekore and Zezuru dialects. However, during the land invasion period, the district was inhabited by Karanga and Ndebele speaking people mostly from Gokwe, the Midlands Province and Masvingo. The Korekore tribe, which is the dominant group and culturally conservative, is known for not valuing the western type of education so much. Most of their children especially in the rural areas do not attend school to levels above grade seven and the main victims are the girl children. English is the language of instruction in the participating schools. However, most of the participants could not express themselves fluently in English and hence both Shona and English were used in the study in conducting interviews.

1.3.4 Brief recent History of Makonde

The agrarian land reform of 2000 witnessed a marked increase in the population of the district. It changed from 117 272 (Zimbabwe National Statistics Agency, 2002) census to 153 540 in the 2012 census giving an increase of 24%. The increment was due to mainly the arrival of the new farmers who had taken over the previously owned white farms. The demand for primary and secondary schools increased. The government had to build new “satellite” schools. The new schools were administratively attached to and controlled by the nearest established school. The main of Government in building these schools was to provide every child with education and cut down on walking distance to schools. However, natural sciences could not be offered by these satellite schools. The schools did not have adequate resources such as qualified science teachers, specialist infrastructure, equipment and textbooks. Consequently, there was an influx of pupils at well-established schools at the former Mhangura mine and Chinhoyi town. However, most of the new farmers could not afford the exorbitant accommodation rental rates at these places. Parents fearing for the safety of their girl-children would not let them go and stay with strangers alone. Although the intentions of the parents might have been for good reasons it is still the girl-child who ended up the loser.

1.3.5 Overview of the study

Scholars such as Asimeng-Boahene (2006), Camfield (2011), Chabaya, Rembe, and Wadesango (2009), Charles Chikunda and Chikunda (2016) Chisamya, DeJaeghere, Kendall, and Khan (2012) and Martín (2011a) have debated the issue of gender inequality on educational access, its provision and problems in Africa and the rest of the world. Such works have considered male and female completion for educational services at the local, national, regional and global levels. Their findings helped add new insights and understandings on this topic. The current study makes use of these academic works as a framework and background to examine the making of choice and performance in the learning experiences of high school students in modern Zimbabwean education in the Makonde District.

Gender issues in Zimbabwe have been studied across many disciplines from history (Swainson 2000) to politics and economics (FAWE, 2011; Gudhlanga, Chirimuuta, & Bhukuvhani, 2012). Swainson's (2000) study was a comparative investigation that focused itself on redressing gender inequalities in education of Malawi, Zambia and Zimbabwe. The study reviewed the constraints and priorities in educational expenditure patterns, enrolments and performances. It also looked at government policies on the provision of infrastructure. FAWE's (2011) study identified the gender-related barriers to access, participation and completion of programmes by women and girls in selected secondary schools, colleges and universities in Zimbabwe. Results of the study indicated that enrollments of females had increased in both secondary and tertiary institutions. The researches cited above did not consider the gender disparities and the learning experiences of students studying natural sciences. The dearth of knowledge on this issue is the niche area that this this study attempts to address.

The issue of gender inequality has been widely researched and the focus has been on wide ranging subjects pertaining, among other themes, to human rights; patriarchal dominance at home; and the work place, as well as marriage and inheritance. In most African cultures, right across the continent, a very strong connection exists between culture and gender in many ways. There are diverse ways in which gender is stereotyped in households, communities and nations across Africa (Bhusumane, 1993; Chipunza, 2003). Bhusumane's (1993) study in Botswana looked at the attitudes of teachers and administrators towards the promotion of women to administrative posts found out that the attitudes emanated and were deeply ingrained in cultural beliefs, values and stereotyping. Chipunza's (2003) study was on a similar issue but was done in Zimbabwe and focused on equal opportunities in educational management in institutions of higher learning. The results of (Chipunza, 2003) concurred with the results of Bhusumane. The findings further revealed that the promotion of women was very subjective. Highly qualified and experienced women would not get promoted because of their gender or less qualified women would get promotion overriding qualified men just because they were women. This study draws on studies done by Bhusumane(1993), Gordon (1998), Chipunza (2003) Leach, Fiscian, Kadzamira, Lemani, and Machakanja (2003), Chinyani (2007) and Masinire (2011). It is well documented by these authors that at home, school and work place females are discriminated. The findings of these studies informed the analysis of data presented in this investigation.

Background to the study

Gender disparities have a long history internationally and it remains a contemporary problem in both developed and developing nations, the North and the South, particularly the later.

1.5.1 Gender and science education in Zimbabwe

Zimbabwe, like most of the sub-Saharan countries, is a signatory to the UNICEF (1990) education for all (EFA) agenda espoused at the Jomtien Conference, Thailand. By so doing, the government made a commitment to its nationals and the international community at large to embrace and address gender issues in education. It is easier for most countries to make commitments than to implement them. Gender disparity reduction in the education system has proved to be a tall order for the government of Zimbabwe. Many factors, among them economic, cultural and political have militated against the efforts. Most science related careers pay well thereby economically empowering the worker. However, most of these jobs are occupied by males as shown in Table 1.1. The tables used in this chapter show both the raw figures as well the related percentages. The adoption of the percentages is done to simplify communication and understanding with the reader.

Table 1. 1 Occupational Classification by Sex, Zimbabwe 2012 Census

Occupation	Male	Female	Total	Female%
Government and Senior Officials	7229	1670	8899	18.8
Directors/Managers & Company Secretaries	28430	12864	41294	31.2
Natural Sciences	996	419	1415	29.6
Business & Finance	83860	65947	149807	44.0
Engineers & Technicians	33636	2325	35961	6.5
Life Sciences Professionals	16815	24354	41169	59.2
Education	61118	72945	134063	54.4
Law & Security	115395	19828	135223	14.7
Information	1651	1064	2715	39.2
Social Science	2200	2400	4600	52.2
Artists	13516	4710	18226	25.8
Religion	8275	2891	11166	25.9
Machine Operators	31644	2286	33930	6.7
Administration	11132	8725	19857	43.9
Clerks & Secretaries	39063	40577	79640	51.0
Transport	109648	3472	113120	3.1
Services	282684	457038	739722	61.8
Agriculture	1024281	1237401	2261682	54.7
Mining and Construction	261458	17246	278704	6.2
Mechanics	66083	1296	67379	1.9
Manufacturing	64667	42033	106700	39.4
Others	119307	7289	126596	5.8
Not Stated	119307	104391	223698	46.7
Total	2420587	2133170	4553757	

Source; Adapted from (Zimbabwe National Statistics Agency, 2013)Report.

Table 1.1 indicates that female workers are underrepresented in five of the eight science related disciplines. The source of the information did not clarify or specify the types of skilled personnel in each of the listed occupations. The terms, life sciences professionals and machine operators are somehow misleading because they lack clarity. One may be tempted to think that teller machine operators in supermarkets require specialized scientific training. The other issue is that the data includes both skilled and nonskilled workers in each of the occupations. Nonetheless the data gives some insight into the number of females in each field. Life sciences professionals, social sciences and agriculture are the only occupations that had more than 50% of its workforce being female. The least represented was mechanics (1.9%) followed by engineers and technicians (6.5%) and machine operators (6.7%), respectively. This seems to suggest that females regard these occupations as male domains since traditionally the occupations were associated with muscular physique. It could also mean that females are not comfortable with doing jobs which do not involve human feelings (Gill, Sharp, Mills, & Franzway, 2008) even if they have the required subjects. Table 1.1 shows that gender disparity is apparent in five of the eight occupations. The Zimbabwe National Statistics Agency (ZIMSTAT) is a government-controlled parastatal and its statistics should be viewed critically because the government protects its political interests.

Table 1. 2 National "O" Level Pass Rate by Gender

SUBJECTS	2005			2010			2011			2012			2013			2014		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
Biology	62.0	52.3	57.2	57.9	47.5	52.7	69.0	55.9	62.4	60.0	44.8	52.4	63.3	56.2	59.7	74.9	63.2	69.5
Chemistry	79.1	56.0	67.5	72.9	52.9	68.6	67.8	58.0	61.6	62.2	45.9	54.0	73.9	52.7	63.3	67.8	52.9	61.6
Human & Science Biology	40.0	13.1	26.5	36.0	26.4	33.2	29.2	25.4	27.1	43.2	28.6	35.9	67.8	58.0	61.6	62.2	45.9	54.0
Int Science				32.6	21.4	27.0	31.0	20.7	26.0	25.8	18.1	22.0	29.2	25.4	27.1	43.2	28.6	35.9
Physical Science				61.8	38.9	50.3	59.9	46.1	53.9	68.7	49.2	58.5	31.0	20.7	25.9	25.8	18.1	21.9
Physics	55.2	39.3	47.0	73.5	57.8	68.6	94.3	81.9	88.9	91.0	85.3	88.1	59.9	46.1	53.9	69.7	50.2	59.9

Source (MOPSE, 2015)

Table 1.2 shows the statistics for the period 2005 to 2014 with period 2006 to 2009 missing. Data for this period was not available because it is the period when the economy of Zimbabwe had collapsed, and most government departments were dysfunctional. The pass rate trend of all the subjects shown during the period indicate that the female students pass rates were less than the male students pass rates nationally. The largest pass rate differences between male and female students were for Physical Science (22.9%) in 2010 and Chemistry (21.2%) in 2013. The lowest pass rate gap was in 2012 for Physics (5.7%) and Biology (7.1%).

Table 1. 3 National gender statistics for ‘O’ level sciences

SUBJECTS	2013				2014			
	Female Entries	Female Pass rate %	Male Entries	Male Pass rate %	Female Entries	Female Pass rate %	Male Entries	Male Pass rate %
Integrated Science (5006)	106720	19.09	95902	28.57	113527	18.08	100223	25.82
Biology 950080	9776	55.88	11146	69.00	10142	44.79	11365	60.02
Physical Science (5009)	3827	41.49	5138	54.77	3544	49.21	4695	68.69
Physics (5055)	978	74.44	1430	88.53	1675	85.25	2233	91.00
Chemistry (5071)	1155	52.03	1584	66.48	1878	45.85	2295	62.22
Human & Social Biology (5097)	1419	9.23	1273	16.58	966`	28.16	856	43.22

Source: (ZIMSEC, 2015).

Table 1-3 shows a rising trend in the number of female candidates in all the sciences except in Physical Sciences (7.4%) and Human and Social Biology (31.9%) which dropped in 2014. The trend supports FAWE's (2011) first finding which acknowledges that there was an increase in the enrolment of females in the education system. Female entries in Integrated Science increased from 106 720 in 2013 to 113 527 in 2014 giving a 6.4% increase. The same trend of increase in entries of female students emerged in Biology (3.7%), Chemistry (62.6%) and Physics (71.3%). Table 1-3 indicates a decrease in the pass rates by female students in 2014 in the following subjects, Integrated Science (1.0%), Biology (11.1%) and Chemistry (6.2%). During the same year, an increase in the pass rate by the female students occurred in Physical Science (7.7%), Physics (10.8%) and Human and Social Biology (18.9%). The high pass rate increase in Human and Social Biology was attributed to a decreased candidature from 1 273 in 2013 to 966 in 2014 representing 31.9%. A comparison with the Provincial results and registration in the subjects could have increased the credibility of the argument but unfortunately at the time of study data was unavailable.

Table 1. 4 Makonde District 'O' Level Registration

SUBJECTS	2007			2010			2011			2012			2013		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
Biology	229	45	274	128	55	183	117	52	169	181	39	220	163	96	259
Chemistry	68	13	81	80	3	83	67	11	78	93	26	119	93	12	105
H & S Biology	14	9	23	3	3	6	0	0	0	2	1	3	3	174	177
Int. Science	1513	1012	2525	1341	889	2230	1535	949	2484	1482	1097	25791	1663	1168	2831
Physical Science	17	3	20	30	22	52	40	23	63	39	33	72	8	19	27
Physics	48	0	48	39	7	46	53	13	66	58	19	77	52	9	61

Source: (Ministry of Education, 2014).

Table 1.4 shows that the registration of female students in all the subjects was less than that of the male students except in 2013 in Human and Social Biology where female candidates were more than the male candidates. Although the data of national registration was for two years which would be unfair to compare with the Makonde District's five-year period, a look at the 2013 year registration for both the district and national data seems to indicate a similar pattern of lower female candidature than male candidature in most of the subjects

Table 1. 5 Makonde District ‘A’ level results

Key: M = Male, F = Female, No. = Number of candidates Ov = Overall pass rate (male & female)

MAKONDE DISTRICT																				
YEAR	**2012**					**2013**					**2014**					**2015**				
	M		F			M		F			M		F			M		F		
SUBJECT	**No.**	**% pass**	**No.**	**% pass**	**Ov. % pass**	**No**	**% pass**	**No.**	**% pass**	**Ov. % pass**	**No.**	**% pass**	**No.**	**% pass**	**Ov. % pass**	**No.**	**% pass**	**No.**	**% pass**	**Ov % pass**
Biology	22	78.6	13	81.3	79.5	29	96.7	16	88.9	93.8	20	87	20	92.4	97.6	30	90	7	100	95
Chemistry	22	81.5	17	85	95.7	36	92.3	14	87.5	90.9	26	93	13	72.2	84.8	34	87	10	88	95
Physics	7	77.8	12	100	90.5	18	100	2	100	100	14	82	0	0	82.4	21	88	1	100	88

Source: (MOPSE, 2016)

Table1.5 shows that the quality of female pass rate is as good as their male counterparts. However, percentages may mislead as shown by the results of Biology in 2015 of 100% where only 7 students wrote the examination as compared to the 30 males who wrote and got 90%. The 100% pass rates in Physics 2012, 2013 and 2015 were influenced by the small entries. The higher female pass rates may be due to the strict selection process done at O-level. Only high fliers in the chosen subject are allowed to proceed to A-Level. It is, however, the enrolment aspect which is the main cause of concern. The biggest enrolment disparities are in physics. The female uptake of physics from 2012 to 2015 was 12, 2, 0 and 1, respectively. An analogy of this problem would be that of a patient who goes to hospital with heavy diarrhoea such that the doctors, in this case the researcher, must diagnose the causes of diarrhoea (low subject choice).

Table 1. 6 Makonde District A-Level mathematics results analysis

Key: No. = number of candidates

Year	**2010**		**2011**		**2012**		**2013**		**2014**		**2015**	
	No.	Pass Rate %	No.	Pass Rate %	No.	Pass Rate %	No.	Pass Rate %	No.	Pass Rate %	No.	Pass Rate %
Male	48	91.3	53	89.1	58	82.5	52	90.6	49	87.4	69	87.2
Female	17	96.1	23	88.9	33	80.3	19	92.4	21	85.7	24	86.4

Source: (MOPSE, 2016) Makonde District A-Level Results Analysis

Low enrolment by female students is not peculiar to sciences only but also to mathematics as shown in Table1.6. Collectively, Science, Technology, Engineering and Mathematics (STEM) are critical subjects in technology driven careers. Some scholars like (Chetcuti & Kioko, 2012., Clegg, 2007) use the term, Science, Mathematics and Technology (SMT). This study uses the acronyms interchangeably. Table1.5 shows that performance in mathematics is not much of a problem at Advanced level by female students. It is the numbers that choose to do the subject which is the challenge.

The gender disparities in the uptake of STEM subjects both in lower and higher education institutions is, according to Chikunda (2014), attributed to the absence of gender responsive curricula in the institutions. He argues that students are exposed to different learning experiences by the curricula that encourages and perpetuates gender disparities. As Chikunda (2014) write:

> The physical sciences, mathematics and technology subjects in Zimbabwe, like in most other African countries, are still male dominated. This is despite numerous efforts over the years directed towards gender equality in these disciplines. Many studies point at teacher education as not doing enough to assist future teachers in these disciplines with knowledge, skills, attitudes and values required for gender-responsive curriculum practices (Chikunda, 2014, p. 264).

The lack of proper training for teachers creates problems and challenges when in the classroom on how to handle students with different backgrounds in their subject areas. In most cases, this results in poor performance and low uptake of sciences by female students. Despite the design of the curriculum, the way in which it is interpreted by the teachers remains an overwhelming influence. Teachers can provide role models, a sense of direction and encouragement to both boys and girls, or they can denigrate and marginalize them and so perpetuate gender stereotypes (Colclough, 2004).

1.5.2 Gender and science education in Africa

The gender disparities are not only peculiar to Zimbabwe. The gender gap in SMTs in Tanzania, like in Zimbabwe, is still very wide with females lagging far behind males (Masanja, 2004). Contributory factors cited for the under representation of females were low participation rates and lower performance levels in examinations. The study also reveals that marginalized areas especially rural Africa, showed more resistance to gender equality in education due to the predominance of traditional attitudes.

The FAWE (2011) report on three Southern African Development Community (SADC) countries, namely, Lesotho, Swaziland and Zimbabwe, concludes that girls' and women's participation in science, mathematics and technology subjects (SMTs) was severely under-represented at both secondary and tertiary levels. However, Lesotho had higher percentage participation at both secondary and tertiary levels by females but the enrolment in SMTs by female students was lower than the male students. In Swaziland, the enrolment of females was also very high at both secondary and tertiary levels but was characterized by very low uptake of SMTs by females. The reason why both Lesotho and Swaziland had similar enrolments was not elaborated in the report. The large female enrolment in the schools was because most males including those of school going ages migrate to South Africa in search of employment. Forty-five per cent of Zimbabwe's tertiary institutions enrolment was females but only a very small percentage pursued SMT oriented careers argued the report.

In Rwanda, Huggins and Randell (2007) cite five factors which contribute to the girls' under representation and under achievement in secondary schools. The factors were grouped into levels, namely, macro, legal and political, school and socio-cultural. Some of the identified factors comprise inadequate resources (macro), lack of government funding (legal and political), biased curriculum (school) and gender-based violence (socio-cultural). Many scholarly studies done so far argue that the educational and occupational attainments of women are a critical vehicle to both the economic and social productivity of a nation (Hyde & Kling, 2001). Chetcuti, and Kioko (2012) in studying the girls' attitudes towards science in Kenya established that the negative attitudes of girls towards science were precipitated by the lack of gender-responsiveness in the curriculum that resulted in widening gender disparities. Many female students opt out of the subjects they perceive as suitable to males not because they are unable but because the lack of gender- responsiveness forces them. Whatever reasons that have been advanced by the cited authors, the current available information shows that there are gender disparities in the uptake and performance of natural sciences. A study by Rarieya, Sanger and Moolman (2014) in South Africa concluded that affirmative action was necessary in order to provide girls with more opportunities and equal learning experiences. Africa still lags behind other continents in terms of the provision of science and mathematics education for girls ((Asimeng-Boahene, 2006).

1.5.3 Gender and science education in the world

Studies done in the European Union (EU) by Baumert and Köller (1998) and Hidi (2000) revealed that females were under represented in SMTs related disciplines. The period from 1990 to 2005 saw the United Kingdom (UK) experience a problem of a general decline in the uptake of SMTs. Therefore, the challenge of low enrolments in SMTS is not unique to Zimbabwe. However, developed countries like the UK no longer have wide gender disparities in SMTs which Zimbabwe still has.

Table 1.7 A-level examination entries in England and Wales (1990-2013)

Year	Biology	Chemistry	Physics	Mathematics
1990	6.8	6.8	6.2	12.8
1995	7.2	5.8	4.8	9.2
2000	7.1	5.2	4.1	8.0
2005	6.9	5.0	3.6	6.7
2010	6.8	5.2	3.6	9.0
2011	7.2	5.5	3.8	9.6
2012	7.3	5.7	4.0	9.9
2013	7.5	6.1	4.2	10.4

(Source: Joint Council for Qualifications, JCQ)-UK

Table 1.7 shows a decrease in examination entries for Mathematics (1990 to 2005), Physics (1990 to 2010), Chemistry (1990 to 2005) and Biology (1995 to 2010) in the UK. The examination entries for the subjects increased from 2011 to 2013. In the United States of America (USA), women graduating with degrees linked to science, mathematics and technology subjects (SMTs) equate to 18% (Snyder & Dillow, 2012). A report by the Network of Experts in Social Sciences of Education and training by Lynch and Feeley (2009 p 3) for the European Union (EU) on Gender and Education concluded that:

> Gender inequalities persist in education in terms of subject preferences and performance, and in cultural aspects of the education and training experience.
> Mathematics, Science and Technology (MST) are predominantly male in profile and courses with a care bias are disproportionately female. Both cultural and organisational factors contribute to these gendered choices.

However, a later report done by the NESSE (2011) on training indicates that the educational inequalities across the EU regions manifest themselves more in intra-national differences of achievement than in inter-national differences. The differences are a result of how each county or province is run and are not a reflection of national status quo.

Work by Kutnick, Jules, and Layne (1997) on gender and school achievement in the Caribbean reveals that females succeeded at much higher levels than males. The girls performed better than boys on average in the core curriculum subjects throughout secondary schooling years. Gender differences became less pronounced in the choice and performance in mathematics, physics and chemistry. Strategies that were implemented to address this included financial assistance to all female students who chose to study natural sciences and employment of more female teachers in these areas. Probably the female teachers acted as role models and inspired the female students. These findings contrast significantly with the results of studies done in other developing countries like Tanzania (Masanja, 2004) and Runhare & Gordon (2004) in Zimbabwe.

Collins, McLeod, and Kenway (2000) established that, in Australia, factors influencing educational performance of males and females in school and their initial destinations after leaving school, where major differences were found, were in educational participation, performance and outcomes. The retention rate of girls between years 10-12 was greater than that of boys. Girls took subjects which appeared to be less career focused than boys. On average, girls performed better than boys but most of the girls avoided high status subjects like physics, information technology, mathematics and chemistry. These findings comparably tally with the Makonde District situation (Tables 1.3 & 1.4).

1.6 Statement of the problem

In Zimbabwe, educating a child is viewed as an investment to escape the cycle of poverty by many parents. (Chikunda & Chikunda, 2016, Chinyani. 2007, Leach et al., 2003., Proctor & Phimster, 1995). On the other hand, most parents especially in rural areas have very little say if any in the subject choices of their children (Asimeng-Boahene, 2006). Teachers play pivotal roles in influencing students to choose subjects.

This can be done objectively or subjectively depending on the teacher's cultural gender beliefs and professional principles. A teacher who believes strongly that men are superior to women is most likely to transmit the beliefs to the students during socializing and communicating with them during lessons and vice versa. Students, especially at primary and secondary level, look up to their teachers as counselors and advisers. I believe they still do but these days with the onslaught of technology especially social media one can never be sure. They also believe that the teachers are very knowledgeable. Therefore, the cultural beliefs propagated by the teacher to the students have an impact on their perceptions of subjects. The research problem addressed in the current investigation arises out of a deep concern of gender disparities that arise from the learning experiences of students studying natural sciences. However, the nature and scope of the research problem as demonstrated by the available statistics of Tables 1.2, 1.3, 1.4 & 1.5 is that there must be factors behind the low subject choice and performance in natural sciences by the female students.

Zimbabwe is no exception to this educational problem. There is sparse literature concerning the rationale behind the wide gender disparities in the uptake and performance of science, technology, engineering and mathematics (STEM) subjects by girls in African education. In 2010, the commissioner responsible for education, culture, multilingualism and youth in the European Commission (EC) noted that apart from the injustice inherent in all gender stereotyping, gender differences in education can also negatively affect economic growth and social inclusion. Women remain a minority in the fields of mathematics science and technology (Martín, 2011a). Undoubtedly, STEM subjects play a pivotal role in a nation's economic success and females should be afforded the opportunity to play their roles. United Nations International Children's Educational Fund (UNICEF2014) report agrees with the commissioner's remarks stating that:

> There is a need for strengthened gender analysis across the education sector to look at the differences among boys and girls, but more targeted gender focussed exploration needs to be carried out and other important issues of prevailing gender differences in the selection and choice of subjects of study (. UNICEF, 2014, p. 28)

This study aimed at investigating the gender differences in the selection and choice of subjects of study. It was against this background that four questions unfolded. These were: What do students consider when choosing to study natural sciences? Why do fewer girls than boys opt to do natural sciences and what affects the girls' performances in the subjects? Are gender discriminatory practices experienced in the learning of natural sciences? Who are the main agents of gender stereotyping in the choice and learning of natural sciences? Trying to answer these questions was the focus of this study. While the study endeavoured to expose the interactions among the variables by addressing these questions, its design fundamentally remained exploratory, descriptive and interpretative.

1.7 Purpose of the study

The study sought to explore the factors behind gender disparities affecting the learning experiences of students studying natural sciences in selected high schools in the Makonde District of Zimbabwe. Observations from my own teaching experience, government reports, and documents from MOPSE, ZIMSTART and ZIMSEC show the prevalence of gender disparities in the uptake and performance of natural sciences. The SMTs are essential subjects for the socio-economic, political and technical development of a country. A country like Zimbabwe which, according to ZIMSTART (2013), has more females than males will benefit more if as many females as males are engaged in SMTs related fields. The study therefore sought to identify the factors aggravating gender disparities with the hope of coming up with pragmatic solutions to this challenge.

1.8 Main research question

What factors influence gender disparities in the learning experiences of students studying natural science subjects in selected high schools of Makonde District?

1.8.1 Sub-research questions

1. What factors influence choice in natural sciences?

2. Which factors contribute to the low choice and poor performance in natural sciences by female students and why?

3. Do students experience gender discrimination from the teachers in the learning of natural sciences?

4. How does gender stereotyping manifest itself in schools?

1.8.2 Research objectives

Considering the research questions, this study seeks to:

1. Identify factors that affect choice in natural sciences.
2. Establish the factors and reasons behind the low choice and performance in natural sciences by female students.
3. Establish whether students experience gender discrimination from teachers in the learning of natural sciences.
4. Analyze the forms of gender stereotyping and its agents.

1.9 Rationale and motivation of the study

Both the Minstry of Education (2013) and the Ministry of Women Affairs (2013)) in the Education Medium Term Plan (EMTP) and in the National Gender Policy (NGP), respectively, acknowledge the need to have research based evidence to tackle the challenges of low performance and uptake of sciences and the related careers by females. This is the missing scholarly topic identified by this study.

In a bid to encourage enrolment of science, technology, engineering and mathematics (STEM) related careers in its institutions, the Ministry of Higher and Tertiary Education of Zimbabwe resorted to newspaper advertising claiming that:

> If you took your “O” level exams in 2015 and got a grade “C” or better in Physics, Chemistry, Biology or Mathematics and you register for a combination of these subjects at a public school for your “A” levels; the Ministry of Higher and Tertiary Education, Science and Technology Development will pay your school and boarding fees this year. Don’t miss out on this unique opportunity. Go and register today for a combination of these subjects at a school of your choice and STEMITISE your future! (Zhakata, 2016)

This is an acknowledgement of the existence of the problem of low uptake in natural sciences subjects by the government although not specifically mentioning that the problem affected female students most. The envisaged contribution to knowledge of this study will be in the form of adding new ideas to the already existing knowledge. Stakeholders in education sector who may find this study useful include, among others, policy makers, education practitioners like university and college lectures, teachers, school administrators and MOPSE. Students who are the main consumers of government educational policies also stand to gain from the findings.

The study was motivated mainly by a sense of obligation to make a new and significant contribution to human knowledge and understanding of the reasons behind gender discrimination. In modern Zimbabwe, issues pertaining to gender relations and gender equality are pivotal to national development. There is a yawning gap in this field and a study of this nature has never been undertaken in Zimbabwe. This pioneering work has value, significance and wider legislative and policy implications at the national level. The other reason was my daughter’s refusal to pursue STEM subjects at “A” level despite having passed the subjects at “O” level. My experience and observations as a deputy national chief examiner (integrated science) and education officer, quality control gave me an insight into the area of study.

1.10 Overview of the research methodology

A brief overview of the research methodology has been discussed in this section. A detailed discussion was done in Chapter Three of the thesis.

This study adopted the mixed methods research (MMR) approach underpinned by a modified micro, macro and institutional (MMI) theoretical framework of Yazilitas, Svensson, de Vries, and Saharso (2013) on gendered patterns in academic choices. The MMI theoretical framework was chosen due to its holistic approach to gender related issues. It advocates for thorough interrogation of both males and females in the investigation of gender challenges. Bhana and Pattman (2009) note that gender debates or discussions in developing countries have remained one sided concentrating on the problems of girls in schools. Barker and Ricardo (2005) argue that such perceptions assume that men are always the perpetrators and women the victims. It is my assumption that the MMI theoretical framework will assist in exposing a balanced view of the problem under investigation in this study. The theoretical framework is discussed in detail in chapter 2.

An explanatory sequential research design was used, and it involved collecting quantitative data first, followed by qualitative data in depth (see Figure 3.5). The study used the pragmatism paradigm because of its flexibility to allow the researcher to navigate through problems in natural settings and to use all the available practical methods to achieve knowledge. In the first quantitative phase of the study, the Likert-Scale Questionnaire (LSQ) instrument was used to collect data from students on their perceptions, benefits of sciences and learning experiences. The second qualitative phase was done to explain the quantitative results in more depth. Items with statistically significant values from both the chi-square and analysis of variance (ANOVA) from the quantitative phase were then used to formulate interview questions for the qualitative phase. Semi- structured interviews, observations and focus group discussions (FGDs) were used with 8 teachers and 42 students. A total population of 1500 students and sample population of 600 students and 5 school headmasters selected from 5 schools participated in the quantitative phase of this study.. A stratified purposive sampling technique was used. Quantitative data was presented in numerical analysis and qualitative data was presented in the form of narratives, themes and categories. Both quantitative and qualitative data findings were t compared (triangulation) and integrated

The results of the study were presented based on the four research questions that guided the thesis and are presented in chapters 4, 5, 6 & 7. Each of the result chapters stood on its own in addressing the question but at the same time contributed to the bigger picture by providing the relevant evidence which assisted to illuminate and clarify interactions among the explored variables. The findings of research questions 1, 2 & 3 helped the researcher respond to research question 4.

1.11 Definitions of operational concepts

Key terms defined in this study include gender disparity, natural sciences, learning experiences and gender stereotyping. The term gender disparity, as used in this study, means not having equality in terms of gender, either in equal participation in educational programs, in language use, or in the form of textbooks or access itself. This is also referred to as gender gap. The gender gap represents the ratios of males and females studying and passing examinations in natural sciences. The term natural sciences, refers to subjects such as Biology, Chemistry, Physics and Physical Science studied at both Ordinary (O) and Advanced (A) -level. Integrated science (which includes Biology, Chemistry and Physics) was left out because in the Zimbabwean education system it is studied as a compulsory subject by both males and females from Forms 1 to 4. The subject components of integrated science do not have much content depth for those who aspire to pursue science related careers. Therefore, the science curriculum becomes flexible from Form 3 upwards to cater for the different aspirations of the students.

Learning experience refers to any interaction, course, program or other experiences in which learning takes place, whether it occurs in traditional settings like schools and classrooms or non-traditional settings like homes or outside-of-school locations or outdoor environment (Hutter, Oldenhof-Veldman, Pijpers, & Oudejans, 2017). In this study, the learning experiences were confined to the aspect of the traditional educational interactions where students learned from the formal education teachers within the classroom settings in the schools. The learning experiences of the students were used to explore whether gender disparities existed or not during teacher-student interactions in the classrooms. Gender stereotyping refers to the long-established perceptions of women and men as well as girls and boys with regards to how they relate with each other in the context of everyday duties, abilities and how they should think or behave based purely on the ground of their gender (Holdsworth, 2007; Sumsion, Roberts, & Lee-Thomas, 2005)

1.12 Limitations of the study

Makonde District has a total of 108 primary and 59 secondary schools. Out of the 59 secondary schools only 5 offer natural sciences up to A-level. The rest offer only integrated science from Forms 1 to 4. Although the researcher wanted to involve as many schools as possible the researcher got limited to the 5 schools. The 5 schools therefore represented the total population (100%) of the schools under study. The sample size may therefore limit the generalization of the findings.

To overcome this limitation the researcher had to maximize the number of participants involved in the focus group discussions (FGDs). According to Cohen and Crabtree (2006), the composition of the group varies between 6-10 and 6-12 depending on the researcher's needs.

The time allocated to the researcher by the schools was relatively limited given tight school schedules. After school hours, arrangements were made with both the teachers and students. This resulted in some of the teacher-student respondents declining to participate unless certain conditions had been met. Two (2%) and one (1%) of the students and teachers declined, respectively. "If participation stretches over any length of time in a day, you should consider providing something to eat and drink" (Witwatersrand University Human Research Ethics Committee (Education) Application Guidelines: 8).The researcher provided the participants with meals for after school arrangements. According to Patton (2002), willing participants are the rich sources of information and hence the researcher worked with those who willingly participated. The other challenge was that appointments were changed several times by both the teachers and school heads. To overcome this problem, I agreed with the participants to phone and invite me when it was convenient for them. Contact persons were established.

1.12 Organization of thesis

This section gives a summary of the focus of each thesis chapter. Figure 1.2 shows the flow of the chapters.

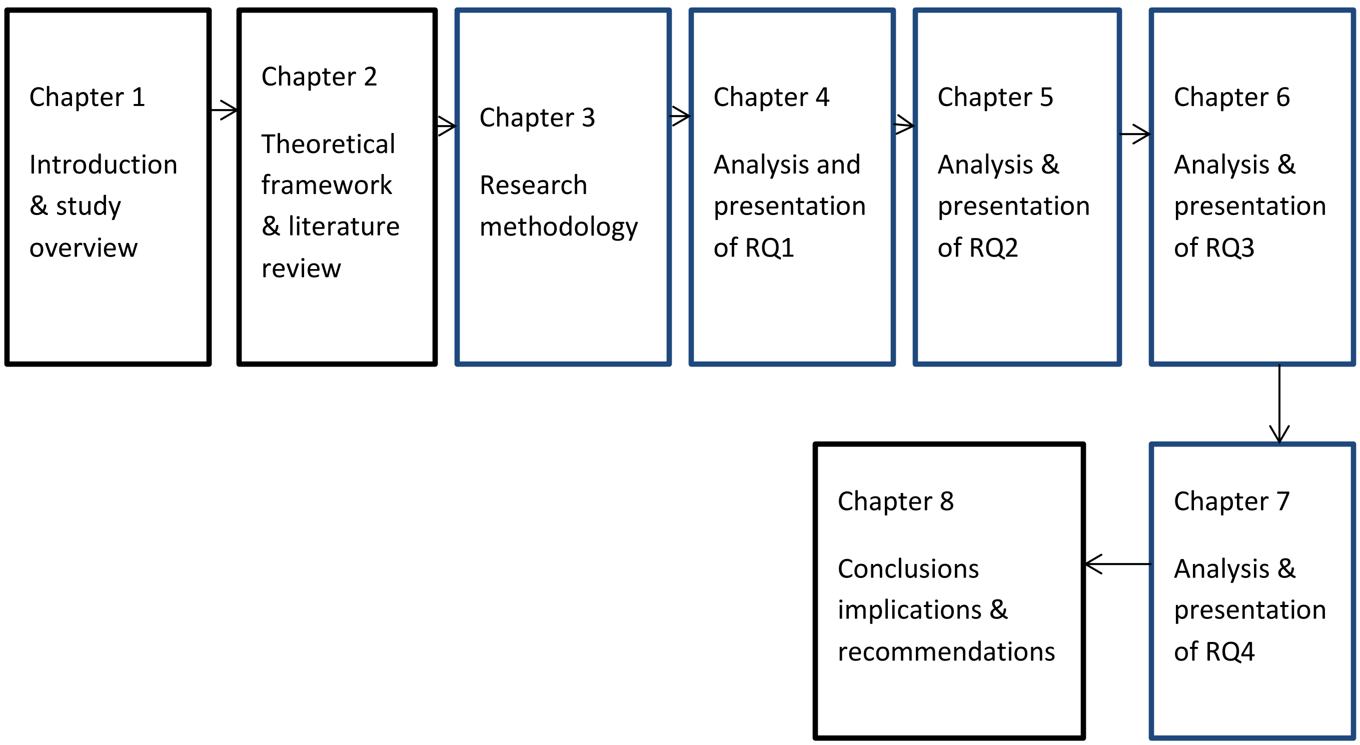


Figure1. 2 Organization of thesis

1.12.1 Chapter one: Introduction and study overview

This chapter introduces the study by presenting an overview of the whole thesis. The introduction defines some key terms used in the study. Detailed definitions and operationalized terms are done in Chapter 2. The background identified the research problem. The research questions, research objectives and the rationale and motivation of the study are discussed in this chapter. The theoretical framework of the study is briefly discussed , followed by an overview of the research methodology, limitations of the study and organisation of the thesis.

1.12.2 Chapter two: Theoretical framework and literature review

Chapter 2 discusses the main concepts and ideas that informed the theoretical framework of the study. The importance and justification of the underpinning theoretical framework (MMI) and its constituents is elaborated in detail. Review of literature under the headings; determinants of subject choice, the role of perceptions in subject performance, gender stereotyping and teaching and forms of manifestations in gender stereotyping are discussed. A summary closes the chapter.

1.12.3 Chapter three: Research methodology

The chapter discusses the research design and methodology in terms of the research approach, research design, research paradigms, population and sampling, data collection instruments, validity and reliability, data trustworthiness, data collection and generation procedures, ethical issues and summary. This chapter also operationalizes the theme of the research methodology, as well as justifies the rationale of the choices of each subsection.

1.12.4 Chapter four: Results from Research Question 1: What factors influence choice in natural sciences?

This chapter provides the description of results of the students' choice factors in natural sciences through presentation of quantitative and qualitative analyses of the research question. The students' choice factors in natural sciences are analysed using the Road to Narratives Model (RNM) figure 3-6. The same model is used to analyze research questions 2, 3 & 4. Chapter 4 also analyzes and presents findings from the STEM project views of the teachers.

1.12.5 Chapter five: Results from Research Question 2: Which factors contribute to the low choice and poor performance in natural sciences by female students and why?

Chapter 5 addresses this question. It gives the description of the results from both the students and teachers of the reasons behind the low choice and poor performance of natural sciences by the female students in high schools of Makonde District. The presentation is done through quantitative and qualitative analyses of the research question.

1.12.6 Chapter six: Research Question 3: Do students experience gender discrimination from teachers in the learning of natural sciences?

The chapter addresses the third research question which focuses on the learning experiences of the students in the classrooms and laboratories. Methodologically, it embraces interviews, classroom and laboratory observations and quantitative instruments to obtain insights into the learning experiences of students studying natural sciences.

1.12.7 Chapter seven: Results of Research Question 4: How does gender stereotyping manifest itself in schools?

In this chapter, selected agents in which gender stereotyping manifest itself are examined and how the agents influence the choice and learning of natural sciences is discussed. The chapter also focuses on document analysis and the researcher's own field observations.

1.12.8 Chapter eight: Conclusions, implications and recommendations.

Chapter 8 draws conclusions based on the results of the four research questions of the study. Implications of the findings to gender and science education are elaborated and recommendations for future research are outlined.

1.13 Summary of the chapter

This chapter provides an overview of the study. It states the problem, the research questions and objectives. It also discusses the rationale and motivation of the study. The definitions of operational concepts and key terms are discussed. An overview of the limitations of the study and the organization of the thesis is outlined. The next chapter 2 looks at the theoretical framework and review of related literature.

CHAPTER 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.0. Introduction

The previous chapter focused itself on presenting an overview and the background of the current study. The statement of the problem, research questions, justification, the research methodology and definitions of key operational terms were also discussed. Chapter 2 examines and discusses the theoretical framework that informed the study and a review of related literature. The importance of this chapter is to guide the researcher to remain focused and apply relevant theory and literature in the pursuit of finding answers to the research questions. In this chapter, definitions of keys concepts will be given followed by in-depth discussions of the theoretical framework and related literature.

2.1. Definition of key concepts

The terms theory, framework and theoretical framework are defined because they are very critical to the understanding and discussion of the chapter. Ornstein and Hunkins (1993) view a theory as, "a device for interpreting, criticizing and unifying established laws, modifying them to fit data unanticipated in their formation and guiding the enterprise of discovering new and powerful generalisation". In other words, an existing theory can be amended by the researcher depending on the situational needs under investigation. A theory is helpful in identifying the object of study, exposing the characteristics of the object and providing the language to explain the attributes of the different facets of the object. Guided by this comprehension of theory this study unified and modified existing theories (Bandura, 1986; Eccles, 2005; Inglehart & Norris, 2003; Parpart, Connelly, & Barriteau, 2000; Trauth, Quesenberry, & Huang, 2008) through the adoption of a micro-macro institutional (MMI) theoretical framework to study gendered patterns in academic choice. The names and assumptions of the theories are discussed in section 2.2 onwards.

As mentioned previously, the main aim of the study was to explore the factors behind the gender disparities affecting the learning experiences of students studying natural sciences in selected high schools of Zimbabwe. By adopting the MMI theoretical framework I was challenging and arguing that the theories of the above quoted authors singly cannot adequately explain gender disparities in the choice and learning of natural sciences. MMI is explained in detail in section 2.2. Research is a robust and dynamic process of engagement of old and new discoveries. For the research to achieve its objectives it must be guided by a clearly stipulated theory whose tenets are explicitly defined. A theory is scientific by its nature and emphasises a logically unified framework, generalization and explanation.

Theories are formulated to describe, explain, predict and understand phenomena and in many instances, to challenge and carry on the existing knowledge within the boundaries of critical binding assumptions (Connelly, Li, MacDonald, & Parpart, 2000). In a nutshell, a theory is a structure of propositions and principles for describing a phenomenon. The human being in its quest to understand itself and the environment has established many theories which include the theory of education, theory of gravity, and theory of social cognitive development and achievement goal theory, among many others.

A framework is fundamentality a basic structure underlying a system. It gives a body or a structure its shape. (Connelly et al., 2000) sums it up by advancing that:

> A framework is a system of ideas or conceptual structures that help us "see" the social world, understand it, explain it and change it. A framework guides our thinking, research and action. It provides us with a systematic way of examining social issues and providing recommendations for change (Connelly et al., 2000, p. 11).

Planning done by teachers or lecturers can be regarded as a framework or a basic process to achieve the intended goals. In a human being the framework is the skeletal system together with all the other organs that attach themselves to it form a system. Likewise, in the social world our conceptualisations and explanations of the observations of the interplay of forces in our everyday lives constitute a framework in social sciences research.

2.1.1 Attributes of a framework according to Connelly, et al. (2000)

- A specific framework provides a set of concepts to be used in explaining an issue or problem.
- Consists of primary suppositions concerning the nature of the social world, how it operates, and the people in it and how they interact. People have different views or perceptions about the social world they live in. Optimists see society as being in harmony and pessimists as being in conflict. The lens by which one sees the social world is determined by one's type of framework.
- Different frameworks suggest varying solutions to problems. Inequalities in society can be transformed gradually through legislation. For example, the

National Gender Policy (MWAGCD, 2013) of the Zimbabwean government and peaceful demonstrations like the #fees must fall of 2016 of South Africa Universities. The fees must fall demonstrations later turned violent in most universities. The inequities can be changed radically through violent protests, grabs and war. A good example is the land reform programme of 2000 in Zimbabwe which was characterised by violent land grabs from the whites.

- A framework shows how problems are defined and the types of questions to be asked. Unequal access to education and socio – economic resources of a nation creates less powerful working-class citizens fragmented by race and gender.

In this study, the MM1 framework was developed and used to explore the problems associated with gender disparities in the learning experiences of students studying natural sciences.. Having described both the theory and framework in details, the discussion focuses next on theoretical framework.

2.1.2 Theoretical framework

Creswell (2014) views a theoretical framework as a conceptual model that establishes a source of structure that guides the research. The definition emphasizes the word “structure”. A structure is basically a composition of parts or constituents of something complex. A theoretical framework has, among many others, important characteristics which are:

- The ability to demonstrate an understanding of concepts and theories which are relevant to the topics under study and relate to the wider areas of knowledge.
- It is chosen on the grounds of its relevance, ease of application and explanatory power.
- It provides the background that supports the investigation and offers the reader a justification for the study of a research problem.
- It helps the researcher to consider other possible framework options and reduce biases which may affect one’s interpretation.

- It introduces and explains the theory which describes why the research problems under study exist.

On the surface, the framework and the theoretical framework seem similar, but they are not. The line of demarcation is very thin but does exist as outlined in the discussion. Based on the five attributes outlined above, I constructed the MMI theoretical framework which is discussed next.

2.2 The micro-macro institutional (MMI) theoretical framework

Figure 2.1 below shows a model of the MMI framework.

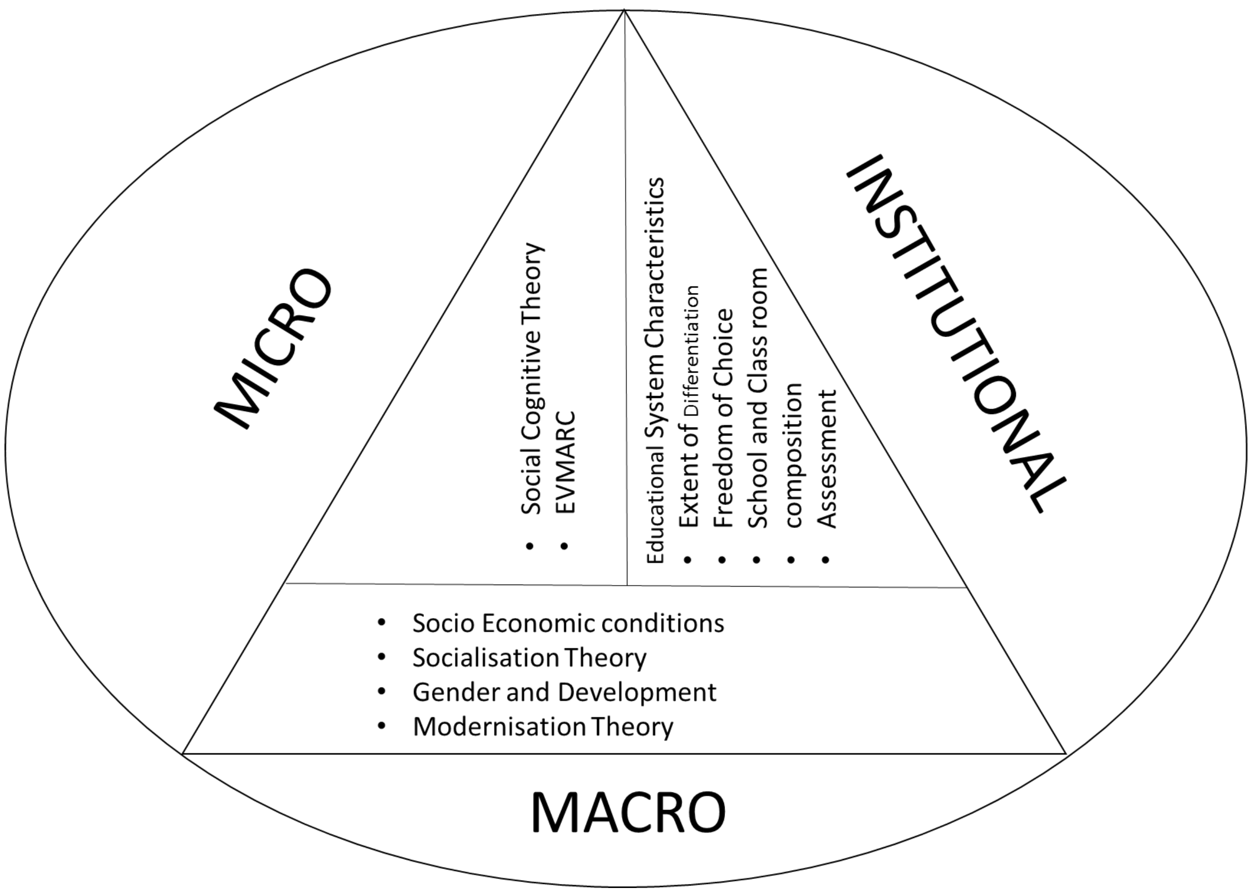


Figure 2. 1: The micro-macro institutional (MMI) theoretical framework

The theoretical underpinnings of this framework are derived from the study done by Yazilitas et al. (2013) on gendered study choices. The study revealed that there were three main factors which explained gendered patterns in academic choice with reference to the STEM subjects. The identified factors were classified as micro, macro and institutional. However, Yazilitas et al. (2013) just exposed the main factors but this study reorganized and aligned the factors to the relevant theories to come up with the MMI theoretical framework (cf. Figure 2.1). I do not think or believe that there is one ideal theoretical framework for conducting a research or indeed one ideal method and hence the design of the MMI framework and choice of the MMR methodology. The significance of the circle in the framework is to explain the cyclic nature of the process of choice. It is neither static nor linear at any given situation. Making a choice may not be an easy decision to make. I a lot of debate take place inside one's mind. Likewise, the students leave home to go to school and still come back home thereby completing a circle. Therefore, during the students' learning journey, they are exposed to and interact with various factors in somehow a cyclic way.

The triangle houses the theories or frameworks which identify and describe the sub factors associated with each main factor. A triangular shaped object has stability because of its wider base and in this study the wide base of the MMI framework are the various theories it houses. However, the triangle is inside a rotating circular container that mixes its contents due to the existence of rotational forces. Likewise, the triangle constituents experience the same fate and hence the interconnection of the subject choice factors and learning experiences. Each of the main factors has its own sub-factors that are explained by the relevant theories and shown in Figure 2.1. The situation is such that there is interlinking and intersection of the factors, theories and frameworks. This research adopts the socio-psychological route. Taking a single phased route may not help me unearth the underlying causes because, in my opinion, the human behaviour is shaped by many complex processes, sociological and psychological aspects being some of them. The relevance of this framework to the study is its holistic approach in investigating gender-related issues. It is neither feminist nor masculinist in studying the problem at hand. The framework captures both the voices of male and female students' learning experiences in natural sciences with the aim of trying to unravel the factors behind subject choice, low uptake and performance.

The MMI theoretical framework satisfies these assumptions. Under the micro level factors (Yazilitas et al., 2013) the social cognitive theory (SCT) Bandura (1986) and the expectancy value model of achievement related choices (EVMARC) by Eccles (2005) will be used by the study to solicit for perceptions and attitudes towards natural sciences from the students. This will be done using a questionnaire and interviews to determine whether the challenges are of a psychological nature. The macro level factors will probe for socio-economic related influences through interviews and focus group discussions as well as observations. The theories under the macro level will be used to obtain and explain information on the kind of economic problems students face, the impact of their socialisation patterns on subject choice and performance. The way society views gender differences between male and female students will also be covered by these theories. The theories under institutional factors will be used to assess school system characteristics through class observations, documentary evidence of schools' administrations and the researcher's own observations of the school environment. The detailed discussions of the theories at each level are the focus of the discussions of sections 2.2.1 to 2.3.7.

2.2.1 Micro- level factors

Basically, Micro-level factors are an attempt to explain gender differences in STEM subjects from an educational psychology's perspective. They drive their philosophical thrust from the social cognitive theory (SCT) (Bandura, 1986; Bussey & Bandura, 1999). The expectancy value model of achievement related choices (EVMARC) of (Eccles, 2005) also fits into this category. Gendered choice patterns are described using psychological constructs linked to the level of the individual student. The crucial tenets of each of the theories are described in-depth next.

2.2.1.1 Social cognitive theory (SCT)

The SCT postulates that sections of an individual's knowledge possession can be directly related to observing others within the context of social experiences, interactions and external media influences. Human beings replicate others' actions for survival. Specific witnessed behaviour can alter an individual's way of thinking (cognition). I believe the key process is observation. According to this theory of Bandura (1986) human behaviour is explained in terms of self-efficacy (SE) beliefs, goal representations (GRs) and outcome expectations (OE). These three are the vital elements of SCT.

Bandura (1986, p. 391) defines SE as "the belief in one's capabilities to organise and execute the courses of action required to manage prospective situations."

Based on the above definition of Bandura (1986), I am tempted to argue that SE beliefs impact on the choice of activities, effort used up, resistance against obstacles and finally success. Self-efficacy reflects the cognitive appraisals of an individual's ability and endurances to do specific behaviours. Therefore SE plays a critical role in how challenges, goals and tasks are handled by an individual. From this perspective, it may be argued that individuals who easily give up on challenges at hand have low SE. Outcome expectations relate to beliefs about the repercussions of given actions. They deal with the question: What will happen if I do this? In learning a certain behaviour people try to understand what the potential result will be if they repeat that behaviour. In classroom situations, teachers give students instructions to assist them see what outcome a certain behaviour leads to. The fear of punishment in its different forms compels individuals to do things that one would not do if given a choice. During my teaching career I observed that at school, students who usually do the home works without failure are of those teachers who punish them severely for not doing the work. GRs are viewed as the persistence to produce a particular outcome (Bandura, 1986).The question asked is: What do I choose to do? From the discussion above the relevance of SCT in academic subject choices is evident. Figure 2.2 summarizes the determinants of human behaviour as per the SCT.

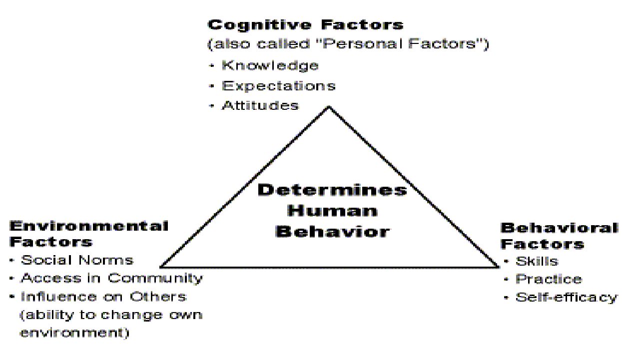


Figure 2. 2: Determinants of Human Behavior. Adapted from (Bandura, 1986)

On the behaviour factors, SE is deemed to have the greatest influence (Pajares, 2005; Schunk & Pajares, 2010). It is argued that individuals will only attempt to do a task when they do not doubt their ability to perform the activity. The assumption of SCT is that males and females differ in STEM self-efficacy. Different information presented to them, both implicitly and explicitly while being educated and growing up, creates the difference. Therefore, they are bound to make different academic choices towards STEM subjects. However, Chipman (2005, p. 18) refutes this claim by advancing that "putative sex differences in cognitive abilities continue to be advanced as the preferred explanation for sex differences in career participation, even though large sex differences in other variables would seem to be more plausible".

2.2.3 Expectancy value model of achievement related choices (EVMARC)

This model posits that gender differences in academic choice are a result of different values males and females attach to the available options (Eccles, 1983). The options are viewed in terms of cost, utility, attainment and interest. Utility value is described as the contributory value of the task that assists to fulfil other short or very long-term goals. Interest value refers to the pleasure an individual derives from participating in an activity. The connection between a task and one's sense of self and identity is defined as attainment value. The negative experiences related to a choice and the lost opportunities describe the term cost. All the explained four terms are classified as subjective task values (Eccles, 1983). These are values individuals put on a specific choice in comparison to the other options. The values are irrational.

Eccles (2005) identified the main determinants of educational and vocational choices as:

> (a) expectations of success on (sense of personal efficacy) the various options as well as one's sense of competence for various tasks, (b) the relation of the options to one's short and long range goals, core personal and social identities and basic psychological needs, (c) the individual's culturally based role schemes, such as those linked to gender, social class, religious groups and ethnic groups and (d) the potential cost of investing in one activity rather than another (Eccles, 2005, p. 12).

EVMARC singles out the expectation of success and subjective task value as the direct influences of academic and occupational choices. Eccles (1983) explains the expectation of success as the anticipated consequences of action. This concept is like the SE in SCT of Bandura because self-efficacy beliefs of individuals determine the choice of tasks, the effort input and the resilience to obstacles towards success. Students with low SE, in most cases, easily give up on challenging activities thereby self-blocking their road to success. Choosing a subject at school and later a career is hinged on the expectation of success in that area. I propose that no one in life really wants to fail in whatever they do but different obstacles stand in their way including low SE. Dissimilarities in subject task value emanate from a complicated interaction between gender and ethnicity schemes, short and long term goal representatives and basic identities of males and females (Eccles, 2005; Jacobs, 2005). The strength of the micro-level theories is in their ability to supply a cohesive basis for understanding how males and females differ in making individual choices. SCT and EVMARC cite differences in external pressure from influencers, differential role models and differential experiences as the main causative factors.

2.2.4. Macro- level factors

The position of this level's theories is that gendered patterns in STEM uptake are a result of societal determinants and differential socialisation of males and females. This stance contradicts that of the micro level theories which focus on social psychology to explain gender gaps in STEM subjects. The cultural construction of sex (gender) difference is the fundamental framing device for social relations (Bem, 1993; Ridgeway, 2006). The gender construction of sex is characterised by pervasiveness, happens almost automatically and is learned earliest (Glick & Fiske, 1999, p. 368). The modernization theory (MT), socialization theory (ST) and gender development theory (GAD) focus on macro level determinants to explain gendered patterns in STEM participation. These contend that the micro level theories have failed to explain the continued existence of gendered patterns of academic choices in the STEM subjects.

2.2.5. Modernization theory

The modernization theory explains the variations among countries in the gender uptake of STEM subjects in economically developed and developing countries of the world (Bøe, Henriksen, Lyons, & Schreiner, 2011; Schreiner, 2006). The founders of MT are Inglehart and Norris (2003). They argued that it offers a more practical approach to the problem of gendered patterns in academic choice. Their theory asserts that:

> ...women and men lives have been altered in a two stage modernisation process including (i) the skiff from Agrarian to industrialised societies reducing fertility rates, bringing women into the paid labour force and increasing rates of literacy and educational and (ii) the more from industrial to post-industrial societies generating more substantial gains towards gender equality in the public sphere and work place (Inglehart & Norris, 2003abstract).

This raises the question:: Is the low recruitment to STEM subjects in more economically developed societies related to social development and the associated changes in the spirit, values and ideas of society (Schreiner & Sjøberg, 2007, p. 2)?" To answer the question the researchers focused on the identity construction of young people. Their findings established that identity construction of young people in modern societies is distinguished by the individual's freedom and independence from collective structures such as gender, social class and family institutions. Therefore, their educational and academic choices are guided more by: "Who do I want to be?" (Illeris, 2003 p 362) Surprisingly, the study revealed that women in developed modern societies pursuing studies in tertiary institutions chose to study traditionally linked female careers connected with their core identity in the fields of teaching and nursing. Women from less economically developed societies were less worried about their core identities and in most cases chose non-rational fields inclusive of STEM disciplines. These findings seem to support the argument that women in economically advanced nations choose careers out of passion and not monetary benefits (Inglehart & Norris, 2003). Anyway, I believe they can still survive comfortably through unemployment benefits given by most of the governments. On the other hand, women from less economically developed nations view their career paths as vehicles to economic independence through high paying STEM jobs.

In this study, the modernisation theory will be used to find out whether the students have the individual freedom and independence to make a choice of their own. Is their choice non-influenced by peers, teachers, parents and society? Information will be obtained through item B4 of the questionnaire, interviews and FGDs.

2.2.6. Socialisation theory

The Socialisation theory assumes that the task roles of males and females in society are the product of complicated interactions between various social and cultural factors (Trauth et al., 2008). It assumes that inequalities between males and females in the education system and labour market gradually vanish as more females fight for their rights (Charles & Bradley, 2002). However, according to Forsthuber, Horvath and Motiejunaite (2010, p. 3), women remain a minority in STEM related fields in Europe despite increased enrolments. The theory argues that the relationship between gendered identities, societal development and gendered choice patterns are the key elements to unlock and understand the gender gaps in STEM subjects. Females have made great strides in increased education enrolments and equal salaries at work places the world over in the last three decades or so. The feminist and equal rights movements have been credited for these developments.

Nevertheless, STEM related disciplines have remained a male domain (Forsthuber et al., 2010). The findings of Forsthuber et al. (2010) are corroborated by the NESSE's (2011) report of the United States of America that stated that only 18% of STEM degrees graduates were women. In the Southern African Development Community (SADC), these results are supported by the findings of Morna and Jmbaya-Nyakujara (2011) who found out that in twelve countries of the SADC none had more female than male students in their tertiary institutions in science faculties. These research findings seem to defeat the argument of the social theory. Feminist movements and female activists have been active since the 1960s fighting for their rights, but gender disparities still exist both in the education systems and labour markets.

2.2.7. Gender and development theory (GAD)

It affirms that equality in the status of men and women is basic to every society. Its origins emerged as a concern with gender relations in development (Parpart et al., 2000). Gender is operationalised in relation to gendered activities rather than treated as an individual characteristic or identity. This is done to enhance the abilities of both women and men to act as agents of social change (Currie & Vernooy, 2010). Development is described as the creation of opportunities for people to earn sustainable livelihoods under a conducive atmosphere so that both men and women can seize the chances. Development must bring about maintainable improvement in the well-being of an individual and bestow benefits to all. The theory argues that a two-prolonged approach to the study of women and development is the most ideal. The focus is on relationship between women and men, not on women alone.

Feminist scholars have argued that knowledge based mainly on males' cultural specific experiences represent a skewed perception of reality and it is only partial knowledge (Connelly et al., 2000). This observation suggests that men propagate and support the knowledge which gives them advantages over women using culture as an excuse. The flipside of this argument is equally true and hence the relevance of the GAD approach to this study. Macro-level socio-cultural research has unearthed factors which can explain and justify part of the cross-national and cross-cultural variation in the STEM gender gap (Ceci & Williams, 2011., Trauth et al., 2008). The GAD theory will be used to collect data in co-educational schools. The day to day interaction of both male and female students and the teachers will be under the spotlight. As propounded by the theory, hearing the different views of both male and female students under one roof through robust interviews and FGDs is most likely to yield authentic information. This is one of the strengths of the macro-level factors.

2.3.7 Institutional-level factors

The approach postulates that different education systems have different outcomes for learners from different social backgrounds. The variation in the education- system characteristics further entrenches social reproduction of inequalities (Ceci & Williams, 2011; Woessmann, 2009). Examples of the education-system characteristics (Ceci & Williams, 2011) include, among many others:

- Government spending on both lower and higher education
- Existence of compulsory education and at what level?
- Existence of free education
- Mono-sex versus co-education schooling
- Availability of teachers and deployment polices
- Teacher-pupils ratio (class size) and

- Length of the school day

In rural Zimbabwe, most of the schools do not have science laboratories, technical subjects' workshops and qualified personnel to teach the subjects. In most schools in low income suburbs of the towns and cities of Zimbabwe, science laboratories are inadequate and ill equipped. The classrooms are overcrowded, and the teacher-pupil ratio is very high. STEM trained teachers are in short supply. It means that institutionally, the students are forced not to pursue STEM subjects. The classification of schools into government, council, church and private further compounds the problem of education inequalities. Inadequate financing of disadvantaged schools by the government particularly in rural settings widens the gap of the learning outcomes. The schools and higher learning institutions have different responsible authorities. Funding models differ from one type of school to the other. Variations in education systems definitely contribute to the reproduction of inequality in education (Buccheri, Gürber, & Brühwiler, 2011; Co-operation & Development, 2010).

The differences in education systems involve both the background features of the students and class structures in their interactions. According to Schütz, Ursprung and Wößmann (2008), cross studies of educational performance of students from different countries, provinces and districts exhibit clear contrasts in outcomes for different educational systems. The dissimilarities are difficult to explain and justify using previously established individual achievement scores. Institutional school environment in which students undergo their education have a strong influence on beliefs, values and norms that are linked with study choice and often interact with attributes of cultural backgrounds (Crul & Heering, 2008; PISA, 2007). The strength of the institutional level factors is that they show that differences in the composition of educational systems are responsible for the variance between apparently homogeneous countries. Although the MMI theoretical framework was the best option available to solve the problem at hand as has been justified it has some weaknesses which are explained below.

2.3. Limitations of the MMI Theoretical Framework

2.3.1 Micro-level theories

The micro-level theories cannot explain the huge variety in gendered study choice patterns which exist across countries. Social Cognitive Theory (SCT) and the Expectancy Value Model of Achievement Related Choices (EVMARC) researchers are unable to explain in depth the exact processes through which these factors influence gendered patterns of academic choices in STEM (Usher & Pajares, 2008). Institutional variables such as the school and classroom contexts which matter in gendered study choice's relation to micro-level factors are unclear. The theoretical framework of EVMARC cannot explain the cross-national variations in choice patterns on a structural level.

The micro-level theories perspective cannot singly give a full comprehension of gendered patterns of study choice. Literature on gendered study choice by Yazilitas et al. (2013) has shown that individual choices are made within social and institutional restrictions and that these limitations matter much. It can be argued that individual attributes such as self-efficacy beliefs are not inborn personality features but rather self-images which boys and girls acquire within an institutional and societal context. Societal impact on the girls' and boys' choices linked to their self-images of low and high efficacy in STEM depends on the society that they have been brought up. A society that assign low STEM efficacy to them prevents them from successful performance.

Gendered patterns on study choice depends on whether the society offers role models that are involved in STEM related occupations and hence opportunities for indirect learning. It also depends on whether the society's educational system places a premium on deciding early choices grounded on one's self image of efficacy in STEM, or not. Students' expectations of positive outcomes from their educational choices towards STEM may be assumed to depend on whether society rewards their choices. It also depends whether there are people (role models) who are enjoying the benefits from such choices within the society. Therefore, the arguments articulated by the micro-level theories somehow become weak and limited in scope.

2.3.2 Macro-level theories

Although the macro-level theories have managed to uncover some of the factors which partially explain the cross-national and cross-cultural discrepancies in the STEM gender gap, the explanation is still limited in scope. The factors are less specific in describing how they affect an individual choice. Countries with matching cultural gender beliefs and levels of economic development's many aspects of cross national differences in gendered patterns of academic choice cannot be accounted for by these theories. The assumptions of the theories that socio-economic conditions of most countries are characterised by wide gaps between the poor and the rich are over simplistic. To what extent do macro- level descriptions translate into measurable variations in micro- level constructs? Currently, there is little research evidence that links micro and macro level variation outcomes.

2.3.3 Institutional level theories

The theories are unable to explain the specific relation between the plan of educational systems and gendered choices. Why does a system characteristic such as the freedom of choice affect more girls than boys? It is possible that institutional differences in education systems collaborate with other factors that are not covered by these theories in describing gendered patterns in academic preferences in STEM. The MMI framework has not been able to explain in depth how these factors interact with each other.

2.3.4 Overview of the theoretical framework

The main strength of the MMI framework lies in its efficacy to explain the interplay and intersection of the factors at the three different levels in studying gendered patterns in academic choice. I have argued and exposed the strengths and weaknesses of a single theory or framework and how each could not have been able to bring all the factors into a coherent discussion of the issue under investigation. In my mother language we have a proverb which says, one person cannot do all things alone (*chara chimwe hachitswanyi inda)*. Linking it to this study meant that one idea or theory was not good enough to explain a phenomenon or offer a solution to the problem. In this section, I have argued and justified why the MMI frame work was deemed relevant to this study.

The strengths and limitations were also discussed. The next presents a review of studies that are related to the topic under investigation.

2.4 Literature Review

2.4.1 Introduction

Literature review is defined as an objective, critical summary of published research literaturerelevanttoaopicunderconsiderationforresearch(https://www.tru.ca/_shared/assests/Literature_Review_Template_30564.pdf).Its purpose is to create familiarity with current thinking and research on a topic and may justify future research into a previously overlooked or understudied area (Connelly et al., 2000). Numerous studies on gender and ability have been extensively researched and to review all the literature is beyond the scope of this study. Therefore, the literature review will specifically confine itself to gendered study choice patterns in STEM subjects. In this section, I start by looking at the overview background literature on gender inequality in education in the SADC, Zimbabwe and statistics of world female scientists. This is followed by literature targeted at the four research questions of the study. These are research question (1): What factors influence choice in natural sciences? Research question (2): Which factors contribute to the low choice and poor performance in natural sciences by female students and why? Research question (3): Do students experience gender discrimination from teachers in the learning of natural sciences? Research question (4): How and in what forms does stereotyping manifest itself? This review of literature revolves around these research questions.

2.4.2 An overview of background literature on gender inequality in education in:

2.4.2.1 SADC

Dube (2015) investigated gender disparities in educational enrolment and attainment in Sub-Sahara Africa and concluded that gender inequalities continue to occur in the educational sector of most of these countries. The results of his study identified various socio-economic causes as responsible for the gender disparities. With reference to gender disparities in STEM education he cited the following factors as the major reasons for the underrepresentation of girls and women.

- Biological differences between men and women;
- A difference of gender-based attitudes to science, technology and mathematics (STEM);
- Non-availability of women role models in STEM careers;
- Classroom learning environment;
- The structure of science curricula and the pedagogical approaches taken and
- Childhood socialization and related social pressure (Dube, 2015 p 282).

Moletsane (2010) acknowledges that in terms of access to education, South Africa has made significant progress since the dawn of independence. However, “it is the poor quality of the girls’ educational experiences and the consequent negative impacts on their learning outcomes, including performance in national and international examinations that remain problematic” (Moletsane, 2010, p. iv).

In a study of students’ perceptions of factors influencing the choice of science streams in Tanzania, Kinyota (2013) established six factors. These were students’ examination scores, self-efficacy, knowledge of available careers, gender and school resources contexts. He also concluded that most of the students lacked knowledge of the available careers and how they were related to the subject choices.

In Mozambique, the literacy rates among adult women is almost 18% lower than the adult men (Wheeler, 2014). “The sources of gender disparity among literacy rates in Mozambique are multi-faceted and cannot be attributed to one specific developmental or educational short coming but rather the combination of many political factors and cultural dynamics” (Wheeler, 2014, p. 3). When Mozambique gained independence in 1975, political differences between the government of Samora Machel and Renamo forces led by Dhlakama plunged the country into a civil war and many ordinary citizens were left homeless. Most of them fled into neighbouring countries. Children and women were the biggest casualties of that war.

In studying masculinity and male sexual behaviour in Mozambique, Macia, Maharaj, and Gresh (2011) observe that the norms of viewing men as the main providers and figures of authority perpetuates and exert strong influences on male attitudes and behaviour. Most people in Mozambique, like their counterparts in other African countries, believe and practise patriarchal customs that regard men as superior to women. According to Morna and Jmbaya-Nyakujara (2011), gender disparity in tertiary institutions of Mozambique was at 23% and 77% for female and male students who studied STEM related disciplines, respectively.

The trend of having fewer females choosing STEM subjects at high school level translate into tertiary education in most SADC nations as shown by Table 2-1.

Table 2. 1 Enrolment in STEM fields at tertiary institutions in some SADC Countries

Angola		Botswana		Lesotho		Malawi		Swaziland		Namibia		South Africa		Zimbabwe	
F %	M %	F %	M %	F %	M %	F %	M %	F %	M %	F%	M %	F %	M %	F %	M %
40	60	28	72	26	74	37	63	28	72	39	61	39	61	24	76

Adapted from (Morna & Jmbaya-Nyakujara, 2011)

The Table above shows the gendered student population in the science faculties of the selected Southern African Development Community (SADC) countries. Lesotho tops the list with a gender disparity difference of 48% and Angola has the least difference of 20%. Botswana and Swaziland have a gap of 44% each and South Africa and Namibia' gender disparity gaps are tied at 22%. Zimbabwe stands at 42%. Several reasons have been cited ranging from low self-concept and performance female students have (Clegg, 2007; Hollins, Murphy, Ponchaud, & Whitelegg, 2006; Hornberger & McKay, 2010) in mathematics and sciences. Other researchers have blamed the lack of gender responsiveness in the curricula offered from primary, secondary and teacher training institutions (Chetcuti & Kioko, 2012; Chikunda, 2014; Christidou, 2011; Herz & Sperling, 2004)

2.4.2.2 Zimbabwe

Since gaining independence in 1980 the government of Zimbabwe has committed itself to the achievement of gender equality and women empowerment. To achieve this, the government has ratified some regional and international instruments. Among the instruments are the Beijing Platform for Action (BPfA), the African Charter on the Rights of Women (ACRW), the Convention on the Elimination of all forms of Discrimination Against Women (CEDAW) and the Southern African Development Community Protocol on Gender and Development (SADCPGD). Several policies have been drafted and legislated. These include the Zimbabwe Economic Development Strategy (ZEDS), the Mid Term Plan (MTP) of (Ministry of Education, 2011), the Gender-Responsive Economic Policy Management Initiative (GERPMI) and the National Gender Policy (NGP) of 2013 (MWAGCD, 2013).

According to the report of Zimbabwe National Statistics Agency (2016), the government acknowledges that although women have seized the opportunities and benefits of education and participation in the labour force in the recent past, they still face challenges of fully accessing these opportunities. Zimbabwe may be a good example of a country which is very good at drafting policies and programmes but limps when it comes to implementation.

Runhare and Gordon (2004) pointed out that the failure by government to achieve gender equality was due to (a) a gender insensitive environment, (b) a home and community environment that is not adequately supportive and (c) a policy environment that is insufficient to address the education needs of girls. It is well documented that the reasons which have largely disadvantaged women stem from patriarchy, customary law and the colonial legacy (Gudhlanga et al., 2012).

A gender audit of the education sector done by the United Nations Girls' Initiative (UNGEI, 2012) revealed that Zimbabwean women and girls of African origin experienced double discrimination in education based on their race and gender. Despite that colonialism ended in 1980, the mind-set of most people, both black and white, still believe that the rightful place of the African woman is at home, taking care of the children. Therefore, there is no need for the girl child to receive high education. Even highly educated and skilled women most of them ascribe to the notion that the man of the house must be the provider for her and the children. Masinire (2011) examined masculinity and schooling in rural Zimbabwe and identified academic competition as one of the methods in which intellectually gifted girls are excluded and frustrated to pursue their educational dreams. This was achieved through the lack of respect from male teachers and boys. The high self-concept of intelligent girls was lowered by gendered stereotype beliefs the girls were regularly subjected to in their interactions with boys. The findings also revealed that the poor performance of girls was related to romantic relationships.

The literature on gender inequality in education in both the SADC and Zimbabwe that I have discussed does not show signs of gender disparities in education ending soon and more so in STEM subjects and jobs. The culmination of academic education is in research because it is research that can improve the human lives and their economic statuses. I wind up this section of literature review by looking at the number of female researchers in the fields of sciences in selected countries of the world as a way of highlighting the prevalence of the problem in the science fields.

2.4.2.3 World Statistics of Female Researchers in STEM Occupations

Gender disparities in science fields are very apparent globally as shown in table 2-2. However, females like Professor Deborah Jin of Colorado University are among the few to break the barriers of gender disparities in society. She was the first world scientist in 2013 to succeed in cooling down molecules so that chemical reactions could be observed in slow motion. Together with other women like Sophia Huyer a world renowned agricultural scientist may be good examples of role models for the young girls aspiring to pursue a career in natural sciences.

Table2. 2 Female researchers by fields of science (%)

Country	Year	Natural Sciences	Engineering & Technology	Medical Sciences	Agricultural Sciences	Social Sciences
Armenia	2013	46.4	33.5	61.7	66.7	56.3
Bulgaria	2012	51.0	32.4	58.8	55.6	55.8
Cyprus	2012	38.7	25.4	46.3	22.8	43.6
Netherlands	2012	23.3	14.9	42.8	31.9	40.8
Russia	2013	41.5	35.9	59.5	56.4	60.3
Chile	2008	26.5	19.0	34.4	27.8	32.7
Colombia	2012	31.8	21.6	52.5	33.6	39.9
Costa Rica	2012	49.7	34.9	56.1	45.8	55.5
Venezuela	2009	35.1	40.4	64.9	47.6	62.9
Iran	2010	34.3	19.6	29.5	24.5	25.5
Iraq	2011	43.6	25.7	41.4	26.1	33.7
Kuwait	2013	41.8	29.9	44.9	43.8	34.7
Qatar	2012	21.7	12.5	27.8	17.9	34.3
Angola	2011	35.0	9.1	51.1	22.4	26.8
Botswana	2012	27.8	7.9	43.6	18.1	37.8
Burkina Faso	2010	10.1	11.6	27.7	17.4	35.9
Egypt	2013	40.7	17.7	45.9	27.9	49.7
Ghana	2010	16.9	6.6	20.8	15.5	22.3
Kenya	2010	14.4	11.2	20.0	30.4	37.1
Malawi	2010	22.2	6.5	17.5	12.5	32.8
Mauritius	2012	36.4	19.4	41.7	45.4	61.0
Mozambique	2010	27.8	28.9	53.1	20.4	32.0
Uganda	2010	17.1	23.3	30.6	19.7	27.0
Zimbabwe	2012	25.3	23.3	40.0	25.5	25.6

Adapted from UNESCO Institute for Statistics, August 2015

Table 2-2 indicates the name of the country, the year in which data was obtained and the different fields of science. The first 5 countries belong to Europe followed by 4 countries from the Latin America and 4 from the Middle East, respectively. The last 11 nations belong to Africa and 6 of them to the SADC region. Except for Bulgaria, the rest of the world countries have less than 50% female researchers in natural sciences. These are the spillover effects of the underrepresentation of female students in STEM subjects at high school and tertiary levels. Burkina Faso tops the list of having the least number of female researchers in natural sciences with 10,1%. Zimbabwe where this study was conducted is second last from Malawi (22.2%) in the SADC region with a representation of 25.3% female researchers in natural sciences. This evidence further indicates the existence of gender disparities in the choice of natural sciences in the education system of Zimbabwe and the need to find the underlying causes.

Table 2.2 shows that there is no country with 50% or more female researchers in the fields of engineering and technology. The data shows that it is a male domain. The medical sciences have 8 countries with a representation of over 50% female researchers. The surprise inclusions in this group are Angola (51.1%) and Mozambique (53.1%). Women are likely to choose careers that involve saving human lives (Baram-Tsabari, Sethi, Bry, & Yarden, 2009; Eccles & Wang, 2012; Gill et al., 2008; Wang & Eccles, 2013). Probably this explains the trend in the medical sciences. The other SADC countries may learn from these two the kinds of policies and strategies that they use to entice many female students to choose STEM subjects at high school level. The social sciences have 6 countries and the agricultural sciences have 3 countries with over 50% female researchers. According to Huyer (2015) the approach of getting more women to study science and choose a scientific career needs to be replaced by an approach that is oriented towards addressing the points of attrition, barriers and culture that cause women to abandon science.

Having discussed the background literature to gender inequality in education and some evidence of the effects on female careers in STEM I now move on to examine the literature that is related to the four research questions.

2.4.3 Subject choice factors (RQ1)

2.4.3.1 Ability/Self-efficacy.

In this study, ability and self-efficacy (SE) were deemed to have the same conceptual and contextual meaning. Self-efficacy is defined as one’s belief in one’s ability to succeed in specific situations or accomplish a task (Bandura, 1986) Therefore, self-efficacy beliefs describe a person’s choice of activities, including educational choices, thought patterns, persistence as well as one's effort expenditure and reactions when resisted by barriers (Pajares, 2005; Schunk & Pajares, 2010).

Many studies on academic choices using the SCT have been done in the last two decades or so and these include the pioneering work of Bandura (1986) and Bussey and Bandura (1999). The other authorities in this area are Ceci, Williams, and Barnett (2009), Else-Quest, Hyde, and Linn (2010) and Patterson and Johnson (2017). Else-Quest et al. (2010) researched on cross-national patterns of gender differences in mathematics in American schools. Their findings established that girls displayed more negative attitudes than boys in mathematics and science particularly those from parents who were non-supportive in the subjects. Patterson and Johnson (2017) postulated that biased feminine gender role socialization diminished the girls' SE in physical sciences thereby threatening their career orientations and competitive norms.

The general findings of most studies linked to SE revealed that boys and girls indeed differed in perceived self-efficacy. Girls displayed lower efficacy than boys on tasks perceived to be a preserve of males. In making a choice the students considered their ability in the subject. The success or failure in STEM was attributed to different factors by both boys and girls. According to Meece, Glienke, and Burg (2006) and Zeldin, Britner, and Pajares (2008), for example, girls attributed their success in STEM to external factors such as support, learning time and luck and boys attributed it to internal factors such as talent/ability. Gender difference in mathematics self-efficacy is greater among students in higher secondary education and tertiary education than in primary and lower secondary education (Pajares, 2005). At primary school level, the confidence of both girls and boys is similar but girls begin to lose confidence as they enter puberty and start higher education (Louise Archer et al., 2010)

Research done by Jansen, Scherer and Schroeders (2015) on students' self-concept and self-efficacy in the sciences revealed that self-efficacy was a better predicator of current ability and was strongly affected by inquiry-based learning activities. Ability as a factor of choice in STEM subjects is also noted by Bennet (2017). Salehjee and Watts (2015, p. 733) posited that there were always students who belonged to the "smooth transition" in a learning set up. These are the students who 'always knew what they were going to do' they never questioned their ability or career direction. The observation by Salehjee and Watts (2015) seems to suggest that some people have inborn traits of high self-efficacy. Could it be that SE is hereditary or acquired through socialization? It is a debate which psychologists and sociologists may never agree on.

Faitar and Faitar (2013) studied the teachers' influence on student's career choice and concluded that the individual choice for a science related career is determined by parental support, individual efforts or ability, courses taken in the school and by the collaboration and support of the STEM teachers. Salehjee and Watts (2015) argued that when it comes to subject choices, the natural inclination and inherent preference of an individual was not determined by immediate contextual factors but resulted from persistent drive (SE) within the individual. STEM uptake, specifically in physics and chemistry, remains unpopular among students (Hofstein, Eilks, & Bybee, 2011). Research has shown that the frequently mentioned reason is that science is perceived to be difficult and irrelevant to the student and the society to which they belong (Dillon, 2009; Stuckey, Hofstein, Mamlok-Naaman, & Eilks, 2013)

Confidence in one's ability to succeed, expectations for success and self-efficacy are important predictors of behavioural choice (Wigfield, Battle, Keller, & Eccles, 2002). The low maths SE in female students contributes to their underperformance in mathematics as noted by Valian (2007). Students with high SE in mathematics are most likely to embark on STEM careers (Dweck, 2008). However these findings are viewed with caution by Shapka (2009) and Wang and Eccles (2012) who argue that ability is necessary but not a sufficient predictor of educational and career choices. Ceci et al. (2009) admit that biological factors may influence the gender gap in spatial ability, but they cannot be separated from environmental factors and thus alone cannot explain gender gaps in STEM.

In a study of students' self-concept and mathematics achievement in south western Nigeria, Yara(2010) established that there is a sustained and significant relationship between self-concept and academic achievement and the two variables seemed to affect each other. Similarly, Ahmed and Bruinsma (2006), in their study of 181 Asian and European graduates, found out that students who feel more positive about their abilities perform well. However, a study conducted by Areepattamannil and Freeman (2008), comprising of 573 grade 11 & 12 students in Greater Toronto, revealed an insignificant correlation between self-concept and academic achievement. These findings were concurred by Baadjies (2004) who categorically stated that he found no correlation between self-concept and academic achievement. The contradictions in these studies are a testimony to the volatility of human perceptions or attitudes. The variations of the studies' outcomes may be indicative of the situational uniqueness of each research and probably the subjectivity of social science researches.

Yara (2010, p. 129) argues that "individuals with a low academic self-concept have shown a low commitment to school". The argument corroborates (Lau & Chan, 2001) who affirmed that generally poor achievers don not believe that they have the ability to achieve, spend minimum effort in studying and easily give up when faced with difficult challenges. According to Lent, Brown, and Hackett (1994), self-confidence is associated with attitudes, feelings and perceptions concerning one's academic abilities. There is a predictive relationship between self-beliefs and subsequent grade performance (House & Williams, 2000). There is certainty that high academic self-efficacy influences academic major and career choice (Moakler & Kim, 2014).

However, a study with 645 University of South Africa (UNISA) students done by Ochse (2003) on students' self-perceptions, their expectations and academic achievement had contradictory results. In this study, there were 3 groups, namely, over estimators, realists and under estimators. The findings revealed that the under estimators scored significantly higher marks than both the over estimators and realists in the test given. The signals are transmitted to the reader by these results are probably two which are: (a) a positive self-concept does not always translate into high achievement and (b), although debatable, students should rather have an accurate self-perception than a positive self-perception to achieve academic success. Accurate self-perception is regarded as the realistic view about one's self-competence and this is different from positive self-perception. The discussed literature in this section seems to suggest that ability or SE is not enough to explain gendered patterns in subject choice.

2.4.3.2 Role models/influencers

Current studies have directed a great deal of attention to the importance of role models which in this study are also defined as influencers (Sjaastad, 2012). The impact of role models is best explained by the socialization theory. These are the participants who give students critical information and feedback on career, educational and academic options disposable to them and on the gender suitability of these options (C. Leaper & Friedman, 2007). The influence includes, among many others, parents, teachers, friends/peers, the media and school counsellors. Parental expectations, the quality of parent- child communication and the parental style may be more highly related to student achievement than the various more overt expressions of involvement (Jeynes, 2010). Simpkins, Fredricks, and Eccles (2012) noted that the beliefs parents have on their child's ability in science and maths and the value they place on the subjects influences the motivation and later career choices of the child. According to (Archer et al., 2014), the family, family friends or neighbours doing the same job as the aspirants were cited as the main source of influence to their choice of subject and career. These observations support Simon et al.'s (2012) findings from Understanding Participation rates in Mathematics and Physics (UPMAP) project. Campbell Leaper, Farkas, and Brown (2012) contend that not much research has been done on examining peer effects on subject choice notwithstanding the fact that peers resolutely influence adolescent behaviours. They argue that the current studies have focussed on relationships of perceived social support instead of actual peer influences.

Research done by Jones, Taylor, and Forrester (2011) who explored the reflections of scientists and engineers to examine early influences on their careers concluded that a supportive and nurturing relationship with their teachers and parents made them what they were. At individual level, not all children within a 'high science capital family' that is a family with science related qualifications, will aspire to a future in science (Archer et al., 2014). Equally, children from 'low science capital families' do find a route into science. This is probably true with students from poor backgrounds that see high paying STEM related careers as the only fastest gate way from poverty to riches. Hattie (2009) argues that teacher expectations on individual student's achievement have an impact on subject and career choice. The influence of role models is either transmitted directly through conversations in classrooms through teaching and parent-child talk or indirectly through admiration of the life styles of the role models. In Zimbabwe, currently, the influence of role models may have little impact because the streets are full of jobless highly qualified and skilled people due to a stagnant economy. It is an environment like this demoralises students in schools and colleges.

2.4.3.3 Social benefits

In this study, social benefits, utility values and subject relevance were operationally used to explain the research findings. . Utility value is a potentially useful forerunner of both interest and performance (Hulleman, Godes, Hendricks, & Harackiewicz, 2010). Perceived value for a task can contribute to both situational and individual interest (Suzanne Hidi & Renninger, 2006). A research done by Ndalichako and Komba (2014) on students' subject choice in secondary schools in Tanzania revealed that student's preference of a particular subject included commitment and support provided by the subject's teachers, the availability of the teachers, their approaches and relevance of the subject to their daily life experiences. Morgan, Gelbgiser, and Weeden (2013) noted that students prefer subjects which assist them to get skills and knowledge that helps them in their daily lives. These results of these studies underscore the importance of subject relevance attached by students to their choice.

Morgan et al. (2013) also revealed that high school job aspirations are predictive of tertiary education majors and that gender dissimilarities in occupational preferences are also key predictors of female underrepresentation in STEM disciplines. Females and males demonstrate different work choices and occupational ambitions that are visibly formed during adolescence (Diekman, Brown, Johnston, & Clark, 2010). According to Su, Rounds, and Armstrong (2009), females prefer professions that allow them to interact with people but males prefer jobs which involve machines and tools. In a nut shell, females prefer people-oriented fields.

Research done by Osborne, Simon, and Collins (2003) in the United Kingdom(UK) on attitudes towards science concluded that the majority of 15- year old pupils find science both 'interesting and useful for jobs,' even though it is not considered 'easy'. In contrast to these findings, Stuckey et al. (2013) reported that most learners do not pursue STEM subjects because they perceive them as both difficult and irrelevant to them and the society they live in. A study done by Else-Quest and Grabe (2012) showed that female adolescents reported higher science task value than their male counterparts. These findings seem to suggest that female students place more importance on social benefits when choosing a subject to study. Else-Quest and Grabe (2012, p. 295) argue that “theoretical support for the importance of STEM attitudes comes from several theories within educational, social and vocational psychology, including EVMARC’s theory which maintains that education-related choices are shaped by attitudes.” Likewise, Powell, Dainty and Bagilhole (2012) looked at gender stereotypes among women engineering and technology students in the UK and revealed that 39% of the participants gave social benefits as the reason of choice. Further gender differences in the uptake, interest and perceived utility value of STEM becomes greater as pupils grow older (Louise Archer et al., 2010). Enhancing Interest and Performance with a Utility Value Intervention a study conducted by (Hulleman et al., 2010) surmised that students ‘preference of a particular subject is hinged on the social benefits that they will derive from learning it.

2.4.3.4 Career pathways

Research on social role conformity, likewise has indicated that college students view careers in STEM as opposed to careers in other fields to obstruct the endorsement of communal goals (Yazilitas et al., 2013). The choice of a career derives its augment from both the socialization and EVMARC model theories. According to Diekman et al. (2010), the tracking of such aims negatively predicts STEM interest and as such reconcile gender difference in STEM careers. Studies engaged in the beliefs, attitudes, expectations and images of young adolescents concerning academic careers in STEM also visibly portray the differences (Christidou, 2011). Girls link science more frequently with developing medicine and finding cures to cancer on the other hand boys associate science with rockets, invention and building machines ((Baram-Tsabari et al., 2009). The impression one gets is that females are comfortable with careers that involve the emotional aspect of saving human lives and males pursue careers that satisfy their adventurous male egos.

Regardless of the United States of America's meaningful investment in STEM education, the size and the composition of the STEM workforce continues to fail to meet demand (Wang & Degol, 2013) These revelations seem to indicate that the problem of the uptake of STEM subjects and related fields is not only confined to developing countries but to developed countries as well. The EVMARC theory which is made up of interest value (enjoyment), utility value (which helps to fulfil personal goals), attainment value (that links task to one's sense of self and identity) and cost (the expected social economic costs of various choices) is more appropriate in explaining career choices (Wang & Degol, 2013). It follows therefore that choice is associated with the relative subjective task values and expectations for success.

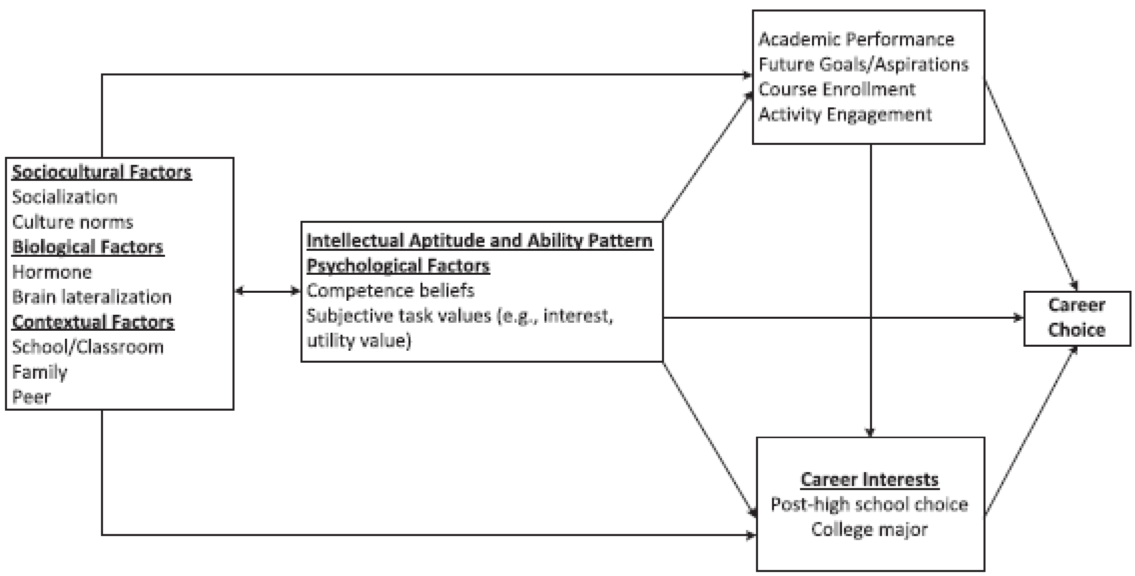


Figure 2. 3 A Theoretical Model of career choices. Adapted from (M.-T. Wang & Degol, 2013)

Figure 2-3 gives a summary of the theoretical model of career choices. The model can be regarded as depicting the intersection and interplay of the MMI theoretical framework constituencies. There is no single factor that can be attributed to the career choice of an individual. However, it can be assumed that some factors are more impactful than others depending on the individual's circumstances. Researchers are not very sure of the motivational factors that entice women to certain STEM disciplines such as biology and medicine against other STEM fields such as computer science, engineering and physical sciences (Ceci & Williams, 2010). Career choice is made at individual level;

therefore it is imperative to model the social and psychological processes that lead to career decisions during secondary school (Wang & Degol, 2013). Powell et al. (2012) singled out career rewards such as job prospects and salaries as one of the reasons why students choose STEM subjects. Remuneration is a more important factor in career choice for men than women (Dick & Rallis, 1991). Women appear to have a strong social ethic and are more influenced by involvement with human issues (Gill et al., 2008).

Subject career choice is best summed up by Reiss and Mujtaba, (2017) who postulate that:

> Young people do make choices about the school and post- school subjects they take and the jobs they accept, but they make such choices not as free agents but as individuals at least partly constricted by circumstances-some of which are specific to them and others of which are more generic (Reiss & Mujtaba, 2017, p. 146).

The statement by Reiss and Mujtaba (2017) may not be far from the truth. My experience of interacting with fellow teachers and other people from different careers has revealed that most of them claim that they never wanted to do what they are currently doing.

The findings of Reiss and Mujtaba(2017) support the results of Mellors-Bourne, Connor, and Jackson (2011) who, in the study of STEM graduates in non-STEM jobs conjectured that the decision to enter STEM jobs was often part of a longer process of career decision- making by individuals. A paper delivered by Bennet (2017) at the SAARMSTE 2017 conference cites interest in a science career as one of the important factors of subject choice for STEM. Research done by Moakler and Kim (2014) in studying a College major choice in STEM found out that female students were less likely to develop outcome expectations towards a STEM career and major choice. These results are consistent with the earlier findings (Fouad, 2007; Sax, 1994) which indicated that most female students were reluctant to pursue STEM related occupations. Value-related beliefs are strong predictors of choice behaviours and beliefs such as career aspirations in STEM (Wang & Eccles, 2013). The discussed literature review shows a strong link between career choice and social benefits. The theoretical model of career choices also ratifies the relevance and choice of the MMI theoretical framework in this study.

2.4.3.5 Interest

Interest in mathematics and science by the youth is linked to the number of mathematics and science courses taken in high school and aspirations for mathematics -related careers Joyce and Farenga (2000). Watt's (2006) study on the role of motivation in gendered educational and occupational trajectories in maths and Frenzel, Goetz, Pekrun, & Watt's (2010) investigation on development of mathematics interest in adolescence postulated that both boys and girls regard mathematics as equally important but boys have a higher interest in it than girls. Boys' interest in mathematics remains constant but the girls' interest wane off as they move through adolescence (Köller, Baumert, & Schnabel, 2001). Girls show progressively lower ability self-concept relative to boys beginning in middle school throughout to college (Pajares, 2005). It can be argued that self- efficacy/concept/ability and interest are intimately interconnected. As earlier alluded to, in this study, the terms self-efficacy, self-concept and ability are interchangeably used. The waning self- ability drive in girls as they pass through high school to colleges may be attributed to several factors among them adolescent pressures. At primary level even up to grade 8 & 9/form 2 girls compete equally well with boys in mathematics and sciences but somehow lose the touch as they progress further to higher levels.

Girls display larger negative attitudes towards school science and out of school science as compared to boys aged 12 which increases more in secondary schooling (Bennett & Hogarth, 2009). A study done by Cvencek, Meltzoff, and Greenwald (2011 p 767) posits that "children have reduced interest in future academic performance courses and occupations that are incompatible with their academic performance." Such findings support the notion that interest in a subject is closely linked to one's performance ability. However, these observations are contradicted by the findings of Hampden-Thompson & Bennett(2013) who posit that:

> There is mixed evidence on students' levels of interest in STEM subjects across the years of secondary schooling. Several studies report declining

> interest, though more recent work suggests levels of interest are higher. However, even high levels of interest do not translate into post-compulsory study. By the age of 11-12, most students already see STEM subjects as something they personally are not going to study (Hampden-Thompson & Bennett, 2013, p. 10).

In a similar study on stability and volatility of STEM career interest in high schools (Sadler, Sonnert, Hazari, & Thi, 2014) showed that of the key factors predicting the choice of STEM career is interest. The findings also revealed that both a lower retention of STEM career interest among females and greater difficulty in attracting females to STEM fields during high school (Sadler et al., 2014). However, these findings are contradicted by the findings of Christensen, Knezek, Tyler-Wood, and Gibson (2014) which revealed that females were significantly more positive than males in STEM career interest and in semantic perceptions of STEM .

Faitar and Faitar (2013) suggested that regardless of the future career choice, there was a prevalent recognition of the individual's effort that is necessary to achieve a high level of competence. The individual effort is triggered by self-driven interest or by forced interest in the subject, so I can argue. Effort in the subject emanating from the student's career prospects and benefits is self-driven interest. However, effort resulting from threats and punishment from teachers and selective subject funding by sponsors is coerced interest. Utility value interventions influence interest and performance on a task (Hulleman et al., 2010). A research done by Christensen et al. (2014) on longitudinal analysis of cognitive constructs fostered by STEM activities for middle school students identified the main sources of interest in Stem careers as follows:

1. A supportive parent/family member (26%)
2. A quality/motivating teacher (17%)
3. Self-motivation/naturally inclined (14%)
4. Science and mathematics classes in school (6%)
5. Science fairs /competitions (6%)
6. Other 16 different types of reasons (31%)

Experience and attitudes developed prior to high school make a crucial contribution to the current disparity in interest in STEM careers exhibited by female students and face ultimate imbalances seen in the workplace (Sadler et al., 2014). Sadler et al.'s (2014) findings seem to suggest that focusing studies on gendered patterns in STEM subjects at high school level is like flogging a dead horse. This is because focusing researches at high school and tertiary institutions should be informed by the situations at primary level education. A strong STEM curriculum should be offered from primary education. Studies should be done earlier at primary school level and the causes identified. The new primary science curriculum introduced in 2015 by the government of Zimbabwe seems to meet the needs of a STEM education. There is a shortage of qualified personnel to teach the subjects as well as infrastructure (Dube, 2015).

2.5 The role of attitudes in subject choice and performance (RQ2)For the purposes of this study, the terms perception and attitudes are used synonymously. An attitude is a feeling or opinion about something or someone, or a way of behaving that is caused by it. The type of attitudes described in this study is affective and the term is operationally used as best explained by Osborne et al.(2003, p. 1053) who notes "Affective attitudes towards science are the feelings, beliefs and values held about an object that may be the enterprise of science, school science, and the impact of science on society or scientists themselves". In this study, data on attitudes was obtained during the qualitative phase of the explanatory sequential research design. It was essential to get to the bottom of the feelings, beliefs and values of the participants which the quantitative approach alone could not do.

A literature review based study by Stuckey et al. (2013) on attitudes towards science concluded that students perceive school science and science more broadly as both difficult and irrelevant both for themselves and for the society in which they live and operate. These findings support earlier findings of Crawley and Black (1992) and Hendley, Stables, and Stables (1996) that identified student's perceptions of science as a difficult subject as being the determinant of choosing the subject for study. In the same vein, Brogan (1998, p. 1) asserted that "the way learners feel about their abilities may for better or for worse, consciously or unconsciously influence their academic choice”. A research done in Papua New Guinea by Kolodziejczyk (2015) on gender issues in access, application and attitudes towards ICT in high education institutions found out that female students embraced ICT application more than male students.

Studies done by Else-Quest and Grabe (2012) on maths and science attitudes and Ganley and Vasilyeva (2011) on sex differences in relation between maths performance and attitudes concluded that attitudes to STEM may be critical to women’s underrepresentation because girls tend to hold more negative attitudes relative to boys. This is supported by Bennett and Hogarth (2009) who postulated that girls exhibited greater negative attitudes towards school science and out of school science as compared to boys aged 12 and at high schools onwards. Young women view physics as a subject for young men and becoming a physicist as distinctly a male profession (People, 2008). In contrast, Christensen et al. (2014) in a study of 364 high school students’ perceptions of STEM found out that female students were significantly more positive than male students in STEM career interest and in semantic perceptions of STEM as a career. These contradictions seem to highlight the complicated nature of gender related issues and the challenges faced by the researchers in this field of study. The focus of the next section is on gender stereotyping.

2.6 Gender stereotyping and teaching (RQ3)

Kurtz-Costes, Rowley, Harris-Britt, and Woods (2008) define stereotypes as judgments about the abilities or characteristics of individuals built on their membership in a social group. Early in their lives as children grow and interact with their environment in different ways stereotypes become evident. Children are unavoidably exposed to gendered environments emotionally, socially, cognitively and physically as they grow up through the process of socialization. Many societies in the world expect boys and girls and men and women to culturally abide to the norms of behaviour based on gender stereotypes (Lee & Kushner, 2008).

According to Räty, Vänskä, Kasanen, and Kärkkäinen (2002), stereotypes have the power to persuade or dissuade students from making choices which do not orient with prescribed gender roles in society. In studying whether stereotype threat reduces motivation to improve, Fogliati and Bussey (2013) found out that stereotypical negative comments made in class by teachers had more effect on the female's performance in mathematics than males. The same stereotype which blocked the female's ability in the subject also reduced their motivation to improve. These findings partly explain why most females drop the STEM subjects in the education system of Zimbabwe whose culture is predominantly patriarchal.

In Zimbabwean science classes pedagogical communication hinges mainly on teachers who hold a lot of power and decides on instruction methods during the process of teaching. Hoadley (2005) argues that the way the teachers communicate and choose pedagogic strategies in the school classroom depends on their social background. The relevance of Hoadley (2005) observations to the Zimbabwean school context is that teachers must always be aware of the diverse socio-economic backgrounds of their students. Whatever communication strategy is used, it has outcomes for the specialization of the subject by the student.

In a study done by Dunne et al. (2005) on gendered school experiences in Botswana and Ghana the results revealed evidence that the experience of schooling for students and teachers was highly gendered in terms of institutional practices, teacher subject allocations and responsibilities, retention of students and students achievement. The effect was to sustain traditional institutional practices and reproduce damaging gender asymmetries (Dunne et al., 2005, p. x). The traditional institutional practices include most of leadership positions and STEM teaching and choice being a male domain, among many others. Masinire's (2011) study of masculinity and schooling in Zimbabwe indicated that it was futile to preach about gender equality in the classrooms without considering the cultural backgrounds of the teachers. According to Mutekwe, Modiba, and Maphosa (2012), girls underperformed in their school subjects because they felt that they were not treated at the same level as boys both at school and at home. Research by Miyake et al. (2010) and Steele and Aronson(2005) indicated that when a student's social identity is erected negatively, the student will be liable to underachieve in a way that is consistent with the stereotype. In other words, when an individual is persistently called a fool they end up behaving foolishly. In a school situation, my experience as a teacher showed me that repeated negative comments on a student's subject ability whether by teachers or peers will virtually drive the student to either drop, dislike or underperform in the subject.

Cheryan, Siy, Vichayapai, Drury, and Kim's study on (2011) whether female and male role models who embody STEM stereotypes hinder women's anticipated success in STEM established that the interplay with a stereotypical role model, regardless of the role model-gender, negatively influences females' beliefs of success in computer science but males' beliefs remain unchanged. Another study done by Nosek and Smyth (2011) in North America indicated that the stereotype that math is a male domain is persistent and pervasive in the American culture. Cvencek et al.(2011) put forward the idea that these gender stereotypes are evident as early as Grade 2. Brown and Leaper (2010) proposed that at adolescence, girls have reported being exposed to sexist comments about STEM abilities from both the teachers and peers. I recall a favourite comment from the teacher who taught me mathematics at form 4: "you are a combination of beauty and brains" directed to one of the bright girls in our class. Perhaps the teacher was trying to tell us that beautiful girls are not intelligent in mathematics. The remark of the teacher was sexist and prejudiced. Parents were cited as being among the guilty that generally support the cultural stereotype that mathematics is more natural for boys than for girls in longitudinal studies done by (Herbert & Stipek, 2005). An investigative study of the abuse of girls in African schools conducted by Leach et al. (2003) had this to say:

> As in Zimbabwe, schools in Ghana and Malawi are a breeding ground for potentially damaging gendered practices, the influence of which will stay with pupils into adult life. Sexual aggression goes largely unpunished, dominant male behaviour by both pupils and teachers is not questioned, and pupils are strongly encouraged to conform to the gender roles and norms of interaction which they observe around them. A school culture which encourages stereotypical masculine- dominant and feminine- acquiescent behaviour makes girls particularly vulnerable (Leach et al., 2003 p vii - ix).

If the findings of the above discussed researches are anything to go by then it may be insinuated that gender stereotyping knows no country boundaries.

2.7 Agents of manifestations in gender stereotyping (RQ4)

There are many forms in which gender stereotyping manifests itself through its agents. Only six will be discussed in this section for the following reasons. The gender and the development theory give insight into the different roles played by males and females. Teachers will be interviewed for their opinions on research questions 1 2 & 3. They will also be observed teaching to obtain data for research question 4. The study will be carried out within the school environments of the five schools. The curriculum reflects the lessons and academic content taught by the teachers. Teachers will be observed on how they teach, and the students will be interviewed about their classroom experiences. Co-education classrooms are offered by all the schools under study and the need to have views from both male and female students. Teachers are assumed to represent parents and therefore their views are considered as a reflection of parental beliefs. The students are the main participants in the research and hence the need to investigate the role they play as peers in gender stereotyping.

2.7.1 Teachers

Teacher attitudes reflect in their treatment of students often favouring the male student than the female (Magno & Silova, 2007). Boys, most of the time, are chastised and given more attention but the girls are instilled with a dependency syndrome. The tacit assumptions about gender and the general lack of awareness by teachers on how they use gender as an organising and categorising tool have great effects on student behaviour (Tsouroufli, 2002). A study done on the effect of teachers' stereotyping of students' stereotyping of mathematics as a male domain by Keller (2001) showed that there is a tendency by teachers to stereotype math as a male domain and to credit boys' successes and failures to ability, but attributing the girls' successes and failures to effort. According to Ifegbesan (2010) and Mwamwenda (2013) teachers sustain male stereotypes by paying more attention to male students than female students unknowingly. This behaviour of the teachers may be attributed to their cultural upbringing where the male child is given more attention and favours at the expense of the female child. Gender stereotypes impact negatively on shaping and developing the identity and education of the female child while still young. The resultant end results are a restricted educational access, achievement and career opportunities to the female child.

Reflecting on my own experience at high school where our mathematics teacher who would comment thus: "*Ngatiwombereyi maoko apa chimhandara chafunga pachirume chaipo*" (Let us clap our hands for the girl who has thought like a male). The remarks would be a response to a girl who would have correctly answered a mathematical problem. The teacher's remarks implied that girls were not supposed to be good in mathematics like boys. The remarks were humiliating, chauvinistic and sarcastic.(Keller (2001) argued further that there is a direct relationship between the emphasis on stereotyping math as a male domain by the teacher and strength of endorsement of math gender stereotyping by the students. Gordon (1998) says, "during socialization, children acquire their gender identities in a number of ways, including imitation and observation of their role models, and, at school, teachers are important role models". It therefore means that if teachers are not gender sensitive, the students will most likely imitate them.

In a case study of teachers' gender stereotyping in South Africa, Mwamwenda and Mwamwenda (2011) established that teachers held gender stereotypes about boys and girls regarding typical school subjects. Both male and female teachers believed that certain subjects like sciences and mathematics were suitable for males mainly and arts subjects suited female students. Teachers can provide role models, a sense of direction and encouragement to both boys and girls, or they can denigrate and marginalize them and so perpetuate stereotypes argues (Colclough, 2004). In the study of Patriarchy Rules: Transforming resistance to gender inequalities in science teacher education in Zimbabwe, Charles Chikunda and Chikunda (2016, p. 11) proposed that "curriculum re-orientation is not likely to be successful if it is done superficially without shaking the patriarchal roots that shape cultural values of the practitioners". Zimbabwe being a patriarchal society (Leach et al., 2003) means that these beliefs are instilled at a tender age of the child and may be difficult to erase later in life.

2.7.2 School environment

The institutional theory argues that work places are used as agents of gender stereotypes. The school environment influences students' achievement especially when gender is used as a management tool for daily organisational procedures (Scott & Morrison, 2005). Evidence has emerged that students' achievement levels are influenced by the school environment and the daily management and organisational procedures of schools which are frequently reliant on gender as a management tool (Forsthuber et al., 2010). This is evidenced through classroom seating arrangements, team sports, staffing ratios, posts of responsibilities, among many others. Gender stereotyping manifests itself in school leadership and teaching as a profession (Drudy, 2008). School leadership contains proportionally more men than women in headship, education inspectorate and assessment organisations in Europe's education systems (Forsthuber et al., 2010). This statement resonates well with the findings of Leach et al. (2003) and Dunne et al. (2005).

It is only now that female soccer teams are being noticed among sports disciplines, but I am yet to see male netball teams in schools in Zimbabwe. It may mean males look at netball as a female's sport not worth pursuing. Surprisingly there are a lot of male umpires in netball teams. A study conducted by Dunne et al. (2005) on gendered school experiences in Botswana and Ghana had this to say on school environment:

> All twelve schools revealed a highly gendered school environment, which served to constrain the learning opportunities in particular of girls and to encourage gender segregation and stereotypical gender behaviour. Institutional practices were rarely questioned by either staff or students… This highly gendered school environment, providing differentiated school experiences for females and males, had varying impacts on retention and achievement, often in interaction with other factors such as quality of leadership, class size and socio-economic status of students (Dunne et al., 2005, p. vii).

The gender stratification hypothesis of Else-Quest et al. (2010) and Else-Quest and Grabe, (2012) maintains that gendered opportunity structures contribute to more negative STEM attitudes and poorer STEM achievement among female adolescents. Gendered patterns in study choice are related to the extent of differentiation in education systems, to the extent that pupils are given free choice to select their specific paths and to methods of assessment in education (Yazilitas et al., 2013). It goes without saying that much time throughout childhood and adolescence is spent in school. Therefore, whatever goes on in the schools has a great impact on the individuals later in their lives.

2.7.3 Curriculum

Research has shown that a lack of gender responsiveness in the pedagogy taught in schools and the gender insensitive curriculum is one of the main obstacles to the retention and performance of females in sciences (Chikunda, 2014; Chinyani, 2007; Kalu, 2005). This creates problems and challenges with teachers when in the classroom on how to handle students with different backgrounds in their subject areas. This usually results in poor performance and low uptake of sciences by female students. Despite the design of the curriculum, the way in which it is interpreted by the teachers remains an overwhelming influence. The lack of gender responsiveness in pedagogy in schools as one of the major reasons for female performance and retention was also advanced by (Chetcuti & Kioko, 2012). In her study of beyond the rhetoric of gender equality, Chinyani (2007) claims that 89.6% of the teachers who were interviewed testified that textbooks used in schools in Zimbabwe were not gender-sensitive in terms of language and illustrations. Findings of Forsthuber et al. (2010) which revealed that regardless of claims of neutrality, the lack of bias, assessment tools and procedures are often gendered resonates well with Chinyani's (2007) results. The claims made by Chinyani (2007) were tested in this study by items B1 & B2 in the questionnaire which asked participants to draw and describe a scientist of their perception.

Some authors like Mavhunga, Madondo, and Phiri (2009) argue that despite the government's efforts to introduce gender sensitive policies even in the school curriculum gender parity remain elusive in education in Zimbabwe. (Mavhunga et al., 2009) assert that:

> Although the government and other stakeholders' efforts through affirmative and gender sensitive policies have attempted to promote chances of access to education by girls and

remove obstacles that hamper their participation, gender parity is yet to be achieved…girls continue to be marginalized (Mavhunga et al., 2009, p. 15)

2.7.4 Single or co-education

The institutional theory fuels the debate on whether single or mixed-sex classrooms perpetuate gender stereotyping is a heated one. Advocates of single sex setting argue that in mixed settings, boys receive more attention than girls and those teachers attach more importance to the boys' learning (Smithers & Robinson, 2006). The biased treatment of girls, according to Huguet and Regner (2007), reduced the girls' geometry test performance in mixed-sex settings and not in single-sex settings. These results resonate very well with the findings of Feniger (2011) and Cherney and Campbell (2011) which revealed that girls-only schools assisted the girls to overcome gender stereotypes and girls in single-sex settings had higher math achievement than those in mixed-sex settings, respectively. These results to a certain extent hold true to the Zimbabwean scenario.

On the other side of the spectrum, advocates of mixed-sex classrooms argue that the environment enables both boys and girls to be inducted into the prescribed roles demanded by society (Forsthuber et al., 2010). Cherney and Campbell (2011) came to the conclusion that there was no compelling evidence that the girls in single-sex settings voluntarily opted for STEM subjects or related occupational choices. Patterson and Pahlke (2011) argued that confining young girls in same-sex schools prompted communal goals and gender normative behaviours thereby reinforcing traditional gender stereotypes as done by mixed-sex schools. The contradicting results on the merits and demerits of both systems seem to suggest that the area is still under researched. (Yazilitas et al., 2013) sums it all by proposing that: "While single-sex schooling may reduce the gender gap in education, additional conditions seem to be required, such as a positive school culture and a strong overall learning environment."

2.7.5 Parental beliefs

Parental beliefs have a great impact on the child's beliefs since the parents are the first educators of the child. According to Spera (2005) and Simpkins et al. (2012), the beliefs parents have about the ability of their child in math and their own value on math generally influence how they behave as well as the motivation and later career choices of their children. Researches done by Frome and Eccles (1998) and by Tiedemann (2000) posit that parents who endorse math and science gender stereotypes are likely to underrate their daughters' ability and overrate their sons' ability in these subjects. Tomasetto, Alparone, and Cadinu (2011) argued that the performance of girls in math whose mothers were not math gender-stereotyped was not easily affected by stereotype threat conditions. However, the opposite is true of girls whose mothers are entrenched with traditional gender stereotypes. The chances of these girls choosing physical science careers over traditional careers is less so, as argued by Gunderson, Ramirez, Levine, and Beilock (2012); Tomasetto et al.(2011) in their studies of the role of parents and teachers in the development of gender related math attitudes affirmed that parental beliefs influenced the ability beliefs of the youth which in turn impacted their future achievement and career choices.

2.7.6 Peers

Several studies insinuate that boys and girls use peers to assess their own achievement and career aspirations and that peers endorse gender stereotypical behaviour and punish non-conformity (Hannover & Kessels, 2004). Peer friendships are associated with both pro-social and anti-social behaviour (Juvonen, Wang, & Espinoza, 2011). Peers who are characterised by a pro-social behaviour do well and are highly self-motivated in math and science. It can be argued that the impact of peer influence on each other is more profound because of the amount of time they spend with each other both at school and home

2.8 Chapter Summary

In this chapter key definitions of theory, framework, and theoretical framework were explained. A review of related studies was presented in this chapter. The sub-topics covered included subject choice factors, the role of attitudes in subject choice and performance, gender stereotyping and teaching and the agents of manifestations in gender stereotyping. The following chapter discusses the methodological approaches that were utilised in this study.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

Chapter 2 discussed the theoretical framework (MMI) adopted for this study and a review of related literature.. The current global gender disparity issues in science education call for a focused and flexible methodology. The methodology employed in this study the mixed methods research (MMR). Ponce and Pagán-Maldonado (2015) define the MMR approach as research that intentionally combines or integrates quantitative and qualitative approaches. .

It can be argued that before embarking on a research it is very necessary for a researcher to ascertain which method would yield the information required for the research problem (Clough & Nutbrown, 2012). The selected research methods must satisfy the requirements of a specific enquiry, are reliable and trustworthy (Lacobucci & Churchill, 2010). The MMR approach appropriately blends well into the exploration of gender disparities in the learning experiences of students studying natural sciences in selected high schools of Makonde District, Zimbabwe. A topic like this, where gender inequalities are under the microscope, cannot be viewed by a single barrelled lens but through a multi-barrelled lens. Mixed methods research is a procedure which embraces a combination of quantitative and qualitative research concepts, techniques, approaches and methods (Johnson & Onwuegbuzie, 2004). Research methodology is the nucleus of any study because it is where all the planning is done. Likewise, this chapter is the ‘strategic room’ where the research strategy, tools and techniques, data collection and analysis procedures are clearly outlined. Accordingly, this chapter endeavours to operationalize the theme of research methodology in the current study, as well as to justify the choices made in the study.

In this chapter, the research context, review of the literature on research paradigm and methodology used in the study of gender disparities and learning experiences of students studying natural sciences is first discussed. The review of the methodological approaches, description of the methodological framework, research process, data collection procedures, the sampling and the data analysis frameworks used in the study follows next. An overview of the aligned features of reliability and validity relevant to the study follows. A review on the instruments used by the study on the perceptions and views of students and teachers concerning gender disparities and learning experiences is articulated. Detailed data collection procedures and a snap short of data analysis are finally presented.

3.1 Research context

The ideal setting for a research study is one that directly satisfies the researcher's interest (Singleton & Bruce, 1993). The study was conducted in Makonde district of Mashonaland West Province in Zimbabwe near Chinhoyi town, the capital of the province. Chinhoyi town is about 125 kilometres from Harare. A total of 5 high schools with a total enrolment of 8065 students (Form 1 to 6) and a sample population of 600 "O" and "A" level natural sciences students were involved. The 5 schools which offered natural sciences up to 'A' level were then purposively chosen to participate in the study. Teddlie and Yu (2007) posit that, among many other reasons, purposive sampling is undertaken to focus on specific and unique issues. The unique issue in this study was the ability of the schools to offer natural sciences up to "A" level. The 5 schools were then deemed to be representative of the whole district.

3.2 A review of the research paradigm and methodology used in this study.

3.2.1 Research paradigm

This study was informed by the pragmatic research paradigm. Morgan (2007, p. 49) defines a paradigm as "systems of beliefs that influence how researchers select both the questions they study and the methods they use to study them." It is the net that contains the researcher's epistemological, ontological and methodological premises (Denzin & Lincoln, 2011). The position of Creswell (2014) agrees with that of Mertens (2010) and Powell et al. (2012) that it is basically a frame of reference which is used to observe and understand the world. A paradigm houses interacting ontological, epistemological, methodological, axiological and lingual philosophies about a knowledge system. This means a methodology adopted in doing research should be in and reflect a paradigm.

These definitions raise issues of not only convergence and divergence but also connections between methodology and methods. This is because there are many research paradigms. Teddlie and Tashakkori (2003) and Cameron (2011 p 101) of the "third movement", which is synonymous with the MMR methodology, singled out five paradigms linked to their movement. It was called third movement because it was a third methodology to the previously known quantitative and qualitative methods. Barnes (2012) listed them together with their advocates in brackets as transformative (Mertens, 2010), pragmatism (Johnson & Onwuegbuzie, 2004), feminism (Hesse-Biber, 2010), realism (Maxwell & Mittapalli, 2010) and dialecticism (J. Greene & Jori, 2010). However, the focus is on pragmatism in this study.

3.2.2 Pragmatism research paradigm

Pragmatism is viewed as a logical and reasonable way of doing things (Cameron, 2011). Flexibility is the guiding principle as decisions are based on specific situations and not on preconceived theories, rules and ideas. It is not dogmatic. Every data is useful and purposeful. As noted by Feilzer Yvonne Feilzer (2010, p. 13), "it aims to interrogate a question, theory or phenomena with the most appropriate research method". In this study the most appropriate method was deemed to be MMR.

A pragmatist is practical and focused on attaining the objectives. Philosophically, many definitions of pragmatism have been promulgated. According to Cameron (2011, p. 101), "it is the practical approach to a problem" and Greene and Caracelli (2003), define it as a stance at the interface between philosophy and methodology. Yvonne Fellzer (2010) views it as an accepted model or pattern. Hence, Johnson and Onwuegbuzie (2004) summarised it with this statement:

> We agree with others in the mixed methods research movement that consideration and discussion of pragmatism by research methodologists and empirical researchers will be productive because it offers an immediate and useful middle position philosophically and methodologically. It offers a practical and outcome- oriented method of enquiry that is based on action and leads iteratively, to further action and elimination of doubt; and it offers a method for selecting methodological mixes that can help researchers better answer many of their research questions (Johnson & Onwuegbuzie, 2004, p. 7)

The emphasis of the given definitions is on pragmatism's ability to link philosophy and methodology as well as providing practical solutions. My view is that social science research should focus itself on the importance, usefulness and practicality of the research to human kind and not on the accuracy of the events. Searching for a solution to the current existing gender disparities in the learning experiences of students studying natural sciences demands for a flexible approach and pragmatism fits well with my study.

From an epistemological stand point, qualitative and quantitative methods are considered to be distinct separate approaches yet pragmatism argues that they can be used to complement each other's weaknesses. Pragmatism strives at dismantling the concept of dualism in research (Biesta, 2010). In this study, pragmatism was applied in the choice of participants. Both females and males were involved in the gathering of data even though the current statistics show that the problem is more linked to the female students' performance and uptake of natural sciences. In the 4 FGDs a total of 24 female students against 18 male students participated in the interviews. Five female teachers against 3 male teachers took part in the interviews. The stance adopted by me was a deliberate pragmatic position since the issue under investigation affected more female than male students. Adopting a pure feminist approach of involving females only would not have given me the rich and balanced views of the problem.

According to Guba and Lincoln (1994), ontology refers to the beliefs about the nature of reality. With regards to ontology, pragmatists acknowledge that there is objective reality and perceived reality.. The objective reality of this study is the social economic injustice that will emanate from the unequal participation of female students in natural sciences.

It is advantageous to investigate both the objective and the perceived reality to have an in-depth understanding of the issue(s) at hand. The study is focused on the exploration of students' learned experiences with regards to gender-based disparities in the learning of natural sciences in Zimbabwe. Pragmatism adopts a value-positioned approach to research (Johnson & Onwuegbuzie, 2004). This statement is corroborated by Denzin and Lincoln (2011) and Sweetman, Badiee, and Creswell (2010, p. 442) who posit that "we are concerned that values are part of all research and that the goals of inquiry should be directed towards social justice and addressing the human condition in our society."

Research must practically benefit the intended recipients. It must add value by changing the existing status quo and the findings should be transferable to other contexts (Barnes, 2012). The current situation in Makonde District, where both the enrolment and performance of the girls in natural sciences (table1.3 & 1.4 in chapter 1) is outnumbered by the boys, is a cause for concern and must be addressed. Social research methodologies should be sensitive to communities that maybe marginalised (Sweetman et al., 2010). If the nature of the research problem is complex, then adopting pragmatism is the way forward to investigate the problem so argues (Teddlie & Tashakkori, 2009) and (Creswell & Plano Clark, 2011). In the study, the pragmatism paradigm was used to provide a workable solution to the multifaceted research problem of gender disparities in the learning of natural sciences. The issues of the research problem included social cognitive (self-efficacy), socio-economic conditions, cultural beliefs and gender stereotyping as well as unequal education characteristics in institutions, among many others. These were investigated using questionnaires (quantitative) and interviews (qualitative). In this regard, pragmatism utilised the strengths of both the quantitative and qualitative paradigms by embracing the MMR (Morgan, 2007).

The main limitation imposed by this paradigm is its inability to go into specific details of an issue at hand. The study addressed this weakness using the transformative paradigm which is a conduit of identifying the restrictions placed on people by gender, race and socioeconomic status (Mertens, 2010). However, pragmatism remained the dominant philosophical paradigm of this study. Pragmatism allows the researcher to navigate through the problem in a natural setting and use all the available practical means to acquire knowledge (Creswell, 2014). In this study, the population sample and the study location provided the researcher with the natural setting that was desired. Culturally and linguistically the researcher became an observed participant in the research process.

3.2.3 Rationale for using MMR methodology

A mixed method is exactly what it says; it is “a mixture of quantitative and qualitative methods (Lederman, Lederman, & Antink, 2013, p. 1074). Historically, the formalisation of MMR is attributed to Campbell and Fiske's (1959) work that advocated the use of multi-methods in understanding validity in psychological research. MMR has, ever since, made in roads as the so called “third methodological movement” (Cameron, 2011). The incompatible thesis postulates that the qualitative and quantitative designs have basically different interpretations of the social world and therefore cannot be mixed.

Barnes (2012) contends that MMR has grown rapidly in the last ten years when he argues that:

> There has recently been a groundswell of literature suggesting that mixed methods should be reviewed as a unique form of social enquiry with its own set of philosophical, methodology and practice guidelines as opposed to the simple combination of quantitative and qualitative methods in the study. (Barnes, 2012, p. 413)

The predicament of the traditional researchers is that they find themselves trapped in the world of the so called “pure” quantitative or qualitative methodologies at the expense of embracing new appropriate approaches (Barnes, 2012, Cameron, 2011., Schoonenboom, 2016). That is precisely what was avoided by this study. Mixed methodology was the choice of this study because neither quantitative nor qualitative methods can singly capture the details and patterns of a situation. The qualitative techniques, concepts, methods and approaches were used to unravel deep rooted constructs and the quantitative techniques, methods, concepts and approaches were used to investigate constructs and their measures.

The application of MMR includes the use of abduction (unravelling and relying on the best set of explanations to comprehend one's results), induction (discovery of patterns) and deduction (verification of hypotheses and theories) as advanced by Johnson and Onwuegbuzie (2004). The MMR approach enhances both the reliability and validity of research results because it embraces triangulation and cross-checking. Tashakkori and Teddlie (2010) posit that a combination of quantitative and qualitative methods complements each other and permit for a more vigorous analysis, thus taking advantage of the strengths of each. It is imperative that before a researcher adopts a mixed method study, the researcher must have an in depth understanding of the assumptions and characteristics of the MMR (Caruth, 2013., Creswel & Plano Clark, 2011).

The study used MMR to generate broader and deeper insights into the problem of gender disparities and learning experiences of students studying natural sciences using both quantitative and qualitative data collection procedures. The approach facilitated a better understanding of the relationship between gender, choice and performance in natural sciences. The data was collected from a diversified range of interests that included students, teachers, school headmasters, ZIMSEC officials and MOPSE officials. Interpretation of the results was improved through triangulation and cross checking. Quantitative results were interrogated through interviews and probing. This was possible because of the adoption of the mixed method approach. MMR facilitates both intra and extra perspectives to improve the research. This was achieved by collecting data from the students (intra) and cross-checking them with the views from the teachers (extra). One of the strengths of both the pragmatism paradigm and MMR is the flexibility to allow or accommodate unexpected eventualities. Some students' responses in the questionnaire and during interviews on funding from the STEM project featured frequently as a reason for choosing natural sciences. This study was not about the STEM project but because it had been mentioned several times by students, the researcher pragmatically included a question on the teachers' interview schedule to find out what it was all about and its contribution to the uptake of natural sciences.

The reasons for the justification and application of the methodology in this study are perhaps condensed in the quote of Creswell and Clark(2007) who define MMR as follows:

> Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and true mixture of qualitative and quantitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone (Creswell & Clark, 2007, p. 5)

The relevance and suitability of MMR in gender related studies has been tried and tested in previous studies (Chisamya et al., 2012; Ely, 1995; Kolodziejczyk, 2015; Mertens, 2012; Nordenmark & Nyman, 2003). For this reason,, this present study adopted the MMR process.

3.3 A review of the methodological approaches used to study students and teachers' perceptions on gender disparities and learning experiences in natural sciences.

3.3.1 Quantitative approach

According to (Antwi & Hamza, 2015, p. 220) "a quantitative paradigm is an approach to research that fundamentally follows the confirmatory scientific method because its focus is on hypothesis testing." It assumes that the behaviour and cognition of human beings are highly predictable and explainable. Quantitative researchers try to use the natural science model of research in social science research. . The use of quantitative approaches including the convergent type instruments has been widely criticised (Abd-El-Khalick & Lederman, 2000; Bezzi, 1999). The convergent instruments classify the views of the respondents as adequate or inadequate without explaining the rationale behind the labelling (Lederman, Wade, & Bell, 1998).

Emphasis is placed on the discovery and verification of theories using multiple methods to capture reality (Denzin & Lincoln, 2011). By adopting this stance, the researchers are insinuating that reality can never be fully comprehended, but only approximated. Data is collected by different ways following a strict procedure and prepared for statistical analysis. This study used closed ended questionnaires to collect data on students' perceptions and beliefs of natural sciences and school enrolments and staffing from headmasters. The strength of the quantitative paradigm of using statistics as a mode of communication was utilised in this study at the data analysis stage. Statistical information simplified into percentages makes communication easier and brings reality closer to the reader. The construction of instrument items which are based on chosen philosophical positions confine participants to ascribed views which are not theirs but artefacts of the instrument. The pre-defined categories do not give the respondents the chance to elaborate on their own views and thus compromises the researcher's understanding of the respondents' views. This limitation was addressed through the adoption of the explanatory sequential research design in this study.

Measurement of perceptions and attitudes to science by questionnaires dates to the early 60's (Gardner, 1975; Moore, 1985) till up to now there is no consensus on what exactly constitute the measurements. The attitudes and perceptions of yesterday may not be the same as of today and probably so in the future for the same group or sample. To deal with this, this study used the "snap-shot" method. The researcher was interested in the perceptions and attitudes prevailing at the time of the study.

As much as possible, quantitative researchers try to remain value-free or neutral to eliminate human bias (Vosloo, 2014). The use of standardized questionnaires and other rigorously validated quantitative tools is a testimony to the obsession with objectivity. The obsession of quantitative researchers in formulating laws which are applicable to all people at every moment and their neglect of context has resulted in the abandonment of the paradigm by many social science researchers (Creswell, 2014; Welman, Kruger, & Mitchell, 2009).This explains why this study adopted a mixed method approach.

3.3.2 Qualitative approach

According to Welman et al. (2009 p 188) qualitative research is an "umbrella" phrase "covering an array of interpretive techniques which seek to describe, decode, translate and otherwise come to terms with the meaning of naturally occurring phenomena in the social word." It deals with non-statistical methods and in most cases small samples that are purposively chosen (Delport & Roestenburg, 2011). This study used 8 out of 41 science teachers and 42 students out of 590 for interviews. Gaining a rich and deep understanding of people experiences, meanings, perspectives and capturing their voices and conversations is the focal point of interest of a qualitative researcher. Words and not numbers are used in the qualitative research. Therefore, the qualitative approach is basically a descriptive form of research.

It is an approach which aims at understanding people (Babbie & Mouton, 2001) and which believes that reality is multiple and relative (Hudson & Ozanne, 1988). Understanding and interpreting people's daily experiences, interactions with the social structures and the values they attach to these phenomena is the purpose of the research, according to qualitative researchers (Rubin & Babbie, 2012). In the world of these researchers, social reality is nuanced and subjective. The reality is moulded by the aims and values of the researcher and the perceptions of the participants. An exploration of gender disparities in the learning experiences of students studying natural sciences is values laden and quantified information alone is not enough to understand the problem at hand. To address the limitation imposed by the quantitative approach, the researcher used interviews, probes and observations to understand the students and teachers' daily experiences and interactions with their social structures.

Knowledge is acquired through social construction and is not objectively determined (Carson, Gilmore, Perry, & Gronhaug, 2001). The argument of the qualitative researchers also known as interpretivists is that it is the mind which interprets experiences and events and then constructs meanings from them (Henning et al., 2004;

Hennink, 2014). Therefore, anything that is perceived as reality cannot happen outside the mind. Schwandt, Lincoln and Guba (2007) postulate that the meaning of reality is only discovered through language and not necessarily through quantifiable findings. The position taken by Schwandt is agreed to by Fouché and Schurink (2011) when they dismissed the idea that social sciences should apply research ideologies adopted from the natural sciences. The importance of language proved very important in the study. In the quantitative phase, participants gave their responses strictly in English to items asked in English. During the qualitative phase the respondents had the option of using their mother language in the interviews which most of them did. The advantage was that the participants were able to explain their views in depth and accurately.

Advocates of the qualitative paradigm claim to be guided by the following beliefs and principles which state that:

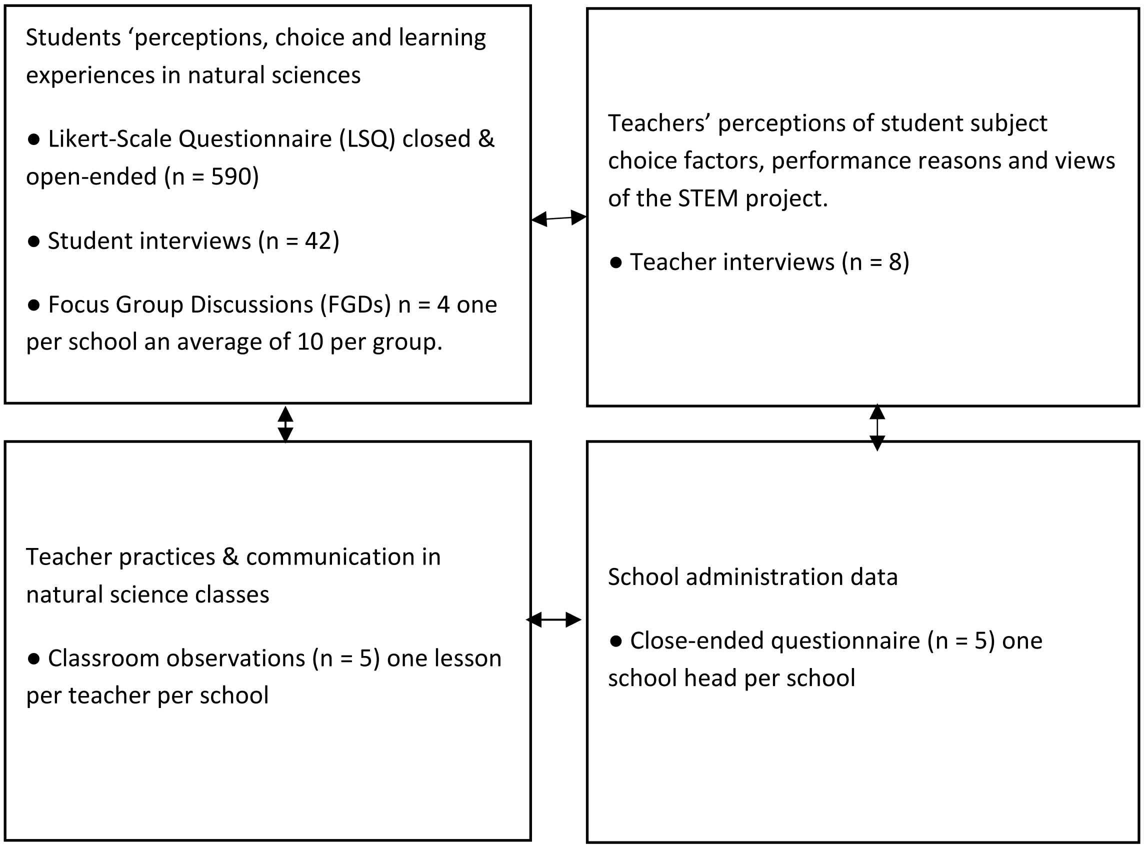
- Research is driven by interest. Human interests direct how we investigate the world, think and build up knowledge. Thus, a research cannot be value- free.
- The social world is constructed and given meaning subjectively by people (Livesey, Lum Mow, Toshack, & Zheng, 2011) contend that social phenomena is complex and simple basic laws cannot explain it. The social world cannot be objectively observed because human beings have different meanings constructed intentionally through behaviour and actions. Different situations warrant different behaviour and actions hence fundamental generalised laws do not apply.
- The researcher is part of the observation and therefore as a participant the researcher tries to make sense of the unfolding events during the investigation.

In this study, gathering information quantitatively alone would not have disclosed the true nature of the problem. To get to the heart of the problem the researcher had to explore the different learning experiences of both females and males to understand how these differences resulted in different meanings and constructions that people associate with the social world. This was achieved using the qualitative approach in the research process. Vosloo (2014 p 309) support the strategy by saying “the researcher is required to dig into the processes of subjective interpretation, acknowledging the motivations, interests, beliefs, values and reasons, meaning-making and self-understanding of the participants."

Generally, it is believed that qualitative approaches can achieve greater validity than quantitative approach (Cohen, Manion, & Morrison, 2013). A disadvantage of the qualitative approaches is that analysis of responses can be time-consuming and difficult. Another disadvantage is that reliability may not be good because it is determined by too many variables which include the place of interview, the time of interview and the nature and experience of the researcher. Some of these shortcomings were minimised using colleagues, experts and tools in the analysis of data. I used my school headship and teaching experience skills of talking to parents, teachers and pupils to conduct the interviews.

3.3.3 Methodological framework

A methodological framework is a typical summary of the approach to the research in such a manner that the research motive, the data collection procedures, the data analysis and the relationships between data can be comprehended (Guba & Lincoln, 1994). Figure 3-2 shows a model of the methodological framework used in this study. Figure 3-2 indicates that data was collected on eight variables. These were students' perceptions of natural sciences, students' choice factors of natural sciences and students' learning experiences in natural science classes. Teachers' perceptions on students' choice of natural sciences, teachers' performance reasons of natural sciences by female students, teachers' views of government sponsored STEM project, teacher practices and communication when teaching natural sciences and the school enrolments and staffing by school headmasters completed the list. The focus and interest were not only to find out about the nature of these variables but also to untangle the interactions among the variables. The study adopted an exploratory strategy to determine both the students and teachers' perceptions because the real nature of perceptions was unknown at the start of the investigation. Likewise, the interactions among the eight variables were also of an exploratory nature. At the end, the study embraced the interpretational analysis to obtain meaning out of the data.



Figurer 3. 1: A summary of the methodological framework

Students' perceptions were obtained using the Likert-Scale Questionnaire (LSQ) closed and open-ended questionnaire (Appendix A-01) and student interviews schedule (Appendix A-02). To get teachers' perceptions, teacher interview schedule (Appendix A-03) was used. To determine teacher class practices and communication, a classroom observation schedule was used (Appendix A-05). For gathering information on school enrolments and staffing, a school administrators' questionnaire was used (Appendix A-04). All in all, five instruments were utilised.

3.4 The research design

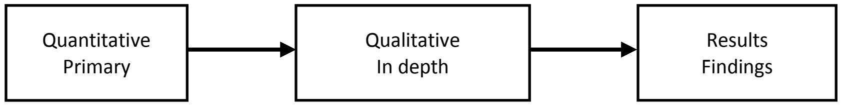


Figure 3. 1: Explanatory sequential research design. Adapted from (Ponce & Pagán-Maldonado, 2015)

When a research problem is known, but solutions remain elusive, then the explanatory research design is the most relevant to study the problem in depth. For the current study, the existence of the problem was known as evidenced by the literature from both MOPSE and ZIMSEC Tables 1-2 to 1-5 of chapter one. The mixed-methods explanatory sequential design was informed by the methodological framework discussed earlier in section 3.2.3. In phase one, quantitative data was collected and analysed. These results were used to carry out phase two (Figure 3-3). While quantitative data was obtained to give a general picture of the phenomena under investigation, the core of the methodological approach was qualitative (Creswell & Plano Clark, 2011; Tobin & Fraser, 1998) because this facilitated greater insights and depth into students and teachers' perceptions of natural sciences. However, it is important to note that the design has its own shortcomings though chosen for this study. It is not easy to implement because it is time consuming and may end up very costly. Weighting quantitative and qualitative data collection and analysis can be tricky. To overcome some of the limitations a comprehensively thought research process (figure 3-4) was used.

3.41 The research process

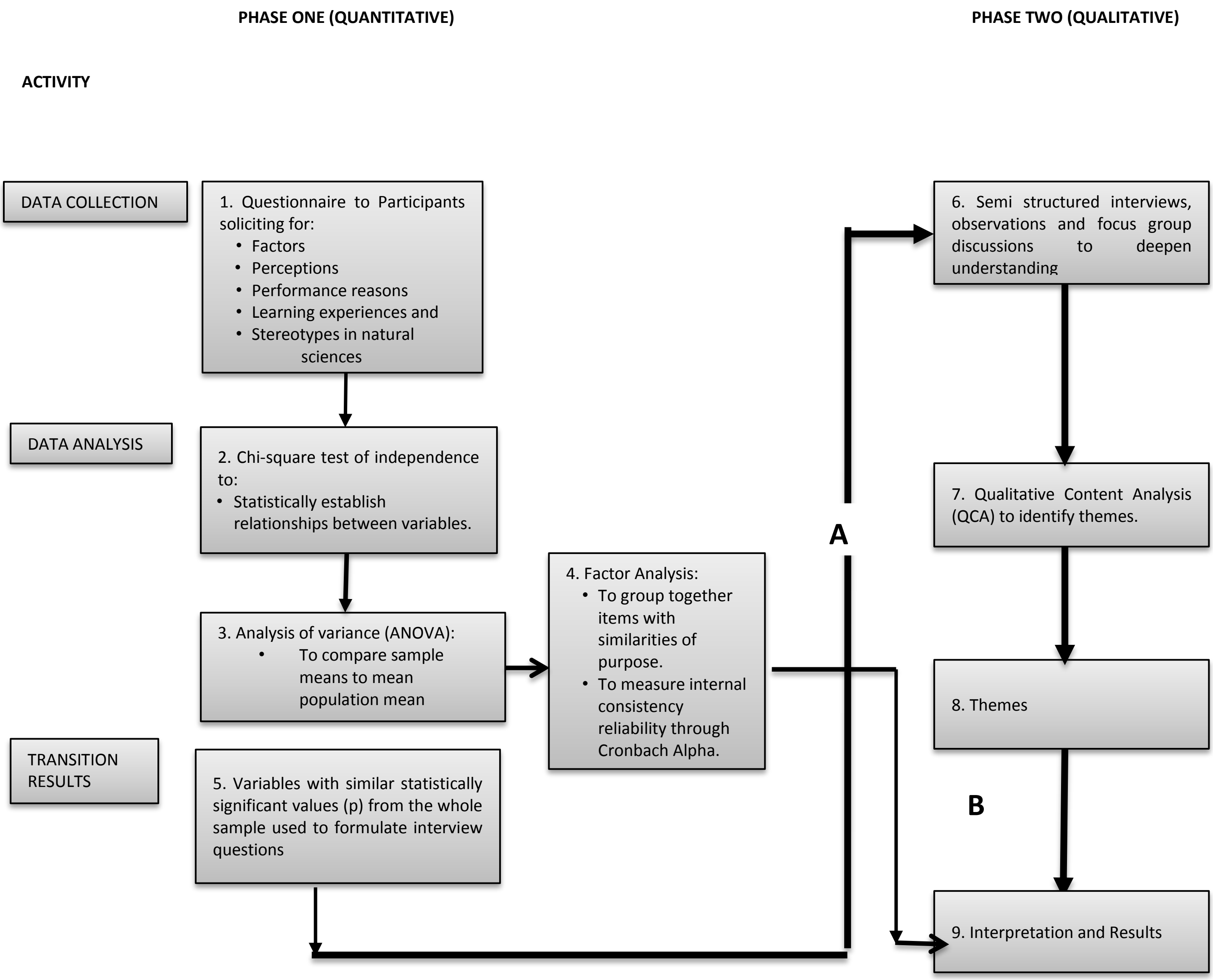


Figure 3. 2: The mixed-methods research process model. Adapted from (Schoonenboom, 2016)

The model illustrated in Figure 3.3 above represents the mixed-methods research process journey undertaken by this study. The explanatory sequential design had two distinct phases, namely, the quantitative followed by qualitative. In this study numeric data was first collected and analysed (quantitative) using the chosen analytic tools as shown in the diagram. In the second phase, qualitative data was collected and analysed. The second phase qualitative data was used to explain the first phase quantitative data. The integration of the two sets of data was done at stage 9 where interpretation was done (Schoonenboom, 2016). The logic behind this approach was that quantitative data and its analysis alone is not explanatory enough but gave a general understanding of the students' perceptions and learning experiences in natural sciences. This is the role played by the qualitative data and its analysis to fill the void and explain the statistical quantitative results by exploring respondents' views in more depth (Creswell & Creswell, 2017; Moghaddam, Walker, & Harre, 2003; Tashakkori & Teddlie, 2010; Teddlie & Yu, 2007).

The strengths and weaknesses of the mixed-methods design have been explained in detail under section 3.2.3 and are also widely discussed in the literature (Creswell, 2014; Creswell, Plano Clark, Gutmann, & Hanson, 2003; Greene & Jori, 2010; Greene & Caracelli, 1997; Morse, 2010). Straightforwardness and chances for the exploration of the quantitative results in more depth are among some of the advantages of this design. The views of the students concerning gender disparities in natural sciences were unknown at the beginning of the investigation and therefore this approach was found to be useful to the study. Figure 3-3 summarises the sequence of the research activities undertaken by this study.

3.5 A review of the research instruments used in the study.

A review of the literature done on studies of students' perceptions and attitudes to science shows that most of the studies have adopted the methodology and instruments developed in the 20th century spilling into the 21st century. Examples of these include, Science Attitude Questionnaire (Wilson, 1954), Test on Understanding Science (Klopfer

& Cooley, 1961), Likert Scale (Likert, 1932) and Relevance of Science Education (Schreiner & Sjoberg, 2004). This study combined ideas from different research instruments to develop the student questionnaire and class observations. In line with the mixed methods approach and a pragmatist stance, the following instruments: Likert scale, Puppet Interview Scales of Competence in and Enjoyment of Science (PISCES), Relevance of Science Education (ROSE), Questionnaire on Teacher Interaction (QTI), Programme for International Student Assessment (PISA, 2007) and Classroom Observation Schedule (COS). were used.

3.5.1 Likert scale questionnaire

The rating scale utilised for evaluation and quantification of data was the Likert scale. The assumption behind its use in the study was that each item on the scale measures some aspects of a single construct such as attitudes towards the item statement. Respondents were required to indicate their degree of agreement or disagreement with a variety of statements related to perceptions. In its essence the scale is an indicator of the participant's agreement on a given continuum to an item. Several scholars included among them (Pietersen & Maree, 2007) and Delport and Roestenburg (2011) agree that the Likert rating scale is the appropriate one to evaluate survey data. The scale allows for the removal neutral responses due to laziness, fatigue and time constraints (Gravetter & Forzano, 2018). For purposes of this study, the scale was constructed as shown Table 3.1 and Table 3.2.

Table 3. 1 Items B6 1-14

Agree	Strongly Agree	Disagree	Strongly Disagree
1	2	3	4

Table 3.2 Items B6: 15-23

Zero Times	1 or 2 times	Few Times	Many Times,
1	2	3	4

Responses for items on perceptions and relevance of science items (B6 1-14) scored 1, 2, 3 or 4 for agree, strongly agree, disagree or strongly disagree. I deliberately left out the neutral option response because I did not want the responses of the undecided participants.

3.5.2 Puppet interview scales of competence in and enjoyment of science (PISCES)

The instrument measures the students' beliefs about learning science with help of a puppet. The items are descriptive statements that solicit for the student's beliefs and learning experiences. The items borrow heavily from the original items in self-concept and competence scales and values of (Chapman & Tunmer, 1995) (Jacquelynne Eccles, Wigfield, Harold, & Blumenfeld, 1993) and (Marsh, Craven, & Debus, 1998; Marsh, Ellis, & Craven, 2002). The perceived science competence scale measures the students' beliefs about their competence in science and the science liking scale assesses the students' engagement and enjoyment in science and its activities. In this study, items B6- 4 & 5 of the student questionnaire were constructed along the format of PISCES. Patrick, Ryan and Kaplan (2007) in a study on motivation for learning science in kindergarten found the instrument to be reliable in measuring science beliefs in children.

3.5.3 Relevance of science education (ROSE)

ROSE is an international comparative research project whose objective is to shed light and share information on factors of importance and relevance to the learning of science and technology as perceived by the students. The instrument simply called the ROSE tries to get the views of the students aged around 15 years on the importance and relevance of science to them and the world. In this study, the construction of items B6; 10-14 questionnaire were based on this instrument. The project compares the views of students from different nations of the world, but this study compared the views of the students based on their gender although from different schools within the same district. Schreiner and Sjøberg (2004) pioneered in the development of the ROSE questionnaire instrument and used it in several of their comparative studies of students' views of science and science education.

3.5.4 Questionnaire on teacher interaction (QTI)

According to Fraser (1998), the development of this instrument has its roots in the Netherlands. It strives to measure the nature and quality of interpersonal relationships between students and teachers Wubbels & Brekelmans, 2005; Wubbels & Levy, 1993) . Originally, QTI was developed to assess perceptions of students based on eight behaviour tenets. A five-point response scale along the lines of the Likert type was used with responses ranging from Never to Always. However, in the study the responses ranged from Zero times to many times on a four-point scale. Items B6, 15-23 on learning experiences in the student questionnaire adopted the format in this study. The researcher was interested in the kind of communication and the language used by the teachers when teaching natural sciences.

3.5.5 Class observation schedule (COS)

Observational studies are designed to describe and explain educational phenomena and many various observational systems have been developed and used in classrooms and laboratories (Good & Lavigne, 2017). For example, Dolan and Grady (2010) developed a classroom observation matrix to categorize student complexity in reasoning during teaching through laboratory inquiry. This study used a modified version (Scharmann & Smith, 2001) of Classroom Observation Schedule (COS). The schedule assessed classroom organisation, teacher activities, student activities and teacher student interaction using an observation table indicating time spent on each activity and the frequency of involving each gender during communication. Varley, Murphy and Veale (2008) also used the COS to assess teacher classroom practices in South African science classrooms. They found the instrument to be effective, reliable and reasonably easy to use and understand.

3.5.6 Students semi-structured interview schedule.

To get a deeper understanding of the extent and nature of gender disparities in the choice, performance and learning of natural sciences by students in Makonde District, a sample of 42 students from 4 FGDs were interviewed using a semi-structured format. The students were purposely selected using the criteria of equal representation of form and school. During the pilot study, the interview schedule had 5 questions which were later reduced to 3 after realising that most of the questions overlapped and gave almost the same responses. The remaining three questions elicited students' views on gender disparities in subject choice, performance and gender preference of natural science teacher. The three questions used were: (i) which natural science subject are you studying and why are you doing the subject? Elaborate on your reasons. (ii) Research has shown that fewer girls than boys choose and pass natural sciences at O and A-level in Zimbabwe. In your own opinion what do you think are the reasons? Probe for justifications. (iii) Would you like to be taught natural sciences by a teacher of the same sex as you and why?

The conduct of the interview process was done within the context of the FGDs and was guided by these three core questions whose structuring was informed by the literature of (Hennink, 2014; McMillan & Schumacher, 2010; K. Welman, 2005). According to McMillan and Schumacher (2010), FGDs provide an alternative interview to get a better understanding of a problem or an evaluation of a problem, new idea or concern. Perhaps the most unique characteristic of focus group research is the interactive discussion through which data is generated, which leads to a different type of data not accessible through individual interviews (Hennink, 2014). During the group discussion participants share their views considering what they have heard. The key element in all the descriptions is the free flow of different ideas in an enabling atmosphere, managed and controlled by a skilled interviewer.

However, the FGDs have some disadvantages that include: (1) failure to give the desired results if handled by an unskilled moderator, (2) require thorough planning and time management,(3) not as strong as participant observation on the naturalistic observation of interaction (Morgan & Spanish, 1984) and (4) not as strong as interviewing on the direct probing of informant knowledge. For this study, I used his skills of an experienced classroom teacher, school headmaster, education officer and trainer of public examinations markers (ZIMSEC) to facilitate the group discussions to reduce the limitations. As the facilitator, the researcher discouraged single dominant voices by encouraging everyone in the group to participate thus empowering the participants to speak out their own opinions.

3.5.7 Teacher semi-structured interview schedule

The motive for interviewing the teachers was to authenticate the views or responses of the students. Merriam and Tisdell (2015), in the classification of the Interview Structure Continuum, argue that a semi-structured interview guide includes a mix of structured interview questions with no predetermined wording or order. For the current study, the interview guide was developed according to the research objectives and the MMI theoretical framework on gendered patterns in academic choices. The guide had five (5) interview questions and the concepts covered by the interview questions included the following: (1) Perceptions and attitudes of natural sciences. (2) Factors that affect choice of natural sciences. (3) The relevance of learning natural sciences. (4) Reasons for poor performances in natural sciences by girls. (5) Reasons for low uptake of natural sciences by girls. (6) Natural sciences teacher preferences. (7) Learning experiences in natural sciences. (8) Forms of gender stereotyping and (9) Views on the STEM project.

This was done to get a deeper understanding of the teachers' perceptions on gender disparities that affect the students of natural sciences. Before the pilot study, the teacher interview schedule had eight questions which were trimmed down to five after the pilot study. Four questions are similar or almost like the questions on the students interview schedule. However, one question is very different, and it was necessitated by the responses that came out of the student interviews and the survey questionnaire. It was a pragmatic move to get to the bottom of the project and its influence on the issue under investigation. The semi-structured interviewing of the teachers was premised around the following questions:

1. In your view what do you consider to be the factors that affect choice of natural sciences by students? Encourage the listing and justification of the factors.

2. Do you think the way the students perceive natural science subjects influence their performance in the subject? Probe for reasons and how they impact on performance.

3. Research has shown that fewer girls than boys choose and pass natural sciences at O and A level in Zimbabwe. What do you think are the reasons? Encourage the listing of the reasons and justification.

4. Given a choice, which gender of teacher would you like to teach your son or daughter natural sciences? Justify your choice.

5. In February 2016 the government launched the STEM project to encourage more students to do sciences at “A” Level, are you aware of this project and if so what are your views? Probe for its influence on the uptake of sciences, implementation strategies and challenges of the project.

3.5.8 School administrators’ questionnaire

The questionnaire elicited quantitative data from five school heads on the following issues: (1) The responsible authority of the school, is the school run by a church, government, council or a private board?, (2) the locality of the school, that is, whether it is urban, peri-urban or rural, (3) the total number of natural science teachers by gender and responsibility, (4) total school enrolment and natural science students at O and A-level by gender, (5) school infrastructure and resources and (vi) school performance in external final examinations of natural sciences in the last four years (2013-2015). Data from the school administrators was used to corroborate the findings from the quantitative and qualitative phases of the study.

3.6 Reliability and validity

It is very crucial for a research to satisfy acceptable standards of a research inquiry through the provision of checks and balances. This section deals with the issues of reliability and validity that were relevant to the study. The two concepts are basic and treated differently in quantitative and qualitative research. Accordingly, an overview of reliability and validity as defined and contextualised in both research paradigms is presented since the study adopted a mixed-methods approach.

3.6.1 Reliability in quantitative research

Reliability, according to Joppe (2000), in quantitative research, is, :

> …the extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is reliable (Joppe, 2000, p. 1).

The underlining emphasis embraced in the definition is the idea of replication of results under different situations. According to Brink (1991), a quantitative study is characterised by three reliability types, namely, (1) the similarity of measurements over a specified time line. (2) The extent to which a measurement, given repeatedly remains the same and (3) a measurement's stability over time. When questionnaire items are answered relatively the same at two or more different times, then the instrument has stability. Stability is an indicator of reliability suggesting that the results are replicable. The limitation of test-retest method of items is that the method is prone to influencing the participant's responses on the subject matter.

3.6.2 Questionnaire design

The Programme for International Student Assessment (PISA, 2007) and Egan & Perry, (2001)'s Gender Identity model format were used to design the questionnaire items. To reduce the short comings of the questionnaire, the following was done: (1) Clear and consistent instructions to respondents for completion of questionnaires were given

(Appendix A-01). (2) Items were short and precise and devoid of double negatives to increase validity. Examples include items: Natural science subjects are difficult and praised you for good performance among many others. (3) Questionnaire items were scrutinised by fellow colleagues for content and ambiguity. Initially, before advice from colleagues, all the 23 items were t presented numerically in the questionnaire.

The items were finally arranged according to specific categories of perceptions, benefits of science and learning experiences after intervention from the colleagues. The items used the word ‘science’ vaguely for example: Science subjects are difficult. This was later to be changed to natural science subjects are difficult so that there is resonance with the title of the thesis. Such strategies to minimise the limitations of the questionnaire were suggested by Leedy and Ormrod (2010) and Rubin and Babbie (2012). The questionnaire was then ready to collect the required survey data. The advantages of using the survey are (1) it is relatively inexpensive to use. Expenses were incurred in the printing and photo copying of the questionnaires. (2) Questionnaires are filled in anonymously and this encourages candid responses to sensitive issues. (3) Less time is spent in collecting data. In this study an average of 30 minutes was taken per school to complete the questionnaire. (4) Large amount of data can be collected and standardised. A total of 590 participants were involved in the study. However, the disadvantage of the survey method is its tendency to be artificial (Rubin & Babbie, 2012). The respondents may not be honest as there is no room for probing and interrogation. Also, the researcher must be knowledgeable about the nature of errors that may occur during data collection and interpretation (Leedy & Omrod, 2010).

3.6.3 Reliability test for questionnaire items

If an instrument is consistent in yielding what it is intended to do, then it can be described as reliable. According to Salkind (2016 p 115), the words trustworthiness, dependability and predictability are synonymous with the word reliability. There is no research instrument which is totally free of error but effort to increase its reliability can be achieved through the following (Sekaran & Bougie, 2010):

- Standardizing instructions;
- Eliminating unclear items;
- Carrying out pilot studies and pre-tests;
- Standardizing the conditions under which the test is done and
- Reducing the effects of external events.

Internal consistency measures for assessing the inter-item consistency are part of the reliability process designed to discover whether the items in the instrument measure the same thing. This study used the Likert-type instrument and the Cronbach alpha coefficient to measure the inter-item consistency. However, there is also the Kuder-Richardson K-R 20 & K-R 21 test which is based on the ratio of right or wrong responses to each of the items in the instrument (Miller, 2009). In this study, there was no right or wrong response and hence the choice of the Cronbach alpha. The Cronbach alpha is a reliable method to show the extent various items positively correlate to each other (Sekaran & Bougie, 2010). For strongly correlated items with a high internal consistency, the value of Cronbach alpha is close to one. Internal consistency refers to the uniformity of scores obtained using only a single administration of an instrument. It is the high degree of similarity among many items that are formulated to measure a certain construct (Maree, 2016).

In this study, the instrument used was a questionnaire of the Likert-type instrument. A pilot study was conducted first with two schools from the same population using a sample of 100 participants from each school. These respondents did not participate in the final sample population of the study. Data analysis was done, and the Cronbach alpha test conducted. Its values were greater than 0.70. Values of 0.70 and above are considered reliable. For the current study, the Statistical Package for Social Science [SPSS] version 23 was used to calculate the Cronbach alpha coefficient to determine the internal consistency of the questionnaire items.

In the main study, the mean alpha coefficient for the questionnaire items B6:1 to 23 was (0.798) higher than the threshold of 0.7 indicating that all the items had passed the reliability test (Appendix B-01). A research survey which does not have reliability loses its credibility. Nunnally (1994) argued that high Cronbach alpha values (inter-item coefficients) were indicators of construct validity and assisted in explaining the extent to which the same attribute was being measured. However, reliability and validity are not synonymous because an instrument can be reliable without being valid (Lincoln, Lynham, & Guba, 2011)

3.6.4 Reliability in qualitative research

Reliability is viewed as the link between what occurs in settings, events or the actual nature of phenomena and what is recorded as data by the researcher (Grbich, 2012). Its purpose is to generate an understanding of the issues at hand. The use of the term reliability in qualitative research has been disdained upon by several scholars (Bashir, Afzal, & Azeem, 2008; Bryman et al., 2017; Maree, 2016; Stenbacka, 2001). Their argument is that the purpose of qualitative research is not to generalise findings to a wider population, but it is an attempt to have an in-depth comprehension of a phenomenon. Instead, the term “dependability” is preferred. Hoepfl (1997) proposed that an “inquiry audit” can be used to examine both the process and product of the study for consistency. Consistency is achieved when the research process is verified through the examination of raw data items, data reduction products and process notes.

3.6.5 Validity in qualitative research

The aim of a qualitative research is not to generalise findings to a broader population but to seek an in-depth understanding of a phenomenon (Du Plooy-Cilliers, Davis, & Bezuidenhout, 2014). Therefore, the terms reliability and validity are not very useful in qualitative research. Interpretivists prefer to use the term trustworthiness to measure validity. Repeating a qualitative study may not yield the same results because the responses of the participants are not objectively measurable. A participant’s response is unique to the participant’s experiences. The concept of trustworthiness as a substitute for reliability and validity is broken down into credibility, transferability, dependability and confirmability (Lincoln et al., 2011). When the researcher accurately interprets the collected data from the participants, it is known as credibility. For the purposes of this study, credibility was enhanced by: (1) spending more time with the participants during interviews to understand them better and gain insight into their lives through probing. An average time of 30 minutes was spent with the teachers and 50 minutes with the students during interviews and FGDs and. (2) Triangulation: data was collected using semi-structured interviews, FGDs, classroom observations, non-participant observation and document reviews. Triangulation is a way of ratification. It gives the researcher confidence about the study's findings and conclusions (Greene & Jori, 2010). Transferability is the extent to which analysis and results of a qualitative study can be applied to similar situations giving similar results (Du Plooy-Cilliers et al., 2014). When the procedure of integration that takes place between the data collection method, data analysis and the theory that is derived from the data is of good quality, then dependability will have been accomplished (Collis & Hussey, 2013;Shenton, 2004)

Confirmability refers to how well the data collected support the findings and interpretation of the investigator. In other words, it is the internal coherence of the data in relation to the results, interpretations and recommendations. In a nutshell, it points to the quality of the results. It can be viewed as the extent to which qualitative data and their interpretations can be verified. In most cases it is built through member-checking data triangulation and investigator triangulation. Both dependability and confirmability can be achieved through an audit trail (Padgett, 2016). For this study, the audit trail was accomplished through a detailed description of the research process.

3.6.6 Validity in quantitative research

Validity refers to the extent to which an instrument measures what it is intended to measure (Du Plooy-Cilliers et al., 2014; Maree, 2016). There are many different types of validity which include content validity, face validity, sampling validity, construct validity, criterion-related validity (or predictive validity), concurrent validity, factorial validity, instrumental validity, convergent validity and divergent validity (Du Plooy-Cilliers et al., 2014; Maree, 2016; Miller, 2009). For this study, face validity, content validity and construct validity were appropriate for the type of instruments used in the study. Internal and external validity in their broader sense and application to the study are also discussed.

Face validity refers to the scope to which an instrument “looks” valid. It is about looking at the operationalization and seeing whether, on its face, the instrument appears like a good transformation of the construct (McGartland, 2005; Miller, 2009). In other words, it is what the instrument superficially seems to measure. It is difficult to be quantified or tested but can only be established or scrutinized by experts in the field about the relevance of the items to the construct intended to be measured. For this study, the constructs were the perceptions of gender disparities in natural sciences by students and teachers. The face validity of the instrument was determined by a panel of experts during research weekend workshops and by my supervisor during discussions.

Construct validity is the extent to which an instrument measures the trait or theoretical construct that it is intended to measure. Usually the following questions are asked to determine construct validity: (1) does the test correspond to other variables? (2) Does it measure what it is meant to and (3) is there agreement between a theoretical concept and a specific measure device or procedure? (Du Plooy-Cilliers et al., 2014) Construct validity is the extent to which the research findings accurately represent what is really happening in the situation (Welman, 2005). Thus, it is concerned with the technical soundness of a study.

The degree to which a test measures what it is intended or claims to be is what is referred to as construct validity. A construct is a theoretical construction that focuses on making sense out of our habitat (Welman, 2005). In research, observable variables are used to describe constructs or concepts.

The correlation between the proxy independent variable (indicator) and the intended independent variable (construct) which is used such as the students’ responses to the Likert scale questionnaire can also explain construct validity. The presence of the construct is established through inference (Welman et al; 2009). In the words of Ryu and Smith-Jackson (2005), it is the extent to which an instrument is ‘creative’ i.e. the ability of the instrument to solicit out its intended measurement. Several individual instrument items constitute the instrument’s creativity. Creativity is not something that is directly observable, but can be inferred from other observable behaviour (Miller, 2009).

However, scholars such as Cronbach and Quirk (1976) believe that construct validity cannot be quantified through mathematical coefficients. They further indicate that it is qualitative and identified the relationship between the cause of the construct (formative indicator) and the effect of the construct (reflective indicator). If an instrument has multiple items that express the indicator, then the approach to construct validation is factor analysis. Factor analysis is defined as a statistical procedure that seeks to determine which items “belong together” in the sense that they are answered similarly and therefore measure the same dimension or factor (Maree, 2016).

Maree (2016) proposes some guidelines for conducting factor analysis in a study. The guidelines include: (1) if items can be justified on logical grounds, the subjective opinions of the item writer should be accepted, despite statistical results and (2) the size of the sample should be between 5 and 10 times the number of items in the instrument. The instrument used in this study had 23 items and the sample had 590 participants and hence the adoption of the confirmatory factor analysis (CFA).

Content validity refers to the extent to which the instrument covers the complete content of the construct that it is set to measure or to which a test or instrument measures a representative sample of subject-matter content (Cohen, Manion, & Morrison, 2000; Maree, 2016; Miller, 2009). A construct is, thus, an idea, hypothesis or concept that gives the researcher the basis to make decisions on how to conduct the research consistent with the construct (Bashir et al., 2008). With regards to determining the perceptions of gender disparities, content validity addressed the question of whether the instrument’s items were relevant and captured the tenets of the issue under investigation as discussed in chapters 1 and 2’s theoretical framework.

Welman (2005, p. 107) defines internal validity as “the degree to which changes in the dependent variable are indeed due to the independent variable rather than to something else.” Hence, Cozby (2009, p. 86) argues that “the internal validity of a study is the extent to which its design allows the researcher to draw accurate conclusions about cause and effect relationships”. A researcher must try to remove any other possible explanations of the observed results to achieve internal validity. For purposes of this study, a very comprehensive theoretical framework covering both quantitative and qualitative data was adopted.

If the results of a study can be generalized to other measurement variables and wider populations beyond its confines, then *external validity* would have been attained (Du Plooy-Cilliers et al., 2014). According to Cohen et al. (2013, p. 186), “external validity in quantitative research concerns generalizability, typically how far we can generalize from a sample to a population.” External validity of a study is compromised and threatened when a non-representative sample from the population is used. According to Johnson and Onwuegbuzie (2004), lack of representativeness of available and target populations is a common factor that can threaten external validity. In this study, external validity was ensured through the selection of all the schools that offered natural sciences up to” A” level in the district of study.

3.7 Sampling and participants

3.7.1 Schools

According Neuman (2013), sampling is the process of choosing a small portion or subset from a defined population with the aim of representing that total population. Makonde District has a total of 108 primary and 59 secondary schools. Out of the 59 secondary schools only 5 offer natural sciences up to A-level. The rest offer only integrated science (which combines biology, chemistry and physics) from Form 1 to 4.

Although the researcher wanted to involve as many schools as possible the researcher got limited to the 5 schools. The 5 schools which offered natural sciences up to “A” level were then conveniently chosen to participate in the study. Teddlie and Yu (2007) posit that, among many other reasons, purposive (interchangeably used with convenient) sampling is undertaken to focus on specific and unique issues. For this study, the selected schools can be described as generally uniform in terms of availability of learning and teaching resources for the natural sciences and class sizes. There was at least one science laboratory for the teaching of natural sciences at each of the selected schools. These were the unique issues in this study. The 5 schools were then deemed to be representative of the whole district.

Table 3. 2 Population and Sampling

Participant Type	Quantitative Population	%	Quantitative Sample	%	Qualitative Population	%	Qualitative Sample	%
School Heads	5	100	5	100	-	-	-	-
Male Teachers	-	-	-	-	3	60	3	60
Female Teachers	-	-	-	-	5	100	5	100
Students	1500	100	600	40	42	-	42	-

Table 3.2 shows that the study had a total population of 1 500 natural science students and 5 school heads from 5 schools. It had a sample population of 600 students which represented 40% of the wider population and above the recommended representative sample threshold of 25% (Welman, 2005). Only 590 participants returned the questionnaire giving a return rate of 98%. Of these students, more than half or 60% (354) were male students. They formed most of the respondents, indicating they are more males that than females taking up natural sciences. Female students comprised less than half or 40% (236) and were in the minority.

The participants were selected using quota sampling because it has some advantages for yielding reliable research results. One of the advantages of quota sampling is it helps create an accurate sample of the population when a probability sample cannot be obtained. Also, quota sampling does not need a sampling frame or spelling techniques, it is easier and quicker to perform (Merriam & Tisdell, 2015). One of its weaknesses is that it is difficult to see potential sampling errors. Another limitation of the quota sampling is that it is not possible to apply inferential statistics and generalise the findings to a wider population due to the non-employment of random sampling. Quota sampling strives to represent significant characteristics of the wider (total) population in proportions in which they are found in the wider population (Cohen et al., 2013). The wider population of the study was 1 500 natural science students (900 males and 600 females).

A total of 42 students (24 females and 18 males) from 4 focus group discussions (FGDs) participated. The FGDs were from 4 different schools. The fifth school which was very close to one of the chosen schools within the same township was deliberately omitted. It was deemed the participants shared similar experiences and the number of respondents in the FGDs would have been too large for the management of data analysis. Teachers comprised of 5 female teachers (1 head of department and 4 ordinary teachers) and 3 male teachers who were purposively chosen from the five participating schools. I deliberately involved more female teachers than male teachers because their opinions and experiences were considered to be more relevant to the problem under investigation because literature review had revealed that they were fewer than male teachers in sciences.

3.7.1 Teachers

Table 3. 3 Demographic Summary of Interviewed and Observed Teachers

Teacher code	Pseudonym	Sex	Qualifications	Locality of School	Teaching Experience
T1	Pupurai	M	B.Ed., Dip.Ed.	Per-Urban	16yrs
T2	Mazvida	F	B.Sc. (Gen); PGCE	Urban	21yrs
T3	Patience	F	B.Ed., Dip.Ed.	Urban	15yrs
T4	John	M	B.Sc. (Gen); PGCE	Urban	28yrs
T5	George	M	B.Sc. (Gen); PGCE	Urban	20yrs
T6	Rudo	F	B.Ed., Dip.Ed.	Per-Urban	24yrs
T7	Jane	F	B.Ed., Dip.Ed.	Urban	18yrs
T8	Samukeliso	F	B.Sc. (Gen); PGCE	Urban	19yrs

Table 3.3 shows the demographic summary of the teachers involved in the research. Eight teachers, two each per school from two schools and one from each of the selected schools made the study sample. The teachers whose names are not their real names to protect their confidentiality were chosen to participate in the study for the following five reasons. (1) The teachers were considered highly qualified. (2) They were judged to be most experienced. The average teaching experience was 20 years. The experience later proved to be very useful during interviews. (3) The teachers taught natural sciences to either form3 and 4 or form 5 and 6. The sample population was constituted of students from form 3 to form 6. (4) The teachers were cooperative and willing to participate in the research. (5) They had their own children who had either finished schooling or were still attending high schools and therefore they played the

double role of teacher and parent. All the eight teachers were interviewed about their perceptions on gender disparities in the choice, teaching and learning of natural sciences. Five teachers were also observed teaching natural sciences.

Six of the eight teachers taught in the urban schools of Chinhoyi town. All the urban schools were government owned schools. Two teachers taught at peri-urban schools whose responsible authority was Makonde Rural District Council. The government schools had better infrastructure than the council schools. Four of the teachers had initially trained at teacher training colleges but had upgraded themselves to degree qualifications. The other four had not gone through teacher training colleges but had also acquired professional qualifications through distance learning. In Zimbabwe there is very stiff competition for highly qualified teachers and with STEM subjects. This may explain why diploma holders continuously upgrade themselves. Headmasters of urban schools are also very selective because they know that the demand to teach in urban centres is very high. The decision by bachelor’s in science degree holders to teach high school natural sciences may be indicative of lack of opportunities in both the government and private sectors due to a subdued economy of Zimbabwe. This trend was not there in the last two decades or so.

3.7 Data collection procedure

Before any field work was undertaken, the researcher made sure that all the ethical considerations had been satisfied first.

3.7.1 Ethical considerations

McMillan and Schumacher (2010) propose that ethics are generally concerned with what is wrong or right from a moral perspective during the research process. Ethics indicate a social code which carries consistent values and moral integrity. Gratton and Jones (2010) argue that every researcher, irrespective of the research design, choice of methods, techniques and sampling is liable to ethical considerations. Thus, policies, rules and guidelines may be there, but the adoption and implementation squarely rest with the investigator. Before this study was done a comprehensive prescribed application was submitted to the Human Research Ethics Committee (Education) of Witwatersrand University for approval to carry out the research. Permission was granted (annexure 1) Protocol number 2015ECE009D OF 19 June 2015. A University of the Witwatersrand letter of introduction of the student to the relevant organisations was issued (Appendix F-02).

The letter of introduction from The University of the Witwatersrand was used at MOPSE at head office, provincial and district levels to seek clearance to conduct my research in their schools and districts. Permission was granted (Appendices F-03, 04 & 05). To distribute the relevant forms prior appointment dates were made with the schools and collection dates agreed on. Information sheets were distributed to the learners, teachers and parents guaranteeing them confidentiality and anonymity. Forms were signed and returned. Consent forms were administered to the students, teachers and parents since most of the students were under the age of consent and majority (18). Forms were signed and returned. The local home language (Shona), where necessary, was used to explain the contents of both the information and consent letters to the learners.

3.8.2 Quantitative data collection

After the pilot study and validation of the instruments, students and school administrators' questionnaires were distributed and administered. Telephonic appointments were made in advance through the school heads to visit the schools and introduce myself. After introductions, specific dates were agreed upon for each school for the distribution, completion and collection of the questions. Contact persons who were the science heads of departments (HODs) were established to facilitate effective communication. A survey comprising of structured questionnaires was given to the participants. Distribution and collection of the completed questionnaires was done on the same day for each of the participating schools. This was done to increase the chances of higher return rates. Prior arrangements between the researcher and the respondents made it possible to use this approach. According to Scott and Usher (2010), survey researches usually concentrate on areas or groups with similarities. In this case it was secondary schools that offered natural sciences up to A Level within

Makonde district. The empirical survey afforded me the opportunity to collect current data on gender disparities and the learning experiences of students studying natural sciences.

3.8.3 Qualitative data collection

Classroom observations followed the administration of school administrators and students' questionnaires. Whilst the classroom observations were taking place, numeric quantitative data was being analysed. This was followed by interviews with students. The students were the first to be interviewed using semi-structured interviews because they required more time, patience and were many.

Due to the shortage of classrooms, the involved schools practised what is known as "hot seating". Learners are divided into the morning session which normally starts at 0700 hours to 1200 hours and the afternoon session commences at 1230 hours to 1730 hours. The voices of both the morning and afternoon sessions had to be captured and hence the advance appointments. The interviews with students were all done in the science laboratories and those of teachers in their offices.

Collecting data using interviews is the most sensitive aspect of a qualitative research. Ethical considerations were implemented in toto. Both the teachers and the students were not comfortable in being video-taped during the interviews and I accepted the participants' positions. The responses of the participants were then audio recorded using a digital voice recorder because they were comfortable with this approach. FGDs recordings were coded using numerical numbers starting with the school that was visited first e.g. FGD 1 represent the first school visited.

Notes were also written down during the interview process. These were used to probe further grey areas. The interviewee's responses were recorded verbatim and the home language was translated with the help of qualified and experienced teachers of both Shona and English. The use of the mother-language was done to get the best possible explanations from the respondents as it is easier to express one-self in the mother language.

The key basis of an interview is to obtain a special kind of information (Merriam & Tisdell, 2015). The creativity and astuteness of the interviewer determines the quality and quantity of exchanged information between the participant and the interviewer. The thrust of a qualitative research interview is to view the study topic from an interviewee's perspective. Perhaps the purpose of an interview in a qualitative research is best described by M. Patton, Q, (2015) who posits:

> We interview people to find out from them those things we cannot directly observe… We cannot observe feelings, thoughts and intentions. We cannot observe behaviours that took place at some previous point in time. We cannot observe situations that preclude the presence of an observer. We cannot observe how people have organised the world and the meanings they attach to what goes on in the world. We must ask people questions about those things. The purpose of interviewing, then, is to allow us to enter the other person's perspective (M. Patton, Q,, 2015, p. 426).

Indeed, as I navigated through the interview process with both the students and teachers I found myself playing the roles of both the interviewer and interviewee. Participants in FGD groups vary from 4 to 12 (D. L. Morgan & Spanish, 1984), 6 to 8 (Floyd & Fowler, 2009), 8 to 12 (McMillan & Schumacher, 2010) and 6 to 10 (Merriam & Tisdell, 2015). The average number of participants per group in this study was ten.

Meeting times for the group interviews were arranged in advance with the help of the science heads of departments. The contact persons (HODs) were phoned a day earlier before the interviews. I bought lunch for the participants because the interviews were done after school hours. The students would be hungry and wanting to go home. Krueger and Casey (2002) argue that incentives for participation in the form of money, food, gifts etc. are all in order and ethical. All the questions were used flexibly and aimed to extract specific data from all the respondents. The following extract shows how the FGDs were handled.

3.8.4 Example of audio extract of FGDs handling

"Good afternoon and welcome to the session. Thank you for taking the time to join me to discuss about gender disparities and learning experiences in the studying of natural sciences at your school. My name is Welensky Mashavave and I am from the University of Witwatersrand in South Africa. Gender disparities are differences that are linked to the sex of the person. I am here to gather information about your learning experiences in the science subjects. You were selected because you are studying the natural science subjects. There are no wrong or correct answers but rather different opinions. Feel free to respond to my questions honestly and let me know if the question is not clear right from the start. I will be audio recording everyone's contribution using the digital voice recorder of my researcher assistant or helper who is sitting next to me. I do not want to miss any of your comments. When you speak, begin by telling us your name, form and the science subjects that you do. Please may you talk loudly when speaking? Speakers must give each other a chance to speak. We don't want chorus speaking. Well, let us start."

The purpose of the introduction was to ensure that the participants were at ease and aware of what was happening. The environment had to be conducive and at the same time the rules of participation had to be clarified and adhered to.

3.8.5 Lesson observations

Five teachers, one from each school, were observed while teaching natural science subjects. Three of the observed lessons were practicals and before each lesson observation, an agreement was made in advance between the teacher and me of the date and time of the lesson. All the lessons were audio recorded for approximately 40 minutes as explained before in section 3.8. I was not so much interested in the subject content of the teacher and the students. He was interested in the teacher student interaction and the language used by the teacher during the lesson.

There is no universally accepted method of designing a classroom observation schedule (Fraser, 1998). It all depends on the needs of the researcher. Table 3.4 represents my own design to investigate the requirements of research objective three. The frequency of which sex was picked upon by the teacher during the question and answer interaction was audio recorded by the hired assistant researcher whilst the researcher sat at the back of the class taking field notes. The field notes were then compared with the audio recordings during data analysis. The focus was also on student to student interaction during the lesson. During practical work the researcher moved around the groups to observe who the active participants were and the group leaders. Table 3.4 shows an extract from the classroom observation schedule

Table 3. 4 Lesson Observation Schedule

TEACHER ACTIVITY		TO WHOM?	FREQUENCY
Voice & Language	Abusive	Boy	
		Girl	
	Motivational	Boy	
		Girl	
Feedback on Questions & Answers	Positive	Boy	
		Girl	
	Negative	Boy	
		Girl	
	Ignored	Boy	
		Girl	
STUDENT ACTIVITY			
Theory Lessons	Participants	Boy	
		Girl	
Practical Lessons 1.Number of groups------ 2. Sex of group leader---------- 4. Dominant sex in the group-----			

Each aspect of the teacher activities was completed during the deliverance of the lesson. I listened very attentively to the voice of the teacher to pick up any abusive and motivational language. When the students and teachers' interviews and observations were concluded, qualitative (text) data was analysed. The qualitative data complemented the quantitative data of the first phase. Mixing of both types of data was done at the interpretation and explanation stage 9 (figure 3.3).

3.7 Data analysis and presentation

The MMR methodology demands that justice must be done to both the quantitative and qualitative approaches in the collection and analysis of data. This was done in this study to create the most thorough description of the respondent's perceptions of gender disparities in the learning of natural sciences. Quantitative data was analysed first.

3.7.1 Quantitative data analysis

The organisation, analysis and interpretation of the quantitative data were accomplished through the application of descriptive statistical techniques. Chi-square, analysis of variance (ANOVA) and factor analysis tools (CAF) were used to analyse the data.

The use of descriptive statistical techniques was deemed sufficient enough because the research design leaned more towards the qualitative aspect as shown in figure 3.2. Data analysis was achieved using the Statistical Package of Social Science (SPSS) version 23.

The analysis was done in two stages. As earlier alluded to earlier, the study had a more qualitative bias and hence the level of quantitative statistical analysis was deemed enough for the problem under investigation. Inferential statistics were left out of the analysis. The first stage involved the chi-square test and ANOVA that are discussed next.

3.7.2 The chi-square test

According to McMillan and Schumacher (2010), surveys, in addition to being descriptive, can be used to explore relationships between variables in an explanatory way. The chi-square test of independence was used to determine whether statistically significant relationships existed between the dependant and the independent variables.

The tool was relevant because the data was of a non-parametric nature and the sample size was considered large enough (Cohen et al., 2013). It works better with a sample of 500 or more. The study had 590 respondents. I examined the relationship between gender (male vs. female) and attitudes or perceptions (agree vs. disagree). The critical value (p) for the test of independence is set at .05. Values less than p are significant and vice versa. If the value is less than the critical value, the null hypothesis is rejected meaning that the relationship between the variables was not due to chance but is influenced by a variable and in this study, it was gender. For example, on item number 1 the null hypothesis is rejected and therefore gender had an influence on the responses. Table 3.5 shows the presentation of the analysis. In this study six out of 23 items had the hypotheses rejected (Appendix B-03).

Table 3. 5 Null hypotheses rejected by chi-square test of Independence N=590

Item description		Males n=343			Females n=233			Df	2-tailed significance (p=.05)
		A	DA		A	DA			
1	Girls are not as good as boys.	184	159		49	184		1	.000<p
		53.6%	46.4%		21.0%	79.0%			
2	Equal treatment of boys and girls helps in subject choice & performance.	261	76		211	22		1	.000<p
		74.4%	22.6%		90.6%	9.4%			
3	Household duties affect my school performance.	127	200		116	115		1	.008<p
		38.8%	61.2%		50.2%	49.8%			
9	Given a choice, I would rather be taught by a teacher of the same sex as myself.	173	164		84	145		1	.001<P
		51.3	48.7		36.7	63.3			
13	Knowledge of science does not help me to protect the environment.	36	305		12	219		1	.023<P
		10.6	89.4		5.2	94.8			
		ZT	FT	MT	ZT	FT	MT		
16	Made you believe that the subject was very difficult.	254	60	27	160	45	24	3	
		74.5	17.6	7.9	69.9	19.6	10.5		.040<P

Key: A=agree, DA=disagree, ZT=zero times, FT=few times, MT=many times.

3.7.3 Analysis of variance (ANOVA)

Table 3. 6 The Shapiro-Wilks Test: ANOVA items with $p<.05$ N=576.

Item no.	Item description	df	Mean square	Sig.(p)
1	Girls are not as good as boys.	1	.216	.000<P
2	Equal treatment of boys and girls helps in subject choice & performance.	1	.139	.000<P
3	Household duties after school affect my school performance.	1	.244	.008<P
9	Given a choice I would rather be taught by a teacher of the same sex.	1	.244	.001<p
13	Knowledge of science does not help me to protect the environment.	1	.396	.023<p
21	Praised a student with lower marks than yours.	1	.667	.012<P

The one-way analysis of variance (ANOVA) was used to compare the means of the samples to make inferences about the population means and their significances to the hypotheses under test (see Table 3.6). Its suitability was confirmed by its compliance to the assumption of normality and the test of equality of means. To test whether the sample data had been obtained from a normally distributed population, a Shapiro-Wilks Test was done. The threshold value of p like in the chi-square test is pegged at $p = .05$. The interpretation of significance is the same as in the chi-square. Only 6 out of 23 items had their hypotheses rejected meaning that the sample data came from a normally distributed population. If half or more of the items' hypotheses are rejected, then there would be no normal distribution and the instrument is not suitable for analyzing the data.

The assumption of normal distribution had been met and the tool was appropriate for analysing the data. ANOVA was also used to test consistency in the number and type of items whose hypotheses were rejected by the chi-square test. This was done by calculating the standard deviation (SD) from the mean score to detect variation within the distribution of items.

Table 3. 7 ANOVA: Variation from the mean score by gender

No.	Item description	Gender	N	Std. Deviation	Mean	Sig.
1	Girls are not as good as boys in sciences.	Male	343	.499	1.46	.000
		Female	233	.408	1.79	
2	Equal treatment of boys and girls both at home and school helps in subject choice and performance.	Male	337	.419	1.23	.000
		Female	233	.293	1.09	
3	Household duties after school affect my school performance.	Male	327	.488	1.61	.008
		Female	231	.501	1.50	
9	Given a choice, I would rather be taught by a teacher of the same sex as myself.	Male	337	.501	1.49	.001
		Female	229	.483	1.63	
13	Knowledge of science does not help me to protect the environment.	Male	341	.308	1.89	.023
		Female	231	.222	1.95	
21	The teacher praised a student with lower marks than yours.	Male	339	.877	1.46	.012
		Female	231	.718	1.28	

Table 3.7 shows the variation from the mean score by gender. Standard deviation (SD) describes how much variation there is in a given distribution. It indicates, on average, how much each of the values in the distribution deviates from the mean. In other words, it indicates the spread-out trends of the responses per given variable. The higher the SD value the greater the responses are polarized. For example, on item 1 the male respondents were more polarized (499) the female respondents (408) in their responses. It also means that the percentage difference on those who agreed and those who did not agree with the statement was small (Table 3.7).

On the contrary the female students were less polarized in their responses with most of them disagreeing with the statement of item 1. A greater mean value represents a greater number of respondents who disagreed with the statement. A bigger mean value also indicates a greater influence on the value of significance. Table 3.7 indicates that the female responses influenced more items 1, 9 and 13's significant values and the male responses accounted for items 2, 3 and 21 respectively. Gender influence was very apparent in the responses of these items. These are the items out of the twenty-three items which were used as basis for the formulation of interview questions in the qualitative phase. All the other items which had insignificant values and very close mean values and SDs meant that the responses of the participants had no gender influence (Appendix B-04). Chi square had 6 items and ANOVA had 6 items that contributed towards the formulation of questions for the qualitative phase of the study (figure 3.3).

The reasons as to why the hypotheses were rejected could only be unearthed during interview sessions in the qualitative phase. An exploration of the response patterns of the two groups (males and females) was done using two-way frequency tables and cross tabulations (Pietersen & Maree, 2007). The analysed data was presented in numerical analysis and frequency distribution calculations. Results together with the interpretation were represented in the form of tables, figures and bar charts in chapters 4, 5, 6 & 7 per each research question.

3.7.4. Factor analysis

Construct validation of multiple items of an instrument is done using factor analysis. Gorsuch (2003) define factor analysis as a statistical procedure used to uncover relationships among many variables. In this study, confirmatory analysis (CFA) using SPSS, was done to determine the construct validity of the questionnaire items. Kaiser-Meyer-Olkin measures of sampling adequacy (KMO: MSA) to establish whether factor analysis was appropriate for the questionnaire was calculated for each confirmatory factor. KMO: MSA shows intercorrelations among variables. A value of 0.5 and above is indicative that the data is suitable for factor analysis. The value of KMO: MSA for this study was 0.734 (Appendix B-05). After conducting the KMO: MSA test, the items were then subjected to factor analysis and the results are shown in table 3.8

Table 3. 8 Factor Analysis (PCA)

N = 590 (participants) & n = 23 (items) Key: PCA = Principal Component Analysis

Factor number	**Item numbers**	**Factor Name**	**% of Variance of squared loadings**
1	16,17,19,20,21, 22	Learning Experiences (LE)	13.47
2	6,7,13, 14	Attitudes towards Natural Sciences(ANS)	8.95
3	10,11, 12	Social Benefits(SB)	7.77
4	2,5, 8	Subject Choice Factors (SCF)	6.17
5	18, 23	Motivation Factors(MF)	5.89
6	4, 9	Gender Perception & Performance(GPP)	5.15

The principal component analysis (PCA) was used to detect the interrelations among the set of variables to identify the underlying structure of those variables. In other words, it grouped together items with similarities of purpose. A total of eight factors or components were identified but only six remained after the % of variance of squared loadings was done to eliminate the out fliers. The six groups were then named in accordance with what the items commonly represented. These were learning experiences (LE), attitudes towards natural sciences (ANS), social benefits (SB), subject choice factors (SCF), motivation factors (MF), and gender perception and performance reasons (GPPR). The use of the three different tools was to ensure that the questionnaire items were thoroughly tested for reliability and validity and were deemed to be relevant to gather the information required by the problem under investigation. The main strength of the CAF analytical approach is that it allows the testing and improving of the convergence and association of the questionnaire items. The CAF model minimizes the limitations associated with each individual approach. A summary of the CAF tools is shown on table 4.1 in chapter 4.

3.7.5 Document analysis

Table 3.11 shows an example of a document on O- level results analysis obtained from the head office of the Ministry of Education Sports, Arts and Culture (MOESAC) for the period 2000 to 2014. Results for the period 2006 to 2009 are missing from the table. These were the turbulent years in the political and economic history of Zimbabwe when almost all the government departments were dysfunctional.

Similar documents on both registration and pass rates for A-level were also obtained. These are the documents which were used to extract relevant information which was used in the tables in chapter 1 on the background and justification of the research problem. Documents obtained from the district of study were used in the collection of data. Similar provincial data required for the study could not be obtained from the officials.

Table 3. 9 O' Level National Pass Rates (Subject by Gender)

	Biology			**Chemistry**			**Human & social Biology**			**Int Science**			**Physical Science**			**Physics**		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
2000	6	**47.4**	**54.9**	84.4	78.7	**82.2**	**10.7**	**27**	**18.9**	35.7	**20.7**	**22.5**	**53.5**	**35.7**	**44.6**	80.	**71.6**	**76.9**
2001	60	46.3	53.2	79.5	67.8	74.7	37.6	23.7	31.6	37.2	21.2	29.2	55.5	38.9	47.4	76.6	69	73.9
2002	59.7	48.6	54.9	**86.3**	**77.6**	**82.7**	**45.3**	**27.6**	**37.7**	**35.1**	**21.8**	**29.0**	**54.1**	**35.2**	**45.9**	**54.3**	**54.3**	**65.3**
2003	**34.2**	**21.4**	**27.9**	**45.1**	**24.6**	**33.8**	**26.7**	**13.0**	**19.9**	**16.1**	**7.6**	**11.9**	**25.7**	**12.7**	**19.2**	**46.3**	**26.1**	**36.2**
2004	**60**	**46**	53	**76**	**62**	63	**39**	**26**	32.5	27.6	16.4	22	58.8	43	50.9	**52**	**30**	45.5
2005	**62**	**52**	57.2	**79**	**56**	67.5	**40**	**13**	26.5	25	14.7	19.9	54.9	41.1	48	**55**	**39**	47
2010	**44.18**	**31.98**		**87.36**	**75**	**82.12**	**39.61**	**17.6**	**30.28**	**22.82**	**13.36**	**15.55**	**56.32**	**38.88**	**48.74**	**87.3**	**73.1**	**81.34**
2011	69	55.9	62.4	67.8	58	61.6	29.2	25.4	27.1	31	20.7	26	59.9	46.1	53.9	94.3	81.9	88.9
2012	**57.94**	**47.46**	**52.70**	**72.9**	**52.94**	**68.58**	**36.01**	**26.4**	**33.23**	**32.57**	**21.39**	**26.97**	**61.82**	**05.05**	**53.91**	**73.5**	**57.8**	**68.58**
2013	**69.00**	**55.88**	**62.44**	**67.76**	**57.96**	**61.59**	**29.23**	**25.4**	**27.06**	**31.01**	**20.65**	**25.97**	**59.94**	**46.10**	**53.89**	**94.3**	**81.9**	**88.92**
2014	**60.02**	**44.79**	**52.41**	**62.22**	**45.85**	**54.04**	**43.22**	**28.6**	**35.91**	**25.82**	**18.08**	**21.95**	**68.69**	**49.21**	**58.95**	68.7	49.2	58.5

Source: MOPSE (2015)

3.8 Qualitative data analysis

3.8.1 Teacher and student interviews

The analysis for data from both teachers and students were done using the qualitative content analysis (QCA). Analysing teachers and students' sensitive issues on gender disparities required an exploratory approach to get to the bottom of the phenomena. Philosophically, QCA assumptions emanate from the communication theory and the "factist" perspective (Gbrich, 2012). A factist perspective assumes data to be accurate and honest indicators of reality in the world. Ten- Have (2004) proposed that when a researcher wants to investigate the actual behaviour, real motives and attitudes of the participants being studied, then the factist perspective becomes relevant. The data collected by this study was deemed to be an accurate and truthful representation of the issues that were being studied and hence the choice of QCA.

In descriptive qualitative approaches, the collecting and analysing of data is done concurrently (Vaismoradi, Salsali, & Marck, 2011). The description and interpretation of the data was both inductive and deductive. This approach adds depth and quality to data analysis but however all the data can be gathered before analysing it to determine what it shows (Chamberlam, 2004). This study did the latter, but depth and quality were achieved through the correct choice of the analysis tool and its rigorous application. Grbich (2012) define QCA as a systematic coding and categorising approach used for exploring large amounts of textual information unobtrusively to determine trends and patterns of words used, their frequency, relationships and the structures and discourses of communication. QCA was also adopted by the researcher because it is possible to analyse data qualitatively and concurrently quantify the data (Grbich, 2012). Qualitative data analysis involves various procedures that are at the disposal of the researcher. There is no consensus among researchers on the number of steps to be done during the qualitative data analysis process. It all depends on the researcher's objectives and situation (Neuman, 2013). Scott and Usher (2010) advocate for five steps, namely, (1) coding field notes, observations and interviews, (2) identifying the relationships to establish credibility, (3) establishing clear-cut patterns to make sense of the data, (4) initiating sets of generalizations to encompass all the known data eventualities and (5) endorsing these theoretical ideas so that they are transferable to other cases by way of inference.

According to Watling, James and Briggs (2012), six steps are involved that include: (1). defining and identifying data, (2). data collection and storing, (3). reduction of data and sampling, (4). Data structuring and coding, (5). Theory building and testing and 6. Report writing. Miles and Huberman (1994) recommend twelve steps. This fixed linear approach to the process of qualitative data analysis and interpretation is criticized by Creswell (2014). Creswell (2014) observes that that the process itself is cyclic. The lack of agreement on the number of steps and the kind of approach is also evident in the work of Neuman (2013), Schurink, Fouché and De Vos (2011) who argue that qualitative data analysis is distinctively a designed event. When all is said and done the numbers of steps to be taken is dictated by the problem under investigation. In this study, qualitative data analysis was done using qualitative content analysis (QCA) as advanced by Elo and Kyngäs (2008). The version of QCA that was adopted in this study was taken from McMillan and Schumacher (2010) and Elo and Kyngäs' (2008) as illustrated in Table 3.10 below.

Table 3. 10 Data analysis process of (QCA)

Stage	Activity	What is done by the researcher?
1	Preparation	● Researcher immerses in the data to obtain the sense of the whole. ● Transcribes the audio interviews verbatim. ● Reads and rereads transcripts several times. ● Choose developing categories by way of comments. ● Decides on the manifest of content.
2	Organizing	● Initiates open coding and create categories. ● Groups codes under higher order headings. ● Revisits the research questions to finalize the topic categories
3	Reporting	Reports the analysing process and results through any of the following: ● Models ● Compelling extract examples ● Conceptual systems or maps. ● Categories ● Linking analysis to the research question and literature ● A story line.

Adapted from (Elo & Kyngäs, 2008)

3.8.2 Stage1: Preparation

3.8.2.1 Reflection

Before collecting the data, the researcher had to ask the question: What kind of data was really needed? It had to be data that would give answers to the questionnaire items whose null hypotheses had been rejected by both chi-square and ANOVA analysis in the quantitative phase of the study. The responses were not due to chance. These are the items whose responses were influenced by gender. The items formed the basis for formulating the interview questions. Unexpected issues like the STEM project emanating from the responses of students in the questionnaire had to be followed up with the teacher interviews. The pragmatist approach adopted in this study disdains rigidity in dealing with real life issues.

3.8.2.2 Recording of data

This was done by audio-recording on a digital voice recorder. My assistant also recorded on the voice recorder of his smartphone. As a backup, the recorded data was stored on an external hard drive. The audio recording of the students was done in the science laboratories soon after school out. This was done to cut out the noise from the other students during school hours that could have interfered with sound quality. Teachers' interviews were conducted in their offices where the environment was conducive for voice recording. During the interviews, notes were also taken up so that they could provide a further back up and help contextualize the interviews. This was done to increase the trustworthiness of the results.

3.8.2.3 Transcribing the audio interviews

The audio interviews were transcribed verbatim During the FGD interviews, some participants preferred to use their mother language which is Shona and others opted for English which the medium of teaching and learning in Zimbabwe. However, others opted to use a mixture of both Shona and English. The transcripts were read several times and then given to a language specialist to assist with the translation from Shona to English. As if this was not enough, the entire transcripts were reread thoroughly to obtain a deep understanding of the content and context before the process of coding. The immersion in the data by the researcher is critical because it helps the researcher to contextually internalize and understand the process from the platform of a participant. The initial ideas were then summarized as comments (refer to the examples of interview transcripts' extracts) that are attached. The common ideas were used to form categories and each category was given a code or acronym.

FGD 2

Question 1. Which natural sciences are you studying and why are you doing the subjects? Probe for reasons in terms of influence, attitudes/perceptions and relevance (RQ1 & 2).

RF8- I chose Bio and Physical science because I saw that in life other subjects cannot uplift me, if I do Bio I would be studying human beings because I would like to be a doctor and if I become a doctor I can treat people

Researcher comment: Initial important ideas are social benefits and career choice.

Male teacher interview 3

Question 1. In your view what do you consider to be the factors that affect the choice of natural sciences by students? Justify your opinions. (RQ1)

Yah. There many factors. Alright maybe firstly- say *zviri* cultural, it could be cultural…… Secondly if a parent had a choice between choosing a boy and a girl to progress or go further their education, the tendency is to give preferential treatment to the boys…….The traditional feeling that the girls could not handle these subjects at a high level, reason being naturally in the population you have more male doctors than females and you had more you see female nurses than say doctors who are female. You find that influences even the choice of career even subjects.

The ability when you look at it the ability would be a factor, it's very difficult to isolate ability, the ability is determined by upbringing that child, did that child get some opportunity, the same landscape, between their counterparts the male? Secondly you also look at the household chores, Does the boy child do the same as the girl in terms of time, in terms of physical work, you find that will influence the ability, but if it is ability of a person my opinion is that girls are equally as good as boys.

Researcher comment: The important initial ideas are stereotype beliefs, subject ability, role models, career choice, household chores and equality in subject ability.

The reading and re-reading was continued and repeated several times and sub-categories and clustering were formed through the merging of codes. Responses were quantified using frequency counts, a characteristic of qualitative content analysis. The process of isolating the initial ideas was done for all the interviewees.

3.8.3 Stage 2: Organising

3.8.3.1 Coding

Neuman (2013) describes codes as labels assigned to specific units with similar meaning or ideas emanating from the transcripts. In other words, coding is the transformation of data into an understandable form by the reader or computer software. Meaningful categories and themes were extracted from the transcribed text through comments. Student interviewees were coded as RM1 (respondent male 1) or RF3 (respondent female 3) etc. The teachers were coded as MTI 1 (male teacher interview 1) or FTI 2 (female teacher interview 2) and so forth.

3.8.3.2 Open coding

The process encompassed the identification and naming of units from the transcribed text with relevance to the research topic. It focused on phrasing or wording, frequency, consistency, context and exactness of the comments (Appendices C & D-01, 02, 03 & 04).

3.8.3.3 Axial coding

Under this process the identified recurrent ideas or codes from previous coding were then organised in terms of coherence and context. The coding assists the researcher to compare categories of concepts and identify the link and relationships across the categories (Scott & Usher, 2010). Emerging sub-categories or themes were formulated, and repeated codes shown under each of the sub-theme, as shown on Table 3.11. At this stage, I was implementing credibility methods as discussed in section 3.6.

Table 3. 11 Emerging sub-categories

Stereotype Based Beliefs (SBB)	**Subject Choice Factors (SCF)**	**Gender Performance Perception (GPP)**	**Learning Experience (LE)**	**Girls Poor Performance Reasons (GPPR)**	**Social Benefits (SB)**
> Girls are easily affected by adolescent peer pressure. >Female teachers affected more by marital problems. >Women are inferior to men. >Male brain more concrete. >Cognitive ability is different. >Mindset beliefs. Girls prone to stereotyping. >Cultural roles differ. >Female ability in science is doubtful.	>Natural ability in science. >Interest in the subject. >Government funding. >School policy-based ability. >Career choice aspirations. >Role models. >Peer pressure. >Parental pressure.	>Girls think science is difficult. >Girls do well in mono sex schools than in multi sex schools. >Physics is a male domain. >Male teachers more strict and good in mathematics and science. >I prefer a male or female science teacher. >Girls fear sciences. >Teachers are sceptical of girls doing physics.	>Boys and girls are treated equally at school. >Girls are treated differently from boys at home. >Girls discriminated on study time. >Parents discriminate against girls. >Girls are not empowered. >Science is not difficult. >Girls are as good as girls in science. > Subject ability is equal. >Intelligence is not sex linked.	>Girls fear embarrassment. >Girls have more home duties than boys. >Girls lack confidence. >Girls concentrate less than boys. >Science requires more time and concentration. >Negative attitudes lower performance. >Girls have less time to read. >Girls spend more time on social media. >Science is difficult.	>Physical science is profitable. >Job opportunities are many. >Success in life. >Status quo.

3.8.3.4 Selective coding

The coding process helps tentatively describe and identify the essential core codes. At this stage, the six subthemes from the qualitative phase and the six sub groups from the quantitative phase were integrated to come up with the main themes. The adopted procedure was in tandem with the mixed-methods research process shown Figure 3.4 below. . In arriving at the main themes, I was fundamentally guided by the research questions and objectives. These were natural science choice factors (NSCF), attitudes, performance and learning experiences in natural science (APNS) and manifestation forms of gender stereotyping (MGS), as illustrated in Figure 3.4. Both stages 1 and 2 were subjected to through interrogation through the critical analyses of fellow PhD colleagues, my supervisor and other academics outside the University of the Witwatersrand. The inputs of these proved very valuable to this study’s success. Presentations during research weekends provided the researcher with the much-needed academic ideas on how to improve the study.

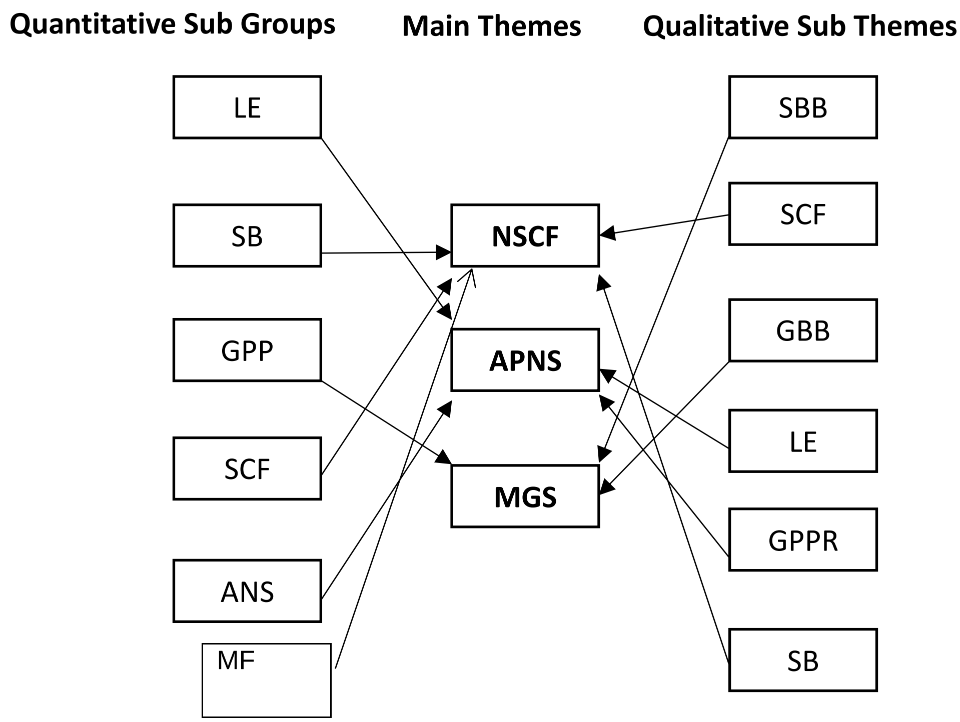


Figure 3. 3 Formulation of main themes

3.8.4 Stage 3 Reporting

Reporting was done using compelling extract examples, conceptual maps and linking analysis to the research questions and literature. The stage is comprehensively discussed in Chapters 4, 5, 6 & 7. Figure 3.5 shows the discussion and interpretation conceptual framework. The main themes were further split into headings relevant for the discussion of each research question.

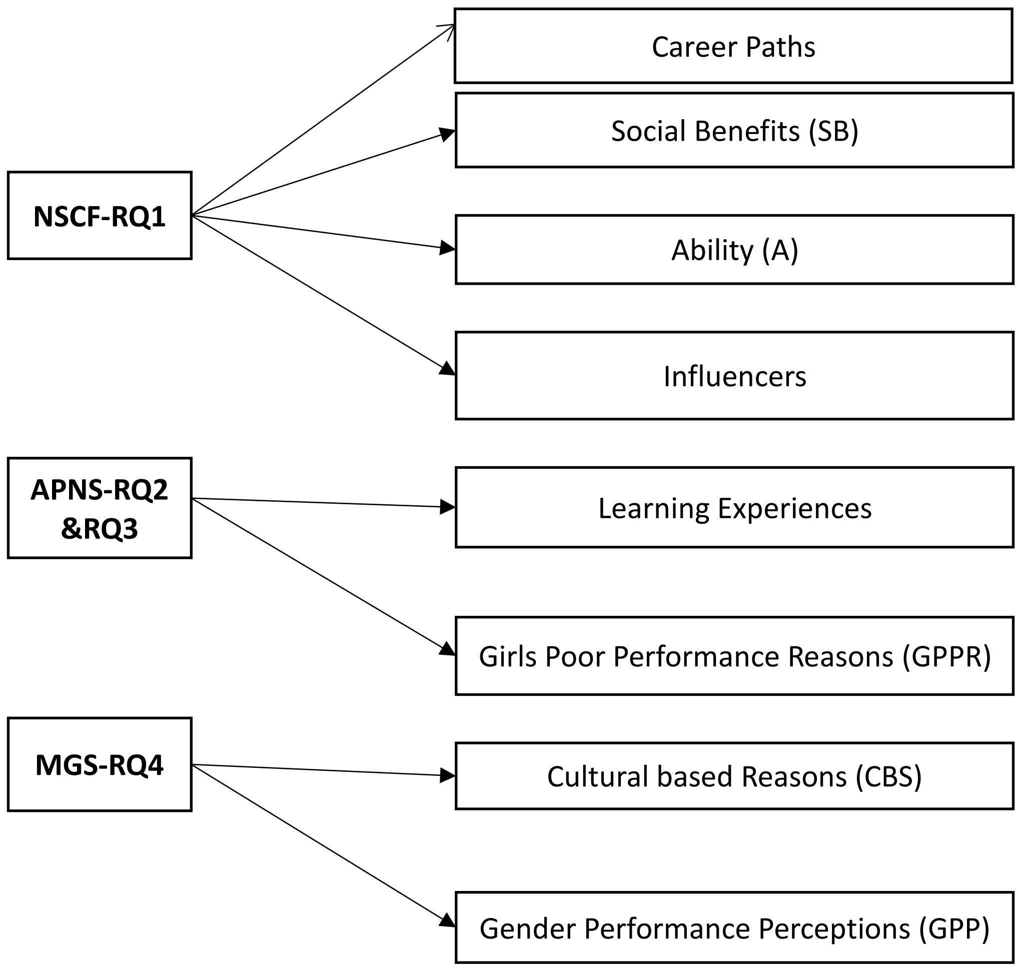


Figure 3. 4. The Discussion & interpretation conceptual framework

3.9 Classroom observations

Lesson observations data were analysed using a tally system for each of the variables that were being investigated as shown in Table 3.4 in section 3.8.5. Me and my assistant researcher sat down and listened to the audio recordings several times whilst taking tallies for each of the variables under investigation. The tallies for each of us were compared until the differences were resolved. The notes were then compared against the audio recording results. A final decision was then arrived at for the frequency of each variable. The process was repeated for each teacher. A final table with all the results was compiled for discussion and interpretation under the relevant chapters.

3.10 Summary of quantitative and qualitative data collection and generation

Table 3. 12 Summary of quantitative & qualitative data & analysis process

Quantitative

Research Questions	**Data Source**	**Methods**	**Instruments**	**Administration**	**Nature of Data**	**Analysis**
1 & 3	Students	Survey	Likert-Scale Questionnaire (LSQ)	Completion by students	Statistical	Statistical Package for Social Sciences (SPSS)
	Documents			Collection by researcher	Statistic	
Demography	School Heads Survey		Administrative Questionnaire	Completion by School Heads	Statistical	SPSS
			Qualitative			
2 & 4	Students	Focus Group Discussions (FGDs)	FGD Guide Classroom Observation	Audio & Notes Audio & Notes	Audio Audio	Qualitative Content Analysis (QCA)
2 & 4	Teachers	Interviews	Interview Guide	Audio & Notes	Audio	QCA.

Quantitative data generation targeted research questions 1 & 3 and qualitative data was used to address research questions 2 & 4. Qualitative data based on previous studies was an on-going process involving general and specific reading of journals, textbooks, government reports, newspapers, conference papers, attending workshops, research school seminars and consultations with colleagues, experienced academics and my supervisor. Literature from all these sources was critically examined by the researcher.

Table 3. 13 CAF Tools of Analysis

Name of Tool	Significance value p = 0.050				
	Items				
	Values<p		Values>p		
	Total	Item numbers	Total	Item numbers	
Chi- Square	6	1,2,3, 9, 13 & 16	17	The rest	
Analysis of variance (ANOVA)	6	1,2,3, 9, 13 & 21	17	The rest	
Principal Component Analysis (PCA)	Factor no.	Item nos.	Factor Name		% of Variance of Squared Loadings
	1	16,17,19,20,21, 22	Learning Experiences (LE)		13.47
	2	6,7,13, 14	Attitudes to Natural Science (ANS)		8.95
	3	10,11,12	Social Benefits (SB)		7.77
	4	2,5,8	Subject Choice Factors (SCF)		6.17
	5	18,23	Motivation Factors (MF)		5.89
	6	4,9	Gender Perceptions & Performance Reasons (GPPR)		5.15

Table 3.13 shows that chi-square and ANOVA rejected an equal number of hypotheses (6) differing in the last numbers only and thus verifying consistency of the items and the

applicability of the tools of analysis. The principal component analysis (PCA) was used to detect the interrelations among the set of variables to identify the underlying structure of those variables. In other words, it grouped together items with similarities of purpose. A total of eight factors or components were identified but only six remained after the % of variance of squared loadings was done to eliminate the out fliers. The six groups were then named in accordance with what the items commonly represented. The % of variance of squared loadings is an indicator of the number of items that are closely related in purpose and the more they are the greater the variance and ranking. Table 3.13 shows that component 1 had the largest number of items (7) giving a 13.47% loading and all the items are linked to learning experiences.

Table 3.14 shows an extract of how the grouping was done. The standard value to place items or variables with a similarity of purpose is .500 and above. These are the values highlighted in yellow. For example, all items in group or component 4 with a value greater than .500 from item 1 to 23 would be grouped together and what they represent is interpreted by the researcher. Extracts of statistical analysis by chi-square, ANOVA and PCA have been shown and discussed in section 3.9 under tables 3.6, 3.7, 3.8 & 3.9 and the full analyses are in appendix B. These are the analytical tools whose results were used to analyse the findings of the four research questions together with the discussion and interpretation framework (DIF) figure 3.5.

Table 3. 14 PCA Extract from Appendix B-O5

	Component							
	1	2	3	4	5	6	7	8
B6-1 - Girls are not as good as boys?	.016	.088	.106	-.067	-.044	.101	.782	.128
B6-2 - Equal treatment of boys and girls both at home and school helps in subject choice and performance	.090	-.172	.086	.573	-.126	.173	-.087	.052
B6-3 - Household duties after school affect my performance.	-.085	-.078	.080	.007	.022	.002	.111	.748
B6-4 - Science subjects are difficult	-.082	.113	-.180	.044	-.027	.655	.180	.265
B6-5 - I learn interesting things in science	.085	-.011	.139	.670	.089	-.049	.229	-.173
B6-6 - I do not like reading about science	-.154	.530	-.257	.123	.079	-.014	.332	.103
B6-7 - I will not use science in many ways in many ways in my adult life	-.043	.536	-.280	.062	.110	-.104	.082	.298
B6-8 - The way a teacher teaches influences my behavior , subject, choice and performance	.025	.139	.032	.708	.055	-.033	-.140	.110
B6-9 - Given a choice ,I would rather be taught by a teacher of the same sex	-.014	.052	.152	.035	.143	.746	-.042	-.167

3.11 Conclusion

In this chapter the research design, sampling and participants, data collection procedures, methodology framework and the data analysis frameworks were described.. Previous studies on the relationship between gender and science education provided some insights on the formulation of data analysis and interpretation strategies. The rationale of the methodology approaches and strategies as well as choice of the instruments used was justified. Appropriate characteristics of reliability and validity for both the quantitative and qualitative studies were reflectively overviewed. Ethical issues were discussed. The chapter ended up with a tabled summary of the quantitative and qualitative data collection and analysis process. In Chapter 4 the, research question one is going to be discussed and interpreted using relevant results from the quantitative and qualitative data analyses.

CHAPTER FOUR

4.0 What factors influence choice in natural sciences?

4.1 Introduction

The previous chapter discussed the mixed-methods research approach which was adopted by this study. The attributes of MMR, research paradigm, research design as well as the data collection and data analysis procedures were explained and justified. This chapter discusses the results based on research question one. Triangulation of both quantitative and qualitative results will form the basis of discussion. Eight major factors that are central to the choice of natural sciences by students were identified. These factors were a combination of micro, macro and institutional as discussed in the literature review chapter. The factors are shown in Tables 4.1 and 4.2. The tables will be referred to throughout the discussion for each factor that was identified in the data. Each factor is discussed in the order of ranking as shown in Table 4.1. Ranking was determined by considering a factor which had the largest number of respondents agreeing as shown by the percentages.

Table 4. 1 Natural sciences choice factors-Quantitative Results N=576

Factor	**Agree %**		**Disagree %**	**Ranking**
Career	Male	60.0	40.0	4
	Female	56.0	44.0	
Social benefits	Male	86.0	14.0	2
	Female	89.0	11.0	
Ability	Male	73.4	26.6	3
	Female	77.2	22.8	
Interest	Male	91.2	8.2	1
	Female	95.3	4.7	
Role models	Male	13.6	86.4	6
	Female	11.2	88.8	
Funding (STEM project)	Male	43.3	56.7	5
	Female	59.8	40.2	

4.2 Interest

The quantitative results presented in Table 4.1 indicate that interest as a subject choice was ranked first by the participants. The table shows that 95% of the female students and 91% of the male students chose natural sciences for learning based on what they called interesting things in the subject. Interest was linked to specific subjects, careers and experiments and perceived social benefits that accrue from learning natural sciences.

The group doing natural sciences in a disinterested mode was represented by 8% male students and 5% female students. This might be the group which was forced to do sciences by the school authorities through the school policy ability (SPA) and other factors which are discussed later on in the report. Notwithstanding the other sources of interest, this emerged as the most influential motivation for of choice of natural sciences from the survey. This is what some of the respondents said during interviews:

FGD2: RM13. *Inini ndingangoti ndakazvitanga hangu ndichiri mudiki. Ndaifarira kukiriyeta, kungokiriyeta something nekugona kugadzira mota dzamawaya. Mukungogadzira zvimwe zvinhu so zvakangosiyana siyana ndainzwa kufara nokuzvida. Pandakatanga Form1 ndakaona kuti kuscience kunoitwa zvema experiment ndichingo experimenter zvinova zvandaifarira sokuti ndakagara ndiine pfungwa yekiretiviti. (I started liking science since I was young because I liked experimenting and creating things like toy cars and this influenced me to like sciences at form 1 level).* Line 84 – 90.

FGD3: RF2. *Well I'm currently studying Biology, Mathematics and Food Science. Why? It is because I have interest in all my subjects, Biology I love, Math's I love, Food science, I love to deal with food. I love everything that concerns food that is why I'm studying these subjects. I don't think there is a subject which is difficult, I think it all depends on your interest and what you like to do and what you do not like and what you prefer so I prefer to do these subjects and I find them quite enjoyable. Well I am planning to be a food technologist if everything goes well.* Line 9-15.

Table 4. 2 Interviews

Factor	**Students N=42 n=24(F) & n=18(M)**		**Teachers N=8 n=5(F) & n=3(M)**
Career		Number	Number
	M	12	3
	F	14	3
Social Benefits	M	11	2
	F	17	4
Ability	M	16	3
	F	18	3
Interest	M	14	2
	F	11	2
Funding (STEM project)	M	10	1
	F	12	3
Role Models	M	12	1
	F	15	4
School Policy Ability	M	11	2
	F	15	4
Stereotype Beliefs	M	16	1
	F	16	2

Table 4.2 shows the number of teachers and students who gave their views on each of the factors. Qualitative results indicate that more male students (14) than female students (11) cited interest as a motivating factor for studying natural sciences. These results contradicted the survey results. The number of male teachers and female teachers who believed that students chose natural sciences due to interest was two each (Table 4.2). The shift in the trend of results for students, when compared to quantitative results, may be attributed to the number of respondents who took part in the interviews. I would like to believe that the quantitative results may be a true reflection of the participants' views. It also emerged during interviews that interest was created by

likeable characteristics of some natural science teachers and the prestigious status associated with natural sciences.

The qualitative results agree with the findings from Frenzel et al.'s (2010) study which revealed that there was a lower interest in mathematics and sciences by girls than boys.The quantitative findings present above are in tandem with Christensen et al.'s (2014) study results which showed that females were significantly more positive than males in STEM career interest and in perceptions of STEM as a career. These were the ones called ‘the smooth transition’ students by Salehjee and Watts (2015). This is evidenced by the following responses.

FGD3: RM3. *I'm studying O Level Chemistry, Biology and Mathematics, I particularly like Chemistry, I need to pursue Chemistry, the reason being I have interest in Chemistry and I really want to make some new inventions. It is out of interest that I do it.* Line 16-19.

FGD2: RF12. *Nobody influenced me. I just chose the subjects since I was in form 1 because of interest and the teachers supported me.* Line 70-74.

MT1: *Fourthly science is a practical subject and students enjoy and show interest doing practicals like the titrations in Chemistry, electricity in Physics and the like. When they make new substances from other substances like making salt and you have got hydrochloric acid and maybe sodium hydroxide so they… they enjoy doing that. I think these are the main factors in my view.* Line 14-18.

Interviewee RM3 is very clear that it is out of interest that he is doing Chemistry. He seems also to know what the subject is all about because he mentions the desire tom come up with some new inventions. Chemistry involves the making of complex chemical materials such as medical drugs and plastics. Perhaps the interest of this participant emanates from both the knowledge of the subject and out of curiosity involved in inventions. Respondent RF12 claims that she was not influenced by anyone but interest which she developed since form 1 made her choose natural sciences. Somehow the participant contradicts herself by citing the support of the teachers because the support given by the teachers can be argued to be some form of influence.

The views of the male teacher MT1 seem to indicate that interest and enjoyment are synonymous. He asserts that students enjoy and show interest in doing practicals associated with most science subjects. The assumption is that students will have been exposed to experiments at form 1 and 2 levels and interest developed there and hence at form 3 level the students would opt to continue studying natural sciences. I agree with the views of the teacher interviewee that enjoyment brings about interest, but interest does not necessarily translate into enjoyment. Interest as a choice factor for studying natural sciences had the most impact on the participants among the other seven factors. The second ranked factor for choosing natural sciences was social benefits or the utility value derived from learning the subject.

4.0 Social benefits

In Table 4.1 more female students (89%) than male students (86%) chose social benefits as a factor. A similar trend emerged during interviews when 17 female participants against 11 male student participants cited social benefits as a choice factor for natural sciences (Table 4.2). Of the interviewed teachers, 2 male and 4 female respondents, respectively, thought students prioritized social benefits when opting to study natural sciences. T The social benefit theory (SBT) is relied upon to explain the choice of social benefits as a factor that encourages the uptake of STEM subjects. The theory assumes that an individual embarks on a task or a challenge only if there is a social reward derived from such an action (Eccles & Wang, 2012). The social reward is expected to change the status score of the benefactor to higher levels of economic independence (Buccheri et al., 2011).

The reason(s) why more female than male respondents chose social benefits as a choice factor should be viewed in the context of cultural beliefs and practices and socio-economic imbalances within the Zimbabwean society. Culturally, most Zimbabweans believe that the role of a woman is in the kitchen, child bearing and rearing (Chikunda & Chikunda, 2016; Mavhunga et al., 2009; Radu & Chekera, 2014). This explains why at most gatherings women do the cooking, serve the men to eat first before they eat themselves although they are the ones who would have cooked.

This cultural practice dates way back before the influence of European and other races cultures in Zimbabwe. The men did this with the good intentions of protecting their women and children from wild animals and other attackers. In other words, males had an obligation to provide for their families ensure that the families were safe. The culture instilled in males a high sense of responsibility. In inheritance issues, males are preferred more than the females because males pass the family name to the future generations whilst females change their family name when they get married. Most key positions with benefits in society such as chiefs, councillors, government ministers, church ministers and company executives are held by males. These views are based on my observations, experiences and documented evidence (Ministry of Women Affairs, 2013; Radu & Chekera, 2014; Zimbabwe National Statistics Agency, 2013). It appears like the relevance, importance and the utility value derived from any activity done is at the fore front of female minds. I also contend that the application and practice of gender stereotyping under the guise of culture is independent of the level of academic education. It is done when it suits the perpetrator.

As girls grow up, they become aware of these glaring gender-disparities. However, it seems that cultural gender stereotyping is slowly fading away especially in town settings due to the integration of many cultures and the influences of modern technology. Therefore, given some opportunity, girls would opt to choose subjects that economically empower them and socially bestow them with a lot of benefits and dignity. The trend in the results is at variance with the findings from some previous studies (Dillon, 2009; Osborne et al., 2003; Stuckey et al., 2013) which have argued that school science and science in general are perceived by students as both difficult and irrelevant to their daily lives and society. In this study, both the boys and girls indicated that natural sciences are relevant to their everyday lives. For the girl-child, the results may reflect an expression to liberate herself from the chains of gender-disparities entrenched in society. The results of this research are support the findings from previous studies too (Hulleman et al., 2010; Ndalichako & Komba, 2014; Powell et al., 2012) which showed that students' preference of a subject is hinged on the social benefits that they will derive from learning it. Some of the views of the participants are shown in the following quotes.

FGD1: RF7. *I'm studying Physical sciences because it doesn't promote laziness, it keeps you occupied just working those sums and my ambitions in the future requires Physical Sciences so that I can earn a living, I will be having that kind of living you know, having my own house, my own car, living peacefully, in low density suburbs.* Line 37-40.

FGD2: RM7: *I am studying science because of interest and it gives me knowledge about many things including creating my own inventions. I will become famous and make money.* Line 43-45.

It is evident from the two respondents that social benefits were a priority factor of choice. RF7's views should be understood in the context of the participants' backgrounds. Most of the participants came from poor families and lived in the high-density suburbs of Chinhoyi town and the surrounding farms. Life is tough in these environments. Most parents are not gainfully employed due to the dilapidated and debilitating prevailing economic conditions in the country. The opinions reflect a typical life in most of Zimbabwe's high-density suburbs. Three issues are raised by RF7. The first one is the intention and ability to earn a living suggesting that the respondent was aware that a career linked to Physical Sciences would pay her well. The second issue is of owning property based on the assumption that a high paying job would enable her to acquire property of her choice or dreams. The last issue is that of living in a peaceful environment and according to her low-density suburbs are the right places to live. The views of the respondent are not far from the truth. Peace in the high-density suburbs of most towns in Zimbabwe is hardly enjoyed particularly during election periods due to forced attendance to political rallies.

According to RM7, studying natural sciences gives him four social benefits. These are knowledge acquisition, being an inventor, celebrity and money. RM7 is aware of the benefits associated with inventions because in most cases inventors become entrepreneurs and make more money than most workers including academics. One typical role model to many young Zimbabweans is Strive Masiyiwa, an electrical and electronic engineer by career who founded Econet Mobile Network-Zimbabwe and has become one of the richest people in Africa.

According to the Wikipedia website, Zimbabwe, as a nation has produced internationally renowned scientists, in the likes of Christopher Chetsanga, Peter Garlake, Simba Makoni, Lindela Ndlovu and Allan Savory. Unfortunately, all are male scientists, and this starves female students of role models and sends wrong signals that perhaps science is a man's world. Whatever reasons were put forward by the participants, findings of this study resonate well with the findings of Morgan et al. (2013) who indicated that students prefer subjects which help them acquire skills and knowledge that assists them in their daily lives. The implications of these findings are that they assist teachers, parents, counselling and career guidance personnel and other interested stakeholders make informed decisions and understand why students choose subjects of study. The next section focuses itself on ability as a subject choice factor.

4.1 Ability

Two forms of ability were identified by this study and these were self-ability or just ability and school policy ability (SPA). Ability is discussed first. Items 1 and 4 in the questionnaire elicited opinions on ability as a choice factor and the results are illustrated in Table 4.1. Semi-structured question 1 in the interview guide lines of both students and teachers probed for the same opinions on ability and the findings are indicated in Table 4.2. 77% of the female students believed in their ability to do natural sciences and used it as a criterion to study the subjects. On the other hand, 73% of the male students considered their ability when selecting to study natural sciences. The results seem to indicate that female students rely more on their ability to do the subject than the boys before choosing to study it. Interview findings revealed that all the male teachers (3) against (3) of the female teachers believed that ability was an important subject choice factor. More female student interviewees (18) than male interviewees (16) cited ability as a natural science choice factor. These results contradict the earlier findings from previous studies (Hackett & Campbell, 1987; Britner & Pajares, 2006) whose studies found out that males displayed higher self-efficacy than females. Ability as a choice factor in STEM subjects was also identified by Bennet (2017) who premised that it did not exist in isolation but was linked to gender.

These results give insight into three possible explanations on the uptake of natural sciences by the students in this study. First, female students displayed higher self-efficacy or beliefs in their ability to do natural sciences than male students but did not necessarily use it to choose to study the subject. Second, if ability is such an important and critical factor in choosing to study a subject, then the students who doubted their abilities would opt not to do the subject. Therefore, based on these results it can be argued that more female students than male students doubt their abilities in natural sciences and hence the low uptake of the natural sciences as illustrated in Tables 1.3 to 1.6 in chapter one. Third, all the 3 male teachers who were interviewed believed that ability is an important factor to be considered when selecting to study natural sciences. From my experience, such a strong position maybe used unprofessionally or unwittingly to ignore other factors which students perceive to be important in choosing natural sciences because it is influenced by stereotype beliefs.

The following interview extracts reflect some of the views of the participants.

FGD3: RF2: *I don't think there is a subject which is difficult, I think it all depends on your interest and what you like to do and what you don't, what you prefer so I prefer to do these subjects and I find them quite enjoyable. Well I'm planning to be a food technologist if everything goes well.* Line 12-15.

FGD4: RF3: *I don't think that science subjects are that hard, it depends on your attitude towards them, if you believe you can make them easier for you they will be.* Line 71-72.

FGD1: RF8: *Ok in my own opinion it is not true that sciences are for boys because they are better than girls, even girls are as good, but it is all to do with reading, girls we are too lazy, but not all of us see the subjects as difficult.* Line 229-232.

MT2: *Umm, I think actually the ability, success and the experience, if they experience success in the sciences they will continue with it because I believe that naturally every student would want to do the sciences, so those who do not do it is not because they do not want but it's because they experience failure and are unable, therefore they tend to move away from it. Initially I'm sure everyone wants to do the sciences.* Line 4-8.

The respondent RF2 gloats in her self- confidence and declares that there are no difficult subjects, natural sciences included. She justifies her stance by citing the interest, vision or ambition and preferences of an individual as the determinants of choice and success in a subject.

The interviewee was clear on her career choice and gives it as a reason why she chose to do natural sciences. RF2 is an example of what Salehjee & Watts (2015, p. 733) identified as the "smooth transition" students in a learning set up. These are the students who "always knew what they were going to do", they never questioned their ability or career direction. In this study, the smooth transition students constituted of 70% (quantitative) and 34 qualitative who believed in their abilities to do natural sciences.

RF3 believes natural sciences are not hard or difficult, but the attitude of the individual will determine whether to choose the subjects or not. It is not clear whether she is identifying attitudes as a factor of subject choice. However, the tone of her views insinuate that she believed in ability as a choice factor by saying "if you believe you can make them easier for you, they will be." The notion or belief that natural sciences are a domain of the males is dismissed by respondent RF8. She argues that the ability of females in natural sciences is the same as that of the male students but attributes perhaps the low uptake and performance in natural sciences by female students to reading and laziness. The respondent is implying that female students are perhaps poor readers or do not get enough reading time or both in natural sciences. Her statement that girls are too lazy is too generalized and may not be true but could have been an indicator of the girls she had known in the study and learning of natural sciences. Ability, as a choice factor, comes strongly out of her views.

The views of the three female participants indicated that female students did not choose natural sciences because they were unable to do the subjects but because of other considerations. Shapka (2009) and Wang and Eccles (2012) argue that ability is necessary but not a sufficient predictor of educational and career choices. The opinions of the teacher interviewee MT2 agree with the views of the three students that ability is an important factor in the choice of natural sciences. Nevertheless, the teacher believes that non-choice of natural sciences by students is not due to other factors other than the failure to do the subject. According to him, failure is brought about by the inability to do the subject only. In my view, the teacher is being dogmatic and may be guilt of failing to think outside the box with regards to what determines the choice of natural sciences by students.

4.2 School policy ability (SPA)

The SPA is a practice in schools whereby students are given subject combinations to study at form 3 and 5 levels without consulting the students themselves. It is not a legitimized ministry policy but nonetheless it is openly practiced and implemented by schools. Table 4.2 shows that 11 male students against 15 female students said that they were coerced to do natural sciences by the school policy ability criteria. That there was a fewer number of male than female students who were forced to do natural sciences against their will may suggest that school authorities believed that male students were more able to do natural sciences than the female students. Among the teacher interviewees, 4 female teachers out of 5 and 2 male teachers out of 3 testified that schools used their own policies or criteria to select natural science students. A total of 6 teachers out of a possible 8 who gave their honest opinions may indicate that they were against the policy but had no control over it. This is what the teachers said about SPA.

FT3: …*at O level, they are using end of year exam in integrated science and mathematics. Umm I'm not quite sure how they do it because we do not do the selection; they get selected at the senior office. Yes, if they do select a person we do not really have a choice because they would have already accepted the student to do the sciences. We really do not have a choice in choosing if you want the person with a C or not. No, the HOD is not involved. We really don't have a say we really don't have a say.* Line 16-21.

As alluded to earlier, the selection of subjects is done at form 3 (O-level) and form 5 (A-level) at high schools in Zimbabwe. At this school B, the criteria were based on the quality of passes in integrated science (general science) and mathematics at form 2 level. The views expressed by FT3 highlights the centralization of power of the selection process in the headmaster's office referred to as the "senior office." Of concern here is the absence of the teachers of natural sciences in the selection process including the head of the department as explained by the respondent. Based on this information, it seems the school policy disadvantages both the teachers and the students.

FT4: *I think it does, umm I have had experience with students who sort of been made to do natural sciences when they had doubts because at this school we don't really give them a choice, it's like we select those whom we think have the capability and place them in the sciences. And you find that out of those children that you pick some will say ahh I don't think I will be able to handle these subjects and some pupils as we move along you find that they may drop out or they continue doing those subjects. They will not be performing that well, they will not be at par with their counterparts. Usually those who don't do well are those who had reservations about their ability when they started.* Line 36-44.

MT3: *Yes, let me give you an example where we had a form 3 class and we had what we believed where quite above average students and we had a girl who pointed out she was not going to waste a lot time in physical science, because after all we do screening. We take let's say a group of 60 leaners for physical science and then three to four months down the line we examine them then re-screen and we get the last 30, so in variably everybody knew at that time that preference was given to the boys, vanhu vaingoti ahh the boy child understands, they are likely to perform well, they are likely to go through their studies they are not going to get married after form 4 and so on. So naturally the interest of girls went down in that area. So, more they were then interested in commercial subjects.* Line 26-35.

The sentiments of FT4 show that at her school the students were not given the chance to choose. Students who doubted their ability to do natural sciences were forced to take the subjects as the school deemed fit. In the same vein, students who would have liked to do the subjects but were deemed incapable by the school policy lost the chance to do natural sciences. I believe most damage is done to the students doing natural sciences in a disinterested mode because their chances of succeeding in a subject where they doubt their ability are very slim. MT4 indicated that his school rigorously screened the students through a series of tests within a stipulated time frame to achieve the targeted enrolment figure. He also pointed out that his school had some sort of a gender-biased atmosphere because female students who opted to do sciences were not easily accepted. . The girls were aware of this and even the interested capable girls would opt out of the sciences fearing that they would fail the tests and after all the teachers believed more in the ability of the boys than theirs.

The issue here is about freedom of choice. The opinions of the three interviewees demonstrate the absence of freedom of choice by students in the studied schools due to the application of school policy ability instruments. Male students, to a certain degree, do enjoy some freedom of choice of natural sciences but the same cannot be said of female students as evidenced by views expressed by interviewee MT4. Generally, the prevailing attitudes, policies and the central role of teachers and headmasters in managing the choice and distribution of science curricula in high schools has much bearing on how girls are entitled access to sciences as well as how they perform to achieve reasonable pass rates. The implications of the existence and implementation of SPA which is not a legalised instrument but is openly used by schools is its impact on the freedom of choice of natural sciences by students. It is clear from my findings the SPA infringes on one of the basic human rights, that is, the freedom of choice. I believe this has far reaching consequences on the students' perceptions of freedom of choice later in their lives because they will grow up thinking that young people do not have the freedom to choose and may also deny their off springs the freedom to choose and express themselves..

4.3 Career paths

The focus on a future career was among the factors in the choice of natural sciences and was ranked fourth by the participants. Table 4.0 shows that 60% of the male students and 56% of the female students agreed that they considered a career pathway when opting to study natural sciences. These quantitative results were supported by 14 and 12 of the female and male students, respectively, who were interviewed. Among the interviewed teachers, 3 females and 3 males thought that students considered a career first before choosing natural sciences, as illustrated in Table 4.2). Career, as a subject choice factor, was reasonably given a fair weighting by more than 50% of students in the survey and 26 of the 42 qualitative respondents. All the 3 male teachers believed it was a key factor in the choice of natural sciences. Student participants did not just cite career as a subject choice, but they were also specific on the type of career they wanted to pursue, as shown in Table 4.3.

Table 4. 3 Respondents by Career Choice N = 394

Types of career	**Male Frequency**	**Male %**	**Female Frequency**	**Female %**	**Total**	**Total %**
Career in the medical field	84	36	56	35	140	36
Career in the Engineering field	19	8	13	8	32	8
Being a Scientist	68	29	45	29	113	29
Acquiring knowledge	65	27	44	28	109	27
Total	236	100	158	100	394	100

Of the 590 participants who responded to the questionnaire only 394 indicated their career choice representing 67%. This representation is quite high indicating that the respondents had not just stumbled into the natural sciences stream but had made choices informed by their career choices. Table 4.3 shows that a career in the medical field was the most popular among the participants accounting for 36%. The margin of difference was just 1% between male (36%) and female (35%) students.

These findings contrast the results of Baram-Tsabari et al. (2009) who demonstrated that girls have more interest in the medical field than boys whose interest lay in the engineering fields which involved a lot of construction. The students probably chose the medical field ahead of the other STEM related disciplines due to the almost daily interactions with personnel from this field. The participants interact with doctors, nurses, dentists, optometrists and pharmacists when they visit hospitals and clinics for treatment as well as buying drugs from pharmacies.

Careers in the field of engineering were the least mentioned (8%). These results were somehow surprising especially these days when technology has advanced tremendously and most of it is developed by engineers in various fields. People working in the engineering disciplines and natural sciences teachers may not be marketing this area enough to attract students in high schools. These results indicate that the participants were not aware that technology is a product and process created by engineers. Makonde District’s ruralness and lack of many engineering-based companies may have contributed to the low choice of engineering as a career.

The career of being a scientist was cited by 29% of the respondents. The participants were not very clear on the kind of scientist they wanted to be other than just saying “I want to be a scientist.” However, it was the second popular to the medical field. Scientists are of various types, for example, political scientist, technician scientist, teacher scientist, entrepreneur scientist and social scientist. I believe the participants were referring to natural sciences linked scientists.

The career path of acquiring knowledge represented 27% of the respondents. Reasons such as I chose natural sciences so that I can acquire knowledge and do a “good job”, “develop logical thinking” and so that “I can help and improve people’s lives” were often mentioned. It is in this context that this study considered knowledge acquisition as a career pathway. More female (28%) than male students (27%) chose natural sciences to acquire specific knowledge which cannot be acquired in other fields of study. Table 4.3 shows small differences in gender preferences of career pathways by the participants. Gender was not a major motivating factor in the choice of a career by participants in this study. Testimony to the trend is supported by the following quotes.

FGD2: RM2: *I would like to do engineering, when I grow up I would like to fix people’s cars, and many other things.* Line 8-10.

FGD1: RF1*: Yes, because I’m in A- level and I would like to study pure sciences. Yes, pure sciences, I’m just interested in them. I would like to use them later in my life. I would like to be a doctor.* Line 5 - 7)

MT3: *In preceding discussions we have mentioned some of the reasons are cultural; some of them are broadly market for employment, employment opportunities.* Lines 80 - 81

FT5: *Normally they consider the career, maybe their future career that's when they look back and say which subjects can I take and then they can take the natural sciences* lines 4 - 5.

The responses of RFI epitomised a girl child who was focussed and knew what she wanted to be in life. She selected her subjects out of interest because she thinks that they would enable her to follow a specific career path. . RM2 somehow seemed to suggest that a career in engineering will expose him to either formal employment or self-employment. He is aware of the possible life options available to an individual who has done natural sciences. The results suggest that the students who participated in this study were smart enough and well informed about the job market trends as represented by 68% of the respondents from the quantitative results, 26 of 42 student interviews and 6 of 8 teacher interviews who cited career as a subject choice factor.

The fact that more female students (14) than male students (12) in Table 4.1 who were interviewed cited career as their choice factor suggests a shift in cultural beliefs of the girl child. Most female students in this study disagreed with the widely held stereotype beliefs that STEM related jobs are a domain of the males. These findings are resonating well with Yazilitas et al.'s findings (2013) that college students viewed occupations in STEM as opposed to other fields as a liberation tool from cultural norms to economically empower themselves. A patriarchal culture, which is very dominant in Zimbabwe, has always expected the girl child to prioritise marriage before her career. Females who are economically independent with high paying jobs but are not married are usually disdained by society.

Teacher's responses reinforced the sentiments of the students as shown by MT3 and FT5. MT3 believes that job opportunities within the employment market are what most of the students consider when selecting a subject to study. In other words, careers that are preferred and are regularly advertised in the media entice students to select relevant subject combinations. The views of both the teacher interviewees are echoed by the findings of Reiss and Mujtaba's (2017) study which revealed that students do careers that are easily marketable and high paying and people with skills in STEM related disciplines are in short supply worldwide. It all starts at high school where the relevant subject combinations are done. From these results it appears that teachers themselves advised their students to consider the career they wanted to do before selecting subjects to study. As a teacher of natural sciences, myself, I used to market the subject to Form 2 students at the end of the year so that they would opt to do my subject when in Form 3.

The results of this study agree with the findings of Mellors-Bourne et al. (2011) who observed that the decision to enter STEM jobs was often part of a longer process of career decision-making by individuals. In the Zimbabwean education system, students are expected to decide whether to study or not STEM subjects particularly natural sciences at form 3 level. What these results indicate is that the respondents who were specific with the type of career they wanted to do had long made their decisions before form 3 and above. Obura and Ajowi's(*2012) study in Kenya on gender and students' perceptions of career aspirations advanced that career aspirations were significantly related to gender of students and gender stereotyping. The findings of Moakler and Kim (2014) indicate that female students were less likely to develop outcome expectations towards a STEM career contradict the results of this study and this may be due to differences in social and economic developments of the contexts studied. The contradictions are best understood in the context of the institutional-level theory a component of the MMI theoretical framework and it postulates that different education systems have different outcomes for learners from different social backgrounds (Schutz et al., 2008). Moakler and Kim's (2014) study was conducted in the USA where cultural beliefs and education systems may be assumed to be different from those in Zimbabwe. Variations in education systems contribute to the reproduction of inequality in education (Buccheri et al., 2011; Co-operation & Development, 2010). Variations also exist within the provinces and districts themselves. In Zimbabwe, a developing country where the cultural stereotyped beliefs disadvantage the girl child, career is considered as a very important outlet valve to economic independence by the students especially the girl child.(Obura & Ajowi, 2012)

The implications of these results are threefold. First ,the cultural stereotype beliefs associated with females as thinking of STEM occupations as a male domain may be dying off, as shown in Table 4.2 where both female and male participants scored equally (engineering (8%) and being a scientist (29%) and differed by 1% in medical field and acquiring knowledge as careers of their choice. Secondly, teaching natural sciences students may be easier and enjoyable for the natural science teachers because they will be working with well-motivated students who know what they want to do in life after school. Self-motivation is among key driving forces behind good performance and achievement and, thirdly, schools, teachers and parents are encouraged to consult and offer proper guidance to the students instead of imposing subjects as this may destroy the student's career ambitions.

4.4 Funding (STEM project)

Secondary education in Zimbabwe is not free. Natural sciences, like technical subjects, are expensive to run. This has led to many schools not offering the subjects and those that do have a low uptake by students because most parents cannot afford to pay the extra fees demanded for the subjects. Schools that offer STEM and technical vocational curricula in most cases require large government financial support.

To encourage many students to study STEM subjects, the then minister of Higher and Tertiary Education in 2015 introduced what is commonly known as the STEM project. Chapter 1.9 briefly discussed the marketing strategy which the government used. The project paid for both the tuition and practical fees for all the students who had opted to pursue STEM subjects at A-level. Unfortunately, by the time this study was completed, the project had collapsed due to political changes in the country.

Table 4.1 indicates that more female students (60%) than male students (57%) were lured by the financial support from the STEM project to study natural sciences. In Zimbabwe, where the dominant culture is patriarchy, the girl child is usually sacrificed for the boy child's education if funding is not enough for both children. This may explain why more female students than male students seized the opportunity because their parents did not have to pay the tuition fees for them. A similar trend is shown in Table 4.3 where 12 of the interviewed female students and 10 male students revealed that they had chosen to study natural sciences due to the support from the STEM project. The table also indicates that 3 of the 5 female teachers agreed that the project had lured more female students into studying natural sciences. Only 1 male teacher testified to that effect. Evidence of the influence of the financial support is in the following extracts.

FGD2: RF4. *As for me I am studying subjects that I wished to, I passed physical science but because of finances I wanted to drop them but now the government is paying for me through STEM my father couldn't.* Line 17-19.

FGD1: RM3. *I am doing physical science at O level because I want to do it at A- level so that I can have help from the government and be a Doctor. It's like there is shortage of students who are taking sciences in Zimbabwe, so the government decided to help those people who go for sciences.* Line 9-12.

The pull over effect that this factor had on the choice of natural sciences is very apparent in the two extracts. The issue of government support came out during interviews with the students. In line with pragmatist principles, I followed this STEM project with teacher interviews to hear their opinions on this subject .The contribution of the STEM project is discussed in detail towards the end of this chapter.

FT5: *Yah we have seen a great change because if you look at our previous intakes we had a few students for instance upper 6 we only have 7 students but the lower 6 those who started the STEM program we have 29 students taking sciences. It's great, we have never enrolled such a great number, so to me that's a great increase four – five times, and that's a great number. Yah now the greatest challenge is on our equipment and resources.* Line 150-155.

If the evidence of these three quotes is anything to go by, it can be argued that the introduction of the STEM project had an impact on the choice of natural sciences by students. Why the government did not introduce the project earlier despite the existence of research evidence documenting the shortage of skills in STEM fields and the low uptake of STEM subjects by students particularly female students was apparent?. This could just be a result of lack of political will. . The next focus is on role models as a subject choice factor.

4.5 Role models

The term role model was used broadly and collectively in the study to refer to the influence of parents or family, teachers, peers and the media on subject choice. A surprising finding was that 89% of the female students and 86% male students did not attribute the choice of natural sciences to role models as shown in Table 4.0. During interviews more female (15) than male students (12) refuted that the role models had an influence in their choice of natural sciences. Possible reasons for this pattern are: first, most of the participants had little faith or trust in the advice coming from these influencers and hence ignored the advice; secondly, many of the respondents' parents or family members were not engaged in natural sciences related fields and therefore no advice or motivation was given to the participants, and thirdly, teachers in Zimbabwe are among the least paid civil servants and most of them live ordinary lives and some even below the poverty datum line status.

Under such circumstances it becomes very difficult for students to embrace them as their role models. Fourth, there were few female role models in STEM related occupations in the area under study including the schools themselves and hence the higher percentage of female students who ascribed to the absence of role model influence in the choice of natural sciences. The views of the students were supported by 4 female teachers and 1 male teacher (Table 4.2).

Notwithstanding the great numbers of participants who were not influenced by role models, the 11% and 14% female and male participants respectively (Table 4.0) who got influenced ranked the factors, as shown in Table 4.4.

Table 4. 4 Role models by ranking N= 576

	Parents	**Peers**	**Teacher**	**Media**
Male	6%	1%	3%	4%
Female	5%	1%	4%	2%
Total	11%	2%	7%	6%
Ranking	1	4	2	3

4.5.1 Parents

Table 4.4 indicates that 6% male and 5% female respondents were influenced by parents to choose natural sciences. More male students than female students took advice from their parents on this subject. At this level of education, most of the students will have attained adolescence and girls mature faster than boys (Meece et al., 2006). . Parents followed by teachers over the years have been named as the leading influencers for the students' interest in science, technology, engineering and mathematics (STEM) subjects (Christensen et al., 2014).

The results of this study confirmed the trend. However, Salehjee and Watts (2015) emphasize that parental influence has an impact only if both parents work in STEM related fields and the social benefits are very conspicuous to the children. Hence, (Archer et al. (2014) argue that the family, family friends or neighbours, doing the same job as the aspirants, are the main source of influence to their choice of subject and career. Archer et al. (2014) cautions that, at the individual level, not all children within a 'high science capital family', that is a family with science related qualifications, will aspire to a future in science. Equally, children from 'low science capital families' do find a route into science. The findings of this study indicate thatmost of the participants came from families where the parents were not involved in STEM related disciplines but still had a strong influence on their children. In the Shona culture, children are taught to respect and accept the decisions which adults (parents) make on their behalf The parents can still make some decisions on your behalf whether you are agreeing or not.

4.5.2 Teachers

The influence of teachers was ranked second in this study. The results given in Table 4.4 show that more female (4%) than male participants (3%) were influenced by teachers to select natural sciences. The reason why more female than male students were influenced by the teachers could not be established at the time of the study. One can only speculate that female students believed that their teachers were the only main sources of reliable academic information than boys did. Most of the student participants were from not so well to do families and did not have smart phones but just ordinary phones which are colloquially called *kambudzi* meaning a non-smart phone that cannot access internet. Hattie (2009) argues that teacher expectations on individual student's achievement have an impact on subject and career choice. Perhaps teachers interacted more with female students, persuading them to choose natural sciences since natural science enrolment figures, as indicated in Chapter 1, showed that there were more male students than female students.

The findings of this investigation support results from numerous studies (Christensen et al., 2014; G. Jones et al., 2011; Kauffmann, Hall, Batts, Bosse, & Moses, 2009; Okumu, 2013) on the positive influence of teachers on the choice of subjects to study in schools.

4.5.3 Media

In this study, the term media comprised Broadcasting media (radio & television), Internet (Facebook, Twitter & WhatsApp) and Print media (newspapers, magazines, journals and books). The influence of media was more pronounced in male students (4%) than in female students (2%). It could be that media with education related information appeals more to male students than female students or maybe female students get less time with media due to other extra duties like household chores.

4.5.4 Peers (Friends)

Friends, who are treated the same as peers in this study ranked last. Peer pressure as an influencing factor was cited by 1% of female and male interviewees, respectively. The respondents in this study did not think that their friends had much to do with their choice of natural sciences. It could also mean that the participants were too smart enough to believe more in people older than them than to believe in their peers. In this era of modern technology, information can easily be accessed from internet. The implication of these results is that in future students may rely more on media for information and advice instead of friends thus destroying human relationships and trust.

4.6 Stereotype beliefs

Stereotype beliefs had more impact on the male students (80%) than female students (73%) in choosing natural sciences, as illustrated in Table 4.2. Male participants believed natural sciences were subjects for males and not for females. This explains why some of them took up the subjects. The female participants blamed the stereotype beliefs for discouraging them from studying natural sciences as most of the times they were subjected to negative comments about their abilities in natural sciences. Teacher interviews revealed that 40% of the female interviewees believed that stereotype beliefs were a subject choice factor against a 33% of the male interviewees who thought otherwise. The following extract exposes some of the perceptions held by some of the participants.

FGD2: RM3*:* *I want to support the point of the other guy, even when we were created men had muscles and brain. We were made for tough jobs and women simple jobs, washing dishes, sweeping and washing clothes can't be hard, that's what they were created for.* Line 125-130.

The deep-rooted stereotype beliefs are very apparent in RM3. He argues that men were created with both the muscles to do tough jobs and the brain to think and do subjects like natural sciences. His views imply that women have just the muscles to do easy chores like washing dishes, but they were not given the brains to do tasks that require a lot of thinking. It is such beliefs which can give some male students a false sense of ability and competence in subjects where they are incompetent and unable. Opinions like these have the potential to reduce the self-efficacy of female students and discourage them from selecting natural science as subjects of study.

4.7 Comparison of choice factors by priority

Table 4.5 below demonstrates the importance attached to each choice factor by both male and female participants derived from the mean percentage of quantitative results and the trend of qualitative results.

Table 4. 5 Choice Factor Priority (Key: High = 60%+; Low = 59%)

Factor	Male	Female
Interest	High	High
Social benefits	High	High
Ability	High	High
School policy ability (SPA)	Low	Low
Career	High	Low
Funding (STEM project)	Low	High
Role models	Low	Low
Stereotype beliefs	High	High

The responses for each choice factor were compared as either high or low. The low or high description was a measure of the priority or importance attached to each of the factors by the respondents. Table 4.4 shows that interest in the subject, social benefits accruing from studying the subject, ability in the subject and stereotyped beliefs associated with natural sciences were given high priority by both male and female students. The imposed SPA and the influence of role models were rated lowly by both female and male respondents. SPA was viewed by the participants as an intrusion and denial of their freedom of choice and hence prioritising it lowly should be a demonstration against the policy. The impact of the influence of role models on the choice of natural sciences was minimal, as explained in section 4.7. Male students prioritized career higher than female students.

In the Makonde District high school students identified eight factors that they consider when choosing to study natural sciences. Gender-disparity existed only in the emphasis of the same choice factors. The results indicate that freedom of choice, a fundamental human right, was greatly compromised by school based subject choice policies. The implications of the results are that the stances and attitudes of school authorities, parents and teachers with regards to student's choice of natural sciences was challenged and exposed by both the students and teachers. The results necessitate a new paradigm shift in the way schools allocate subjects of study to students. Although guidance is necessary, the ultimate decision must rest with the student. The findings of the study demonstrated beyond reasonable doubt that students choose natural sciences from well informed positions.

4.8 Teachers' views of the STEM project

Item B5 of the questionnaire asked the participants to give a reason why they were learning science and some of the respondents wrote stem funding. This did not make sense to me and so I decided to follow it up with both students and teachers during the qualitative phase. During FGDs interviews, some students stated that they had decided to study natural sciences because of the government STEM Project which funded their school fees. The students did not have much information about the project and hence a pragmatic decision was made by the researcher to obtain information from the teachers. The study was about investigating gender disparities in one of the STEM subjects and hence it was deemed prudent to get to the core of the issue through teachers' views. The teachers were asked about their opinions on the positives and negatives of the programme in encouraging an increased uptake of STEM subjects. Figure 4.1 shows the distribution of the comments.

N= 8; males, n = 3 & females, n = 5

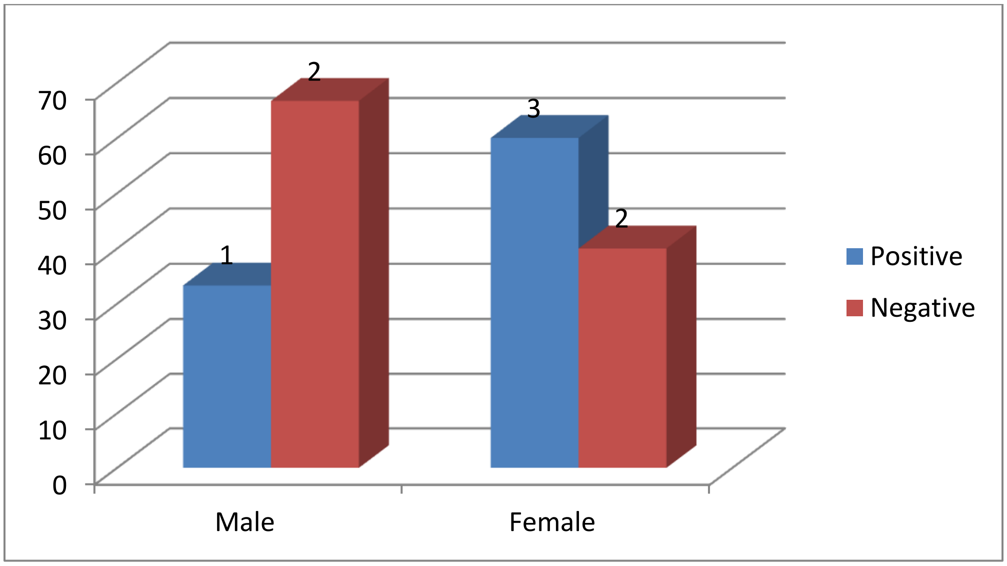


Figure 4. 1 Teachers’ views of the STEM project

Three female teachers and 1 male teacher praised the project as a worthwhile endeavor that could effectively address the challenge of the low uptake of STEM subjects. However, 2 male participants and 1 female participant had negative comments about the project. These results indicate that female teachers were not as skeptical and critical like the male teachers (more negative comments) because maybe they viewed the project as a good initiative to attract more female students into natural sciences. In this section, I examine three of the extracts. The extracts are long but necessary to help the reader get the depth of the interviews.

FT3: *Yes. I think its ok but the way it was started they were not considering the infrastructure in the schools because they were just saying take more students take more what we will pay for their school fees and stuff. But then now like in this school we don’t have enough classrooms for them but then now they are almost 30 something in one classroom. We don’t have enough apparatus to help them with but if they had started probably by first equipping the schools with the right apparatus the required apparatus the infrastructure and all that then we could start enrolling more students.*

Though the program is good but how it was implemented it's a bit difficult. Yes, it has like umm last year we had 15 students now they are 28. Yes, that is the school fees and levies only. I think it's the school fees only. Line 78-87.

The positives raised by FT3 are financial support for the disadvantaged and increased enrolment of natural sciences at A-level. The negatives include level at which the project was implemented and inadequate resources in the schools.

FT5: *Yah, I'm aware of the project and I think it's a good one. It encouraged a lot of students to participate so that in the end we have more in the field of science, more discoveries, lots of research and things like that. It's a good thing, it's a good initiative to encourage the natural sciences because previously the other thing why most students were not opting for sciences at advanced level was because some parents they had the upper hand, the moment that they heard about the STEM and the government initiative and support, most of them came as parents and say, we brought our children and we want them to pursue the sciences. So, to me it's a good initiative and it can take our country far. At least we have more inventors coming into being. The government pays their fees and I think it's enough for them because most of them what is a hindrance is their school fees, so the government pays the fees for every student who is taking sciences, so that's a good initiative.*

… *We are looking at our apparatus they are not enough for a large group. We are also looking at our groups they are now congested so you find out that it's a bit difficult to handle. You really enjoy a large number and at the same time we look at the resources, they are no longer balancing off with the number that we have.*

Mmm I don't think it's a good strategy I thought it was good if it was implemented even at primary so that students appreciate the natural sciences at a tender age and then they are groomed when they come to secondary. They should have a platform whereby we can award the best science student from form 1 going upwards so that we can groom them from the base, so that at A- level we are just moving on rather than just taking from the surface without building the base. I think we must build the base and then award the upper classes later.

Uh for the girl child I think it's a matter of just encouraging, so that they continue in there and maybe awarding them better than the boys to attract them into the system because if we have the same rewards with the boys, at times there isn't much to encourage the girls into the STEM system. So maybe there should be other rewards that encourage the girl child to be part of the STEM. Line 138-171.

The positive comments of FT5 include the fact that it is a good initiative, more students have been motivated to do natural sciences, the country will benefit having more inventors and scientists in the future and financial support given. She criticizes the implementation strategy used and describes it as bad. FT5 advocates that the project should have started at primary school level and not at A-level. The large numbers of students who chose the STEM subjects did not match the available infrastructure. . In her view affirmative action must be done to encourage more girls to embrace STEM.

MT2: *When you talk ehh I'm not sure are you referring to the funding part of it or maybe the concept behind. Looking at the…No! The concept is noble like you say science and technology is the backbone of the economy and almost every aspect of life, quality of life is determined by science. But maybe where they are starting they are focusing on A-Level students when now we have A Level graduates with good science passes at A Level who do not have the opportunity to go to university because they do not have funds. So, we are developing them at that level and throw them in the middle of the street. I'm sure they should be focused on those graduate science students from schools, maybe by funding them at universities and giving grants. I think it should be broad, affirmative action by what I understand you going to allow someone with an inferior qualification to do a certain course. I think it should be equal opportunity for everybody. If you want to help the girl child, let's make her competitive not lower standards for her to proceed. Maybe affirmative action on instruction or whatever so that they perform equally well they become competitive.* Line 151-170.

The interviewee MT2 regards the project as a noble idea but criticizes the level at which it is focused. He is also against the idea of affirmative action. In the three extracts, all teachers agreed that the project was a good idea. It had increased enrolment of science students from the onset. They differed on affirmative action. FT5 advocated affirmative action for the girl child which MT2 rejected. Affirmative action is a deliberate policy done by institutions or the government to give an individual or group of individuals an advantage over others socially, financially, economically or by any other forms as determined by the one exercising authority. Female teachers argued that girls should be allowed to do STEM subjects with lower entry points such symbol C and symbol A which is demanded by most schools and tertiary institutions. They also proposed that more financially support must be availed to the female than the male student. On the other side, the male teachers argued that selection must be based strictly on merit and discrimination should not be practiced in reverse. These are the indicators that the debate on the pros and cons of affirmative action may never have a consensus stand point of views. The other bone of contention was the implementation level. MT2's stance must be understood in the context that at the time when this study was conducted the government of Zimbabwe had stopped funding university education by way of loans or grants. Only those who could afford to pay the required fees or had private sponsorship undertook university education.

On the other hand, FT5 had a solid argument because primary education is the foundation of both secondary and tertiary education. A good investment at this level is most likely to reap rewarding dividends in the long term. The challenges of inadequate resources in the form of infrastructure and equipment coupled with increased enrolment may compromise the quality of teaching. The sentiments expressed by all the teachers who were interviewed seemed to suggest that not enough, if any consultations had been done with the teachers by government. Whatever the merits and demerits of the project are, from the look of things, it appears to be a step in the right direction. The implications of this project are that the study of STEM subjects by many students has wider ramifications for the social and economic development of Zimbabwe. Therefore, the government is advised to go back to the drawing table and consider the following recommendations from the teachers.

4.9 Teachers 'recommendations for a sustainable STEM project

- The government should put in place adequate resources, especially infrastructure in the form of well-equipped laboratories;

- The building of laboratories should be done first in the most disadvantaged rural and farming areas;
- The government is encouraged to adopt the community library concept whereby well-equipped laboratories are built at central schools and serve about five schools within the radius;
- The implementation of the project should start from primary school level up to university level. Primary schools can be equipped with basic portable science kits resembling the Zimbabwe Schools Science kit (ZimSci kit) of Zimbabwe Junior Certificate (ZJC) of the middle 1980s and;
- A comprehensive consultation exercise with all interested stakeholders including natural science teachers through their professional organisations must be done.

On my opinion the list of recommendations looks professional and constructive.

4.10 Conclusion

Interest in the subject emerged as the most important motivational factor for the choice of natural sciences in the Makonde district of Zimbabwe. . The importance of the subjects to the students' everyday lives after school was considered a top priority factor in opting to study STEM subjects.. More female than male participants prioritised social benefits as a factor of choice in studying natural sciences. Ability as a choice factor was almost evenly cited by both male and female participants. However, the school- based policy ability (SPA) factor was viewed as curtailing the freedom of choice by both students and teachers. Most students considered their career first before choosing a subject to study. Many of the respondents wanted a career within the medical field. Financial support through the STEM project and exposure to role models had an impact in influencing students to choose natural sciences. Overall both male and female respondents cited similar choice factors but differed in the importance of the choice factors. The STEM project was viewed as a good initiative by most of the teachers but was castigated for lack of strategic implementation because not much consultation had been done with most of the stakeholders. Chapter 4 analysed and discussed the results of research question 1 which focused on the factors that determine the choice of natural sciences by students. Eight factors were identified as summarised and thus the research objective was accomplished. The chapter ended with a discussion of the teachers' views of the STEM project. The next chapter 5 analyses and discusses the results of research question 2.

CHAPTER FIVE

5.0 Which factors contribute to the low choice and poor performance in natural sciences by female students and why?

5.1 Introduction

The presentation and analysis of the results of research question 1 was the focus of chapter 4. Research question 1 identified eight factors, namely, interest in the subject, social benefits, ability, school policy ability, career, funding, role models and stereotype beliefs. These factors were identified through the survey responses of 590 participants and through interviews of 8 teachers and 42 students in focus group discussions (FGDs). The chapter also explained the views and recommendations of the teachers about the STEM project.

The current chapter discusses and interprets the findings of research question 2 which sought to find out the factors that caused female students to do natural sciences in less numbers than male students. The research objective also sought to establish whether these factors contributed towards low performance in natural sciences by female students. The difference between research question 1 and research question 2 is that the first one focused itself on identifying the factors which students consider when opting to study natural sciences. The second question tried to establish the factors which caused gender disparities in the choice and performance of sciences by female students. I have explained this so that the outside reader appreciates the direction that was followed by the study. Research has shown that there is a decline in the uptake of science, technology, engineering and mathematics (STEM) subjects all over the world (Wang and Degol, 2013) It is even more worrying in the case of girls whose uptake in STEM is very low and the performance of the few is not as good as that of the boys in Zimbabwe (see Tables 1.4, 1.5 & 1.6). That modern world demands that economic and social development be spearheaded by a STEM literate citizenry and the importance of gender equality in the development cannot be over emphasized. Research question 2 explored the low performance in natural sciences by girls in Makonde District.

The rationale behind the research question was based on the statistical evidence as stated in the statement of the problem in section 1.6. The term performance in the study was defined as the observable and measurable behaviour within a specified period and is determined by a performance test (Simpson & Weiner, 1989). It was the academic performance of the students at O-level and A-level examinations written at the end of each cohort. According to Yusuf (2002), the academic performance of a student can be regarded as the observable and measurable behaviour of the student in a situation.. Frequency tables and bar graphs from both quantitative and qualitative data and some extracts from interviews are used in the presentation and analysis of the results.

Figure 5.1 indicates that two main internal and external factors which account for the low choice and poor performance in natural sciences by female students. The format of discussion considers first the internal factors focusing on the results from students and then teachers and ends with external factors.

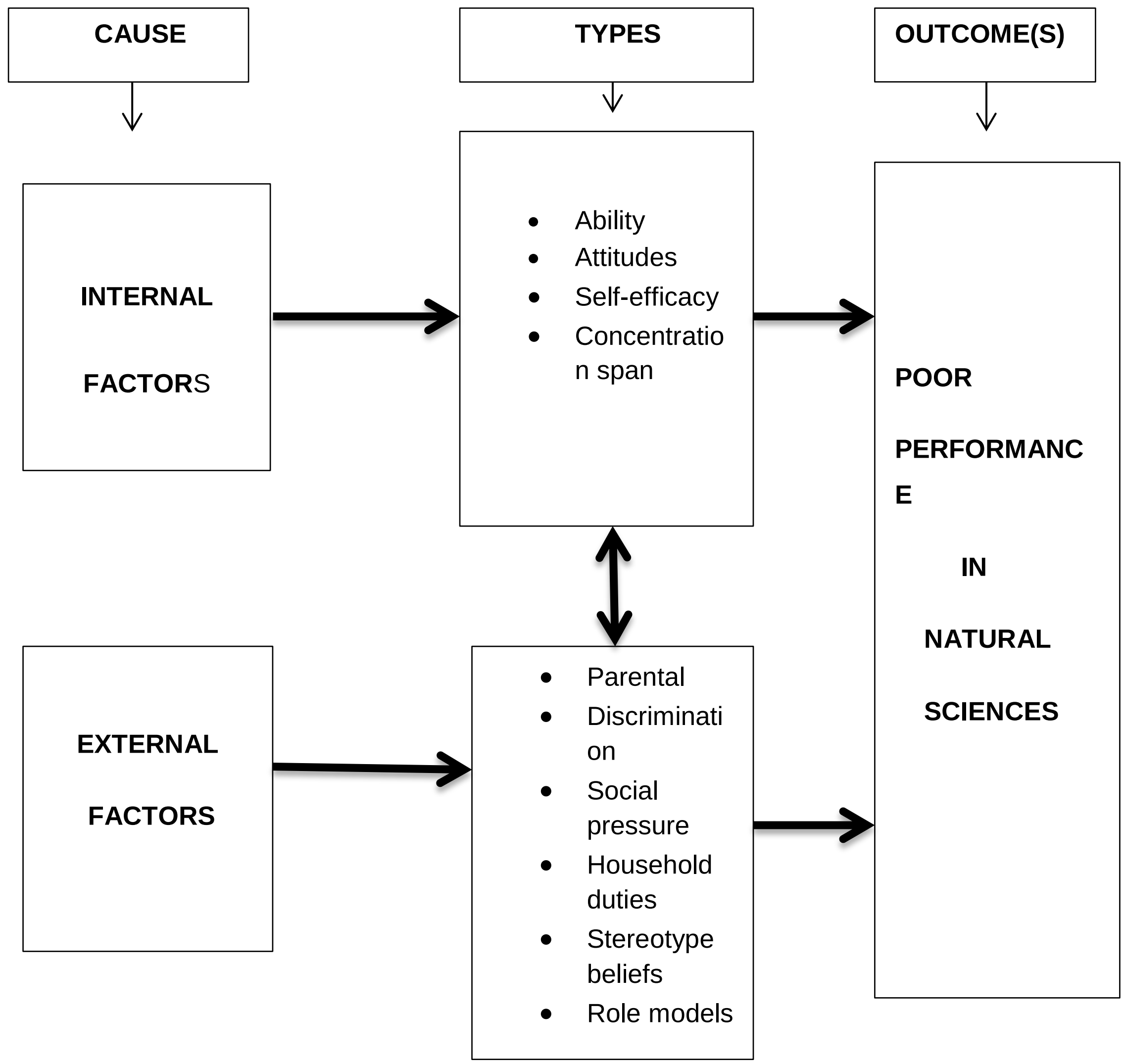


Figure 5. 1 A conceptual framework for poor performance reasons in natural sciences by female students.

5.2 Internal factors: Results from students

These are the micro-level factors within the MMI theoretical framework of this study. The behaviour of the female students is explained in the context of the social cognitive theory (SCT), as developed by Bandura (1986).

5.2.1 Ability

Table 5. 1 Perceptions of girls' ability in natural sciences N = 576

		Agree	Disagree	Total
Male	Count	184	159	343
	% within gender	53.6	46.4	100
Female	Count	49	184	233
	% within gender	21.0	79.0	100
Total	Count	233	343	576

Table 5.1 shows the results of item B6-1 of the questionnaire. The item reads: Girls are not as good as boys in natural sciences. The item is designed on the Likert scale type with four possible categories: agree, strongly agree, disagree and strongly disagree. The strongly part of the responses was finally combined with either agree or disagree as indicated in the table. The quantitative results given in Table 5.1 show that 184 (79%) of the female students believed very strongly that they were as able to do natural sciences just like the male students. The same number of male students (184) representing 54% did not agree with the female students on this issue. . A follow up with student interviews revealed a similar trend in the results, as shown in Figure 5.2. Thirteen male students out of eighteen who took part in the focus group discussions were still of the opinion that female students did not have same ability to do sciences like themselves. This was against the seventeen female students who argued that they had the same ability in sciences as the male students. A total of 30 students out of a possible 42 participated in the discussion on the ability to do natural sciences between boys and girls.

The consistence in the opinions of the male students from both quantitative and qualitative results seems to indicate deep rooted stereotype beliefs in male students. Upon further probing, female students were adamant that they had the ability to perform well in sciences but had to overcome other obstacles, as illustrated in Figure 5.2. Figure 5.2 shows the internal and external that were identified in this investigation.

Students N = 42: Female n = 24 & Male n = 18

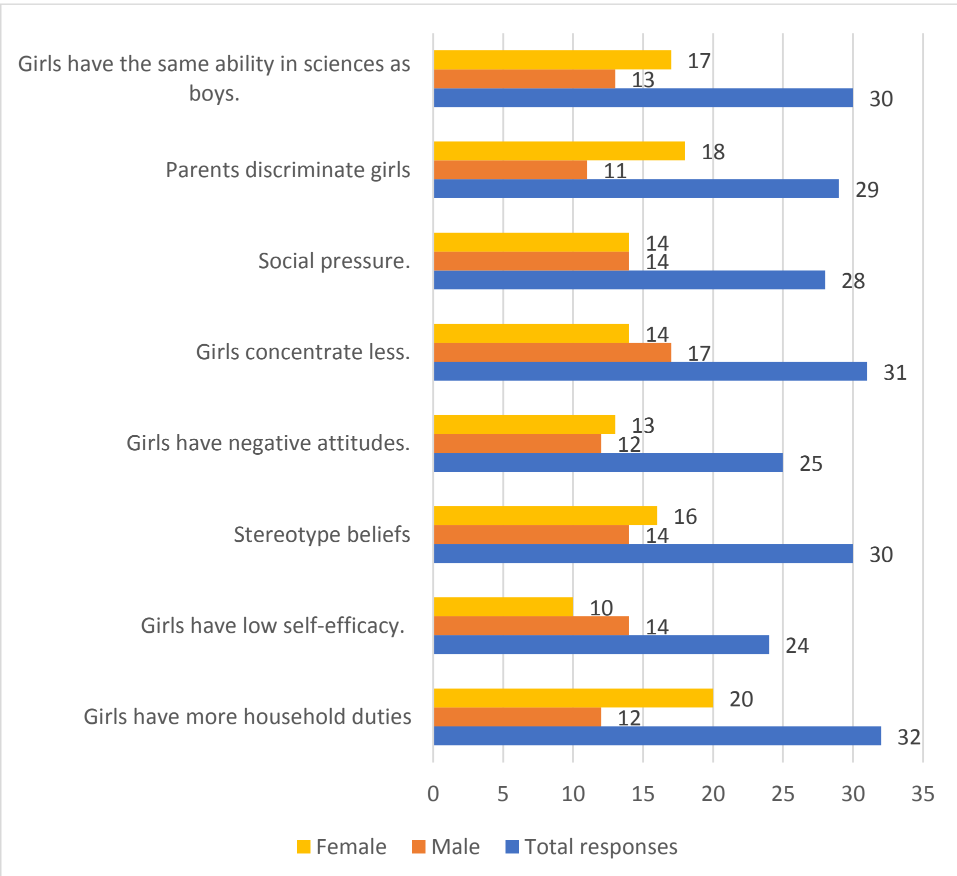


Figure 5. 2 Respondents by poor performance reasons

5.2.2 Attitudes towards natural sciences

To solicit for the participants' perceptions and understanding of a scientist, items B1 and B2 of the questionnaire asked the respondents to draw and describe their own scientist. The assumption of the items was that the perception of a scientist to a certain extent is an indicator of attitudes towards sciences and scientists. Figure 5.3 shows the results. Instead of drawing a picture of a human being, a variety of laboratory apparatus (beakers, test tubes and so forth) and textbook diagrams (evaporation experiment, ammeters and flowers) were drawn by 101 (19%) of the male students and 37 (7%) of the female students. This group of students displayed complete ignorance of what a scientist is by substituting human beings with equipment. More male students than female students are in this group perhaps due to their background upbringing where boys are usually bought toys related to structures and engineering disciplines than girls who are bought dolls in most cases.

N = 532: Male n = 351 & Female n = 181

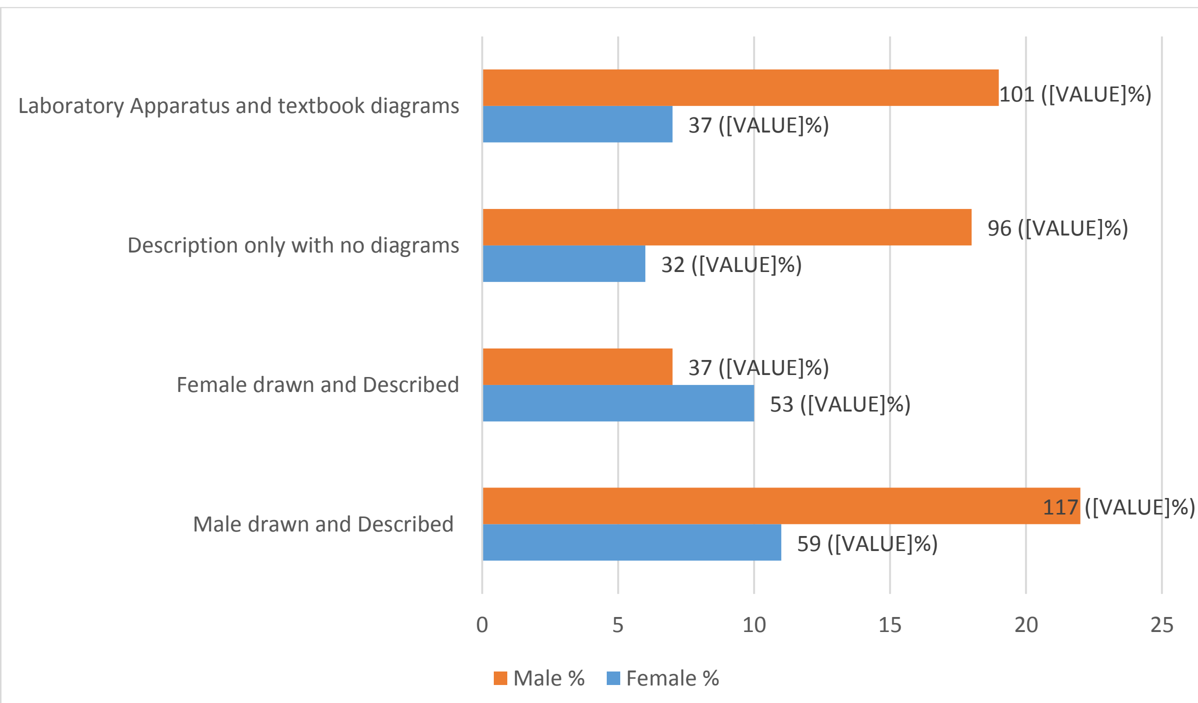


Figure 5. 3 Drawing and description of a scientist

Description only without diagrams was done by male students (96) representing 18% against (32) female students accounting for 6%. This is the group that was non-committed to the appearance of a scientist. The frequently used words to describe the scientist were visionary, genius, intelligent, clever, quick thinking, always experimenting and an intelligent quotient (IQ) of above 140. Names of famous scientists like Gregor Mendel, Charles Darwin, John Dalton, Isaac Newton and Faraday were often cited. The fact that there was no scientist of black origin mentioned reflects the curriculum design itself. Studies done by Chinyani (2007), Gudhlanga et al. (2012 and Chikunda (2014) established that the curriculum design of the Zimbabwe's education system was not gender responsive as reflected by textbooks and pedagogical approaches. A surprise perception was the description of science teachers as scientists by the students. This appeared to suggest a lack of role models in the true sense of a scientist to most of the students involved in this study.

The teachers were described using competence and behavioural characteristics. Examples included: (1) that he is a man, and is good in science subjects, helps me perform well and is polite and (2) she is very hardworking, helpful, understanding and patient. This is what Charles (not real name) wrote about scientists.

Charles: *These scientists are clever people who make rockets, build cars, and treat us when we are sick. I think only intelligent people do such things. They think of the future, but I think they are also not honest people because they make things that can kill others, steal from us using computers but hey their brains are powerful. Even here at school when you do science and maths everyone knows that you are a big engine. Our maths and science teachers tell us that we are the cream of the school and because we do subjects which require quick thinking and sharp minds and I think my science teacher is a great scientist.*

The perception and description of a scientist by Charles was amazing and displayed a lot of knowledge about the attributes of a scientist and the contributions done to society by scientists. Charles is also critical about how scientists can use their knowledge and skills to destroy society and he takes pride in doing the sciences. He drew a male scientist. The finding perhaps helps explain Mutekwe et al. (2013)'s study which found that the social construction of gender through the hidden culture curriculum and pedagogy both at school and at home encourages the male than the female child to be in control and dominant.

Figure 5.3 displays that 117 male participants (22%) drew and described a scientist as a male against 37 (7%) who perceived a scientist as a female. Results shown in Figure 5.3 indicate that 53 (10%) against 59 (11%) female students drew and described a scientist as a female and male, respectively. These findings seemed to suggest that female students did not perceive a scientist along gender lines as evidenced by difference of 1% between those who drew and described a female and male scientist. On the other hand, male students appear to have been influenced by gender in the drawing and description of a scientist as revealed by a large difference in the numbers of male participants who opted for both male or female drawing and description. Studies done by Else-Quest and Grabe (2012) on mathematics and science attitudes and Ganley and Vasilyeva (2011) on sex differences in relation between mathematics and science performance and attitudes concluded that attitudes to STEM may be critical to women's underrepresentation and performance because girls tend to hold more negative attitudes relative to boys. My results partially agree with the findings of previous studies mentioned above. . Table 5.1 shows the results of the survey. The numbers in brackets represent the number of participants who responded to the item.

Table 5. 2 Participants by attitudes - Quantitative results N= 590

Item No.	**Item description**	**Male**			**Female**			**Total**
		Agree	Disagree	N	Agree	Disagree	n	N
4	Natural science subjects are difficult.	26.6% (86)	73.4% (239)	325	22.8% (53)	77.2% (180)	233	558
6	I do not like reading natural sciences.	8.1% (28)	91.9% (316)	344	10.2% (24)	89.8% (212)	236	580
7	I will not use natural sciences in many ways in my adult life.	15.0% (51)	85.0% (290)	341	11.5% (27)	88.5% (208)	235	576
13	Knowledge of science does not help me to protect the environment.	10.6% (36)	89.4% (305)	341	5.2% (12)	94.8% (219)	231	572
14	Science does not open for me many opportunities in life after school.	7.9% (27)	92.1% (313)	340	5.2% (12)	94.8% (220)	232	572

The results of items 4 and 6 indicate that the female students 180 (77%) had a slight edge of positive attitudes towards natural sciences than the male students 239 (73%). But in items 7, 13 and 14 most of the male and female respondents were of the opinions that sciences benefited them in life. The responses to items 7, 13 and 14 agree with the findings of research question 1 in section 4.2 on social benefits.

Results of section 4.2 showed that the majority of students valued the social benefits associated with the subject. Interview results of figure 5.2 confirm that an almost equal number of male participants (12) and female participants (13) believed that girls' negative attitudes towards natural sciences contributed to their low performance in the subject. This what some of the respondents said on attitudes:

FGD3: RF2: *It's because ummh many girls have just this feeling that science subjects they are difficult and that girls usually they tell themselves that they are inferior to boys as a result you find there are fewer girls doing these subjects, Maths, Physics, Biology and Chemistry because they are afraid.* Line 30-33.

RF2 talks of a feeling that sciences are difficult and of girls viewing themselves as inferior to boys and fear. These observations reflect negative attitudes which may discourage the female students from choosing natural sciences or may hinder good performance in these subjects.

FGD3: RM17: *Well bringing back the issue of household chores (laughing), okay basically the girls give themselves excuses so because of that they get this negative attitude, no I can't do this, I can't do this if you get what I mean, they just makeup excuses, they get negative.* Line 103-106.

RM17 is somehow sarcastic in his comments as reflected by the laughing when he talks of household chores and excuses given by the girls. To him, the issue of household duties as a factor that works against girls in doing well in natural sciences is not the problem. He believes that girls basically have negative attitude problems towards sciences and the other reasons which were mentioned by the female students were just scape goats. The views of RF2 are a reflection of the cognitive factors component of the

Social Cognitive Theory of Bandura (1986) in which attitudes are part of the determinants of human behaviour.

FGD4: RF5: *I think most girls lack perseverance and only a few of them are taking science subjects, when it comes to boys they encourage each other among them, they give each other strength, when they want to do something they do it with passion like sciences. I know from some of my classmates, the guys, they work together in achieving something and once they commit to something they make sure they work hard to achieve it, that is quite different with us girls, some girls they are even proud, they are like they want to work on their own and some they even discourage each other, they are like ahh I can't do this and so they just give up just like that, we lack the perseverance in us. Our attitudes pull us down.* Line 79-87.

Views of RF5 seem to suggest that girls easily give up and do not support each other due to negative attitudes towards each other and the subject. This impact negatively on their performance on the subject. These results confirm Bennett and Hogarth's (2009) observation that girls exhibited greater negative attitudes towards school science and out of school science as compared to boys aged 12 and at high schools onwards. Lau and Chan's (2001) study affirmed that, generally, poor achievers who do not believe that they can achieve, spend minimum effort in studying and easily give up when faced with difficult challenges.

FGD2: RM13: *If girls concentrate on their books more and less on socializing, they have the potential to perform well just like the boys.* Line 228 -229.

The above observations by RM13 corroborate the findings of the Organisation for Economic Cooperation and Development (Co-operation & Development, 2010) in The Guardian Online. The OECD indicated that gender disparities in performance do not stem from innate differences in aptitude, but rather from the students' attitudes towards learning and their behaviour in school, from how they choose to spend their leisure time and from the confidence they have.

5.2.3 Self-efficacy (SE)

SE influences perceived scope of viable educational and career choices (MacPhee, Farro, & Canetto, 2013; Saucerman & Vasquez, 2014; Smeding, 2012).

N = 558: Female n = 233 & Male n = 325

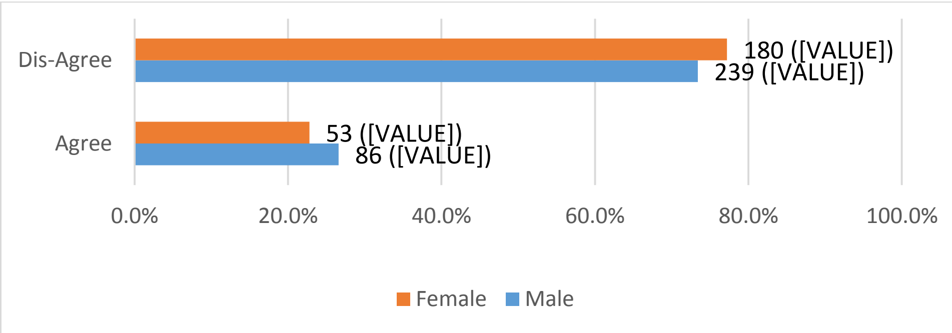


Figure 5. 4 Natural science subjects are difficult.

Of the 325 male students who participated, 86 (27%) agreed that science subjects were difficult, whereas among the 233 female students who participated, only 53 (23%) agreed that science subjects were difficult. These results align with the interview results in which out of 24 female students who were asked this question verbally, only 10 agreed that female students had low self-efficacy (cf. Figure 5.2). This shows that girls have a positive image of their ability to take on natural sciences.

A possible explanation could be that the gender equality programmes done through print, broadcast and social platforms could be influencing a change in cultural stereotype beliefs of the girl-child. Ochse's (2003) study with 645 UNISA students on students' self-perceptions, their expectations and academic achievement found out that a positive self-concept does not always translate into high achievement. Perhaps low self-efficacy does not always translate into academic achievement. The following selected extracts expose the views of the participants.

FGD 2: RF16: *Girls are as good as boys but just that girls are not getting enough time to study like boys do. Us girls when we get home we first do housework, boys just get home and change their clothes, at times their laundry is done by the maid. Girls by the* *time they wash the dishes and when you are done you dry the dishes as well you would be so tired and cannot study anymore.* Line 264 – 268.

The views of interviewee RF16 dismisses the notion that science is difficult to girls but apportions the blame to extra household duties and the lack of adequate time to study.

FGD1: RF12: *The way I see it physical science is not difficult but just because of fear people are told that it's difficult and they say they can't do it but girls they can manage physical science, that's what I think.* Line 270 – 273.

RF12 argues that the subject is not difficult but concedes that low efficacy affects girls when she mentions 'fear'. The findings suggested that the self-efficacy of the girls was high, and this somehow contradicted the earlier findings (Ceci et al., 2009; MacPhee et al., 2013; Stuckey et al., 2013) which demonstrated that girls perceived their academic SE lower in comparison to equally-abled boys particularly in STEM domains. However, they agreed with the findings of Christensen et al. (2014) who found that females were significantly more positive than males in semantic perceptions of STEM.

According to Saucerman and Vasquez (2014), the mindset, of an individual's belief about the nature of intelligence and academic ability, play a stronger role in girls STEM participation than in early childhood. The girls in this study whose ages for most of them ranged between 15 and 18 years displayed strong habits of mind confirming the observations of (Saucerman & Vasquez, 2014). The high SE of the girls in the study appear to provide an explanation to the findings of study done by Shepherd(2017). In her study on gender, self-concept and mathematics and science performance of South African grade 9 students, Shepherd (2017) established that grade 9 girls in the poorest 80% of the schools experienced no difference in domain specific performance, self-concept and motivation. The same study revealed that girls from the wealthiest subset of schools significantly underperformed both in mathematics and science, possessed lower self-concept, motivation and displayed higher anxiety. Most of the girls who participated in this study came from poor sections of the Makonde District.

5.2.4 Concentration span

Lack of concentration was given as one of the reasons why females performed poorly in natural sciences as opposed to males. This observation was made by 17 males and 14 females. The following two extracts highlight this issue.

FGD1: RM13: *I observed that boys tend to be better than girls because girls tend to concentrate less than boys. Boys are more powerful than girls.* Line 276-278.

Perhaps the observations of RM13 were true to some extent because even the girls themselves agreed that they found it difficult to concentrate after doing a lot of extra household duties. It is the reason given by the male student which seemed opinionated and stereotyped. The term: “more powerful” could have meant, stronger physically, perseverance, more able in science or anything as perceived by the male student.

FGD2: RF5*:* *First I would like to say that parents should not be too strict with us girls, there are things we are quick to reason about if we help each other but if we are told to read at home, understanding is not quick or if you are told to go to your friend’s place or you are told to invite your friend, at times you end up being asked why your friend doesn’t come to your place? Visiting each other’s homes and helping each other is very important. We want more time to study and concentrate instead of doing too many duties. It is difficult to concentrate if you are tired.* Line 152-158.

Girls argued that they had the same capacity to concentrate on their school work if they were treated fairly like the boys and less burdened with household duties. Some of the reasons why girls at non-boarding schools find it difficult to concentrate are articulated in the views of RF5. Most of the girls who go to boarding schools perform just as good as the boys and those who go to mono-sex schools do even much better. In 2014, according to the ZIMSEC O-level results report, there were four (girls-only) secondary schools in the top ten among the top 100 schools of Zimbabwe as reported by The Herald Online. All the four secondary schools were boarding schools. It is assumed that at boarding schools the girls have more time to concentrate on their school work without much disturbance from household chores and adolescent peer pressure from boys associated with co-education schools.

5.3 External factors

These are the macro-level and institutional factors considered within the MMI theoretical framework of this study. The factors explain the gendered patterns in the choice and performance of natural sciences by students from the lens of modernization, socialization, gender and development theories.

Table 5. 3 Students (external factors)- Quantitative results N= 576

Factor	Male %	Female %
Parental discrimination	68.3	80.0
Social pressure	36.8	61.2
Household duties	68.7	78.1
Stereotype beliefs	44.0	55.0
Role models	52.3	51.9

5.3.1 Parental discrimination

Gender-biased parental upbringing and treatment of the girl child impacts negatively on her choice of school subjects, career and the related fields (Gunderson et al., 2012). In Figure 5.3 18 out of the 24 girls who participated believed that parental discrimination contributed to the low choice and poor performance in natural sciences by the female students. These views were supported by 11 boys out of 18 who took part in the interviews. Table 5.3 shows that more female students (80%) than male students (68%) believed that parental discrimination contributed to low choice and poor performance in natural sciences by female students. The over fifty percent overall agreement by both female and male participants on this factor indicates its significant contribution to the problem. Both quantitative and qualitative results show a consistent pattern that validates the instruments employed in the study.

FGD1: RF6: *I want to talk about the issue concerning our parents. Most boys can be allowed to study at the library at school, studying in groups and can even spend a week* *away from home while studying without getting involved in any mischief but with us girls if I were to ask for permission to go for group studies my parents would refuse so I just end up studying by myself. Some concepts are difficult to grasp, and some require group discussions.* Line 210-215.

The views of RF6 epitomize a situation where parents, in a bid to protect the girl child, infringe on her rights on freedom of association and thereby compromise the ability of the students to study freely and consultatively.

FGD2: RF2: *Parents don't trust girls to go and have group discussions away from home citing mischief. School home works are many, some easier to do alone but others require group discussions with friends. Girls are denied this chance. There are other situations where you are given lots of homework and when you get home there will be a lot of work like washing the dishes, sweeping the house, cooking and fetching water.* Line 111-116.

RF2 was very blunt with her opinions that parents have no trust in the girl child and often think that the female students misbehave when studying away from home. She also complains of heavy workload at home giving her little space to study. Why parents are skeptical about the ability of the girl child to be responsible when away from home is difficult to understand other than to explain the behaviour of the parents in terms of societal attitudes. Most societies view women as vulnerable species that require protection from the male species.

FGD2: RF17: *I think girls have as much potential as boys, but some are disturbed by love relationships, but the other issue is of parents. Girls need empowerment that was mentioned earlier we girls need encouragement on the importance of sciences but then there is lack of trust from our parents. They don't really trust us, they think when girls mature they start engaging in relationships, they don't trust us, they won't allow us, you would hear a boy child saying they are having a sleepover at a friend's place reading and having discussions but if a girl child says the same the parents would start talking of mischief. We are not allowed sleepovers and at school I will not find the time for discussions as we might be occupied most of the time. We come from different families'* *maybe I am the only child. I must first do housework, so we need empowerment.* Line 281-291.

RF17 summarized the views said by most female participants concerning parental discrimination. Four issues were raised in the interview, namely, lack of empowerment, lack of support in the form of encouragement, lack of trust and household chores. It appears like the girl is accusing parents of selective upbringing and treatment between boys and girls. She also conceded that love relationships do affect girls' performance.

The results of the study agree with the research findings of (Gunderson et al., 2012; Simpkins et al., 2012; Tomasetto et al., 2011) that proposed that parental beliefs have a great impact on the child's beliefs since the parents are the first educators of the child. Why parents discriminate against their own girl child and the lack of trust from parents may emanate from their cultural beliefs. Zimbabwe is heavily a patriarchal society and women are viewed as not being able to economically and socially stand on their own (Swainson, 1995; Leach et al., 2003). Somehow, there is this thinking or belief that a man's advice and support is indispensable to a woman's life. Most parents do not think that their girl child can make informed independent decisions with regards to love relationships. Modern society and technology has done very little to change the mind set of parents when it comes to the distribution of household chores (Bhusumane, 1993; Chipunza, 2003; Masanja, 2004). The girl child is over burdened with work and the argument is that she is being prepared for a future wife's roles. The heavy work load takes its toll in terms of time management and concentration. The way the girls are treated both at school and at home affect their school performance.

The sad reality is that the girls were aware that parents discriminate against them as revealed by the observations above. Parents value male children more than female children (Gordon, 1998; Leach et al., 2003). The lack of trust and motivation to the girls from parents is discriminatory and disempowers them academically and hence it hurts their self-ego resulting in poor performance. The views expressed by the girls are in tandem with the findings of the study done by (Jeynes, 2010) who advanced that parental expectations, the quality of parent-child communication and the parental style may be more highly related to student achievement than the various more overt expressions of involvement. A close friend of mine once said the following remark concerning her daughter; “My girl is like a boy. She has done very well in her mathematics and natural science test.” On the surface the statement appears a good compliment but deep down it smacks of regret. He wished the daughter was a son. It shows lack of trust in the girl’s ability in these subjects hence it is discriminatory and demotivating. Girls were also aware of what should be done to do well in natural sciences but felt powerless to effect any change in the mindsets of the parents. These views of the girls resonated well with (Wang & Holcombe, 2010) who asserted that students feel more confident about their ability in mathematics activities when they work with others than when they work on their own due to the greater array of resources at their disposal. Household chores were among the other reasons that militate against good performance in natural sciences by the girls and are the focus of the next discussion.

5.3.2 Household duties

Both the home and the school environment influence students’ achievement especially when gender is used as a management tool for daily organisational procedures (Scott & Morrison, 2005). Household chores were cited by 20 female students and 12 male students in figure 5.3 as a reason for the poor performance in natural sciences by girls. The quantitative results of table 5.3 indicate that 78% and 69% female and male students respectively believed household duties disadvantaged the female students to achieve highly in natural sciences. These results confirm the findings of Leach et al. (2003) which ascertained that both at home and school, pupils were strongly encouraged to conform to stereotype gender roles and norms. In this regard, both teachers and parents do not see anything wrong in overburdening the girl-child with household chores as expected in a patriarchal culture. Views from the male students on parental discrimination and household duties were represented by lower numbers than those of the female students suggesting that more male respondents harboured some misgivings on the role played by these factors. The following quotes from the students’ interviews testify to that effect.

FGD3: RM12: *If you check the chores that are done by the males right, mostly the garden stuff, its hard work, it requires energy and stuff so if you are a guy doing those jobs let's say today you might be doing it for 2 hours, after those 2 hours you will be tired, you will go to sleep of which the female she might work for 5 hours, washing plates, sweeping the house and it would require that much of energy, less than the guy if you get where I'm coming from, (laughing).* Line70-75

RM12 agrees that household duties done by girls demand more time and energy than the ones done by the boys and this affect their studies.

FGD4: RF9: *Girls I don't think we are treated the same as boys because you at home, we are the ones who do the cooking, washing and the boys at most they are sleeping so the time we are supposed to be reading, I will be doing the house chores, so I don't think we are treated the same. At school we can be treated the same but as I can see most science subjects are being taught by male teachers so as girls we don't feel free to ask those teachers.* Line 119-124.

The message is very clear from both the male and the female respondents that household chores are a burden to the girl child which impacted her performance in school. RF9 raises the idea of being treated similarly at school but not at home. This view supports the issue of parental discrimination discussed above. According to the Gender and Development Theory (GAD) as articulated by Connelly et al. (2000) women are not judged by their individual characteristic identities but by their gendered activities. She also said that she is not comfortable being taught natural sciences by a male teacher because her freedom to ask is limited. This opinion seems to suggest that females do not enjoy freedom of expression when communicating with males. These opinions are discussed under the section on learning experiences in chapter 6.

5.3.3 Social pressure

The other frequently cited reason for poor performance was what the girls termed 'social pressure'. The pressure manifested itself in various forms for example peers expected them to be more feminine and desist from behaving like tom boys by opting to do STEM subjects and to get involved in love relationships. Girls conceded that they take love relationships seriously at this stage and this distracted them from school work and it's a social pressure they find difficult to resist. Peer friendships are associated with both pro-social and anti-social behaviour (Juvonen et al., 2011). Peers with a pro-social behaviour do well and are highly self-motivated in math and science (Kessels, 2005). The opposite may be true for the other group. May be the girls in this study were more subjected to anti-social behaviour groups. The impact of social pressure on the performance of natural sciences was more on female students (61%) than on male students (37%), as displayed in Table 5.3. The difference on the impact of social pressure between boys and girls may best be understood from a cultural context. The cultural norms and values of the patriarchal society where these participants came from expect the boy child to endure pain and suffer in silence than it does with the girl chid. *Mukomana haangochemi pose pose* (a boy should not cry easily regardless of the intensity of the pain being felt). Whilst the margin of difference of perceptions was large in the survey, an equal number of both male and female students (14) each in Figure 5.3 acknowledged that social pressure had a greater negative impact on the girls' performance in natural sciences than it had on the boys. This was a surprising result were both male and female participants had the same perceptions on the factor. A plausible explanation is that the male students are part of the matrix of the environment linked to this factor. The following extracts reveal some of the opinions of the respondents.

FGD1: RF9: *Okay, I would like to emphasize on the issue of the fact that girls are not much better than boys in terms of natural science, I think since natural science needs more concentration most of the girls usually during this adolescence stage, most of the girls lose concentration for school work so natural science it seems as if natural science is much more difficult, much more challenging to girls but according to me natural science is just a subject that needs a lot concentration so girls due to peer pressure that we experience during the adolescence stage we find that the subject at the end will appear as hard or difficult, it's not(laughing), for example at our own stage now teenagers, we are falling in love, we are now being asked out (laughing), its the truth guys, boys are now proposing love to girls instead of concentrating on your books* *sometimes when the teacher is explaining on the board you are thinking of someone, yesterday he told me he loves me so much.* Line 233-247.

The female respondent acknowledges that natural sciences require a lot of concentration which most girls do not have due to adolescent peer pressure in particular love relationships. These results demonstrates the findings and explanations of Bussey and Bandura (1999)'s social cognitive theory of gender development and differentiation. The theory argues that males and females socially and cognitively develop at different rates with females experiencing more social pressure than males at puberty stages due to a lot of hormonal changes.

FGD2: RM14: *I think it has to do with peer pressure. Most of the girls like good life like celebrities and end up dating sugar daddies so that they are bought nice things. They admire their friends who receive lots of gifts from the boy friends and this affects their performance.* Line 237-230.

RM14 put the blame on older men who fall in love with young girls and spoil the girls with gifts and most likely demand more time with the girls at the detriment of their education.

FGD2: RF15: *I think girls when they are young their brains are quite sharp because they would not have started* being *proposed by boys. Especially us girls the moment we are proposed by a boy and being told that you are beautiful and all the sweet nothings, you will be head over heels. It will now be difficult to handle science subjects as they require a lot of concentration and hard work. When you are in a relationship all you will be thinking about is your boyfriend that is what disturbs us as girls.* Line 251-257.

The respondent is of the opinion that physiological changes put pressure on the concentration of girls with regards to school work.

FGD1: RM14: *Physical science is not difficult for everyone whether girls or boys, but the problem Is the issue of relationships, in the afternoon we boys would be sending messages to girls but when it's time to read, we really take it seriously but with girls they* *tend to put more seriousness on those messages sent by their boyfriends and end up losing focus, so at times that is what reduces the girl's performance.* Line 286-291.

The impact of social pressure on the girls was felt through their loss or lack of concentration with school work. This resulted in poor performance in the natural sciences and other subjects. However, the participants in the study reiterated that natural sciences demanded focused attention and concentration if one was to do well in the subjects. Most of the girls seemed to lack this attribute. Factors that contributed towards lack or loss of concentration that came out of the data are:

- Love relationships. Girls at this stage of adolescence were alleged to take love seriously and emotionally but the boys considered the love relationships as male conquering games. The boys did not attach any serious emotions to the relationships (RF9, RF15 & FGD1:RM14).

- Materialistic desires. The desire to live the lives of celebrities forced them to indulge in anti-social behaviour like prostitution and dating sugar daddies that would provide them with what they wanted. The girls succumbed to the pressure from other girls to have a sugar daddy or boyfriend.

- Biological changes. Sudden changes within their bodies pile a lot pressure on the girls to such an extent that if counseling is not given timeously their performance in school work is greatly compromised.

These findings corroborate Bursztyn and Jensen's(2015) argument that students were highly responsive to who their peers were and what the prevailing norm was when decisions were made. In a study done in the USA on the effect of peer and parental pressure on academic achievement of university students in India, (Akhtar & Aziz, 2011) concluded that parental pressure effected positively, and peer pressure effected negatively the academic achievement of female students. The results also showed no effect of pressure on male students. The findings of Akhtar and Aziz (2011) are inconsistent with the results of this study were parents effected negative pressure to the female students through household duties and freedom of movement. The other common reason given for poor performance was the impact of stereotype beliefs which is discussed in the next section.

5.3.4 Stereotype beliefs

The impact of stereotype beliefs on the performance of students in natural sciences was supported by 16 female and 14 male students during interviews (Figure 5.2). This trend of results resonated well with the 55% and 44% female and male students, respectively, as shown by the results of Table 5.3 of the quantitative phase. Girls who had very strong stereotyped cultural beliefs believed that they could not perform well in natural sciences because it was a male designated area. The girls acknowledged that they had embraced these beliefs because they are daily and constantly reminded by both the community and some of their teachers that STEM subjects are for males because their brains are more powerful than the female ones. Miyake et al. (2010) posit that if a student's social identity is erected negatively, the student will be liable to underachieve in a way that is consistent with the stereotype. Fogliati and Bussey (2013) found out that stereotypical negative comments made in class by teachers had more effect on the female's performance in mathematics and science than males. It seemed the girls of Makonde District experienced the same gender disparities.

The different treatment of girls from boys at home was largely attributed to cultural beliefs based on gender roles. The girls were somehow overprotected and oppressed as they were not afforded enough space to determine their own destiny. The spill over effects was reflected in the poor performance in natural sciences by the girls. This is what the interviewees said on the impact of gender-biased cultural beliefs as a reason for the poor performance in natural sciences.

FGD3: RM11: *The female, the girl, well we said due to the cultural beliefs and stuff that the girl is supposed to be doing the household chores and stuff like that so at home I wouldn't expect my dad to call me to come wash the plates, I would expect him to say go do the garden, go wash the car so we classify ourselves according to the chores we are expected to be doing.* Line 65-69.

The boy, from the tone of his response, was cognisant of the cultural expectations of his roles and sounded happy with the status quo. Probably it's a question of retaining those beliefs that gives you an advantage and discarding those which do not. Nevertheless, 14 out of 18 boys interviewed agreed that stereotype beliefs were an obstacle to good performance in natural sciences by the girls.

FGD1: RF3: *I don't agree with the point that one can get tired from washing dishes or sweeping the house because we are responsible to those chores, those small tasks because there is no way the father of the house would wash the dishes. What is important is time management, there is no way you will wash the dishes for 2 hours, you can wash the dishes in 30 minutes then start cooking, by 8 you would be done, there is no way you will read whilst people are watching TV and then you start reading after that.* Line 184-190.

RF3's response, to a certain extent, surprised the interviewer. The girl confidently endorsed and exonerated cultural beliefs as the cause of poor performance in natural science by girls. She blamed the girls for lacking time management. The "father" of the house being referred to is a boy. It is not surprising because right from birth, the Shona culture dictates that a boy child be accorded the status of a father (baba vomusha). The girl was only exhibiting the ingrained Shona culture in her. This kind of behaviour was affirmed by Campbell Leaper et al.'s (2012) findings which indicated that that girls who socialized with peers or social groups with a strong gender identity perpetuated stereotypes about those who maintained gender roles and those who challenged them. Indeed, this is true the interviewee only expressed what she thought was acceptable femininity cultural expectations.

Proctor and Phimister (1995) notes,

> The division of labour between men and women that had begun in gatherer societies developed into a relationship of inequality in settled farming communities. The association of women with domestic work had become a firmly established tradition…Women and children grew most of the crops and cooked the food, but they did not have many rights (Proctor & Phimister, 1995, p. 11)

Therefore, historically the current gender disparities in Zimbabwe date back to the Early Iron Age. Why they are still persistent in the modern Zimbabwe is perhaps best understood in the context of the Path Dependence Theory (PDT). According to Mahoney (2000), PDT constitutes self-reinforcing sequences characterized by the formation and long-term reproduction of given institutional patterns. What has happened at earlier point in time will affect the possible outcomes of a sequence of events occurring at a later point in time (Sewell, 1996). Therefore, the past influences the present. The cultural beliefs of the participants in the study were influenced by the past cultural beliefs despite them living in the present. Old habits or practices die hard. According to Chikunda (2014) and Mutekwe and Mutekwe (2012), teachers often blame girls' acceptance of domestic roles as their primary responsibility and the belief that a man should be the provider and head of family as the major causes of the gender performance gaps.

The findings highlight the challenges faced by both the educationists and gender activists in trying to fight and narrow the gender-disparity gaps created by cultural beliefs. Role models were also cited as one of the reasons that influence performance in natural sciences.

5.3.5 Role models

A role model is someone who influences a student with critical information either directly through conversations for example in classrooms through teaching and parent-child talk or indirectly through admiration of the life styles. Role models normally inspire students to perform better in school.. Table 5.3 indicates 52.3% of male and 51.9% of female respondents believed that role models contributed towards performance of the subject. There were 12 out of 18 of the male interviewees and 15 out of 24 of the female interviewees respectively who believed that the presence or lack of role models was a strong enough reason to explain the performance of girls in natural sciences table 4.1. This is what some of the respondents said:

FGD2: RF11: *Girls have the potential to do well in physical sciences but lack empowerment in the form of motivation.* Line 217-219.

Motivation comes from various sources like peers, teachers, parents and role models. The interviewee was referring to role models.

FGD4: RM7: …*Point 2 is they have few role models, if you take a closer look, a random sample in our communities you find a very few number of girls or women who have achieved in life because they are the few who have endured to the top and by having a few role models in society, you see that the proportion is very different in favor to boys, they don't have role models.* Line 99-104.

These findings seem to suggest that the presence of few female role models in STEM related careers in Makonde District contributed to the girls' poor performance in natural science. Even the school environment itself bore testimony to the shortage of female role models as will be discussed in chapter 7. Findings revealed that the number of female science teachers was less than half the number of male teachers (13/28) in all the 5 schools which were involved in the study and exposed a shortage of female science teachers' role models. These results are affirmed by the study done by (Hill, Corbett, & St Rose, 2010) in USA on why there were few women in STEM. The lack of role models influenced women not to pursue STEM subjects and careers and influenced the performance of those already doing the subjects. The above analysis and discussion focused itself on the quantitative and qualitative results of the students. The shift now focuses on the results of the interviews of the teachers. Teachers' views were important to this study because of the roles they play in teaching different students every given cycle. Their observations, experiences and perceptions add trustworthiness to the results of this study when triangulated with the students' results.

5.4 Teachers' reasons on female students' low choice and poor performance in natural sciences.

The results of what the teachers said when asked what they perceived to be the factors which contributed to the low choice and poor performance in natural sciences by female students are indicated in figure 5.5. The interviewees identified seven factors which they perceived were the major reasons for the poor performance of natural sciences by the female students. The factors comprise both internal and external factors.

5.4.1 Stereotype beliefs

Figure 5.5 shows that seven main factors emerged from the interviews. These were stereotype beliefs, self-efficacy, role models, attitudes, parental discrimination, social pressure and household duties. Four out of a possible five female teachers against two out of three male teachers attributed good performance in natural sciences to gender stereotyping beliefs associated with the subjects. The greater representation of female teachers is suggestive of the fact that the effect of stereotype type beliefs on performance of natural sciences might have affected them during their schooling days. Similar views and trends of responses were exhibited by female students during interviews as explained under section 5.2.4.

N = 8: Female n = 5 & Male n = 3

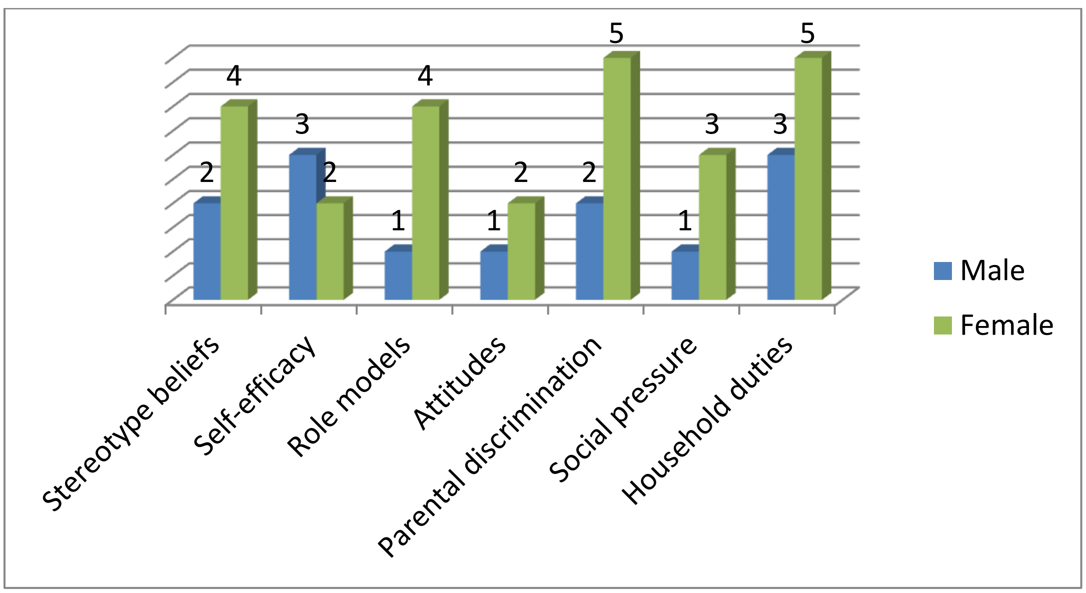


Figure 5. 5 Performance reasons- Teacher interviews

The following quotes show some of the responses from the teachers.

FT1: …*Then the other thing when a student wants to take up physics for example if it's a girl, usually teachers tend to talk more to her trying to really establish if she really wants to do physics. For boys it's easy if they get an A in physical science, they want to do physics but if it's a girl usually people are, a lot of attention is drawn when a girl picks* *science. Even for example at this school it's usually one girl, two girls, maybe three does physics. So, when a girl makes such a choice teacher might want to check, are you sure you are making this choice, physics is quite tough it's for the boys if it's your choice, its ok you know. So those are some of the comments.* Line 117-124.

The impression derived from this interview is that when a male child decides to pursue natural sciences it is granted that it is his choice but if a female child does the same decision then she must be interrogated thoroughly before being allowed to make the choice. These and many other stereotype beliefs thrive in schools but most of the times are unnoticed by the public. Teachers play double pronged roles as parents and classroom teachers which therefore imply that the girl child is disadvantaged in both environments. The gender-biased beliefs of the teachers compromise their objective treatment of the girls and thereby influence the performance of the girl child in the natural sciences. A study done by Ing (2014) revealed that parental influence particularly mother's gendered beliefs was associated with science and mathematics academic achievement and persistence. Ing (2014) results corroborated the earlier findings of Furnham, Pallangyo, and Gunter (2001) and Herbert and Stipek (2005) who found that parents were among the guilty that generally supported the cultural stereotype that mathematics is more natural for boys than for girls. These previous studies' results were supported by the findings of this study. All the 8 teachers who participated in the study were parents with school going children.

MT1: *No, I…I don't think so, umm beginning with at home umm it depends now on the type of home, for girls from those umm orphaned families, I think they don't normally do the household chores and the like. But in other families, like my family, my daughter she must work, I am the old type of father. In the morning she must do something (laughing), so…but in the school with the training, the professional training of teachers, I think for teachers who are trained this is a topic in colleges I think where we are trying to move away from treating the girls differently from the boys*. Line 90-97.

The deeply entrenched gender norms and gender stereotyping was very apparent in the teacher's views. It is such cultural beliefs that sustain gender disparities both at home and school at the demise of the girl child's progress. MT1 was a highly qualified teacher with a master's degree in physics but still his daughter had to subscribe to the cultural norms whether oppressive or not. He is the 'old type of father' as he described himself. A study conducted by Mutekwe, Maphosa, Machingambi, Ndofirepi and Wadesango, 2013) dismissed the common beliefs and misconception held by most teachers that causes of girls' underachievement emanated outside the schools and within the girls themselves. The authors believed that schools as centers of learning and teachers as agents of change had the greatest influence on the performance of girls. On the contrary this study revealed that both students and teachers believed that the factors which caused the underachievement of girls particularly in natural sciences mainly emerged outside of the schools.

5.4.2 Self-efficacy

The belief in one's ability to succeed (self-efficacy) was in this study deemed to have the same definition as self-ability and has been interchangeably used so throughout the study. Only 2 of the female interviewees thought self-efficacy influenced performance in the subject. The other 3 did not think self-efficacy was among key contributors of performance in the sciences by female students. However, all the male respondents (3) thought otherwise as shown in Figure 5.5. The perceptions of both teachers and students showed a similar pattern. Interviews with students revealed that 10 female students and 14 male students cited the factor as contributory to low choice and performance. The reason why adult male teachers thought self-efficacy contributed to performance was not ascertained at the time of the study except to assume that their views were based on their teaching experiences. One of the teacher interviews had this to say:

MT3: *I found that they are at par, in some cases girls are even more commanding especially when you have them in sciences, they are quite assertive, quite strong characters and they can present their argument but then you still have the anomaly that you have fewer girls in that group. That's the disadvantage in terms of what content, expression of themselves, those two are equal but the question becomes how many are there?* Line 115-120.

MT3 had more than 20 years of experience teaching natural sciences to O and A-level students and his views may have some objectivity. He argued that female students in natural sciences have high self-efficacy and perform well but the problem is that they are few. The other factor which was cited as a contributory factor to low performance is role model that is discussed next.

5.4.3 Role models

Surprisingly, only one male teacher out of the three who were interviewed believed that influencers had an impact on the performance of the subject by the students. Almost all the female teachers (4) except one agreed that influencers play a role in the performance of natural sciences. The gap on opinion difference was wide between male and female teachers. Students' views had an equal representation of 52% on the impact of the factor on performance as shown in table 5.3. The believed that female role models were necessary to motivate the female students like natural sciences and perhaps perform well in the subjects. The interviewed teachers displayed strong opinions on role models as shown in the following quotes.

MT3: *The girls don't see these women who are pharmacists, engineers, miners and geologists they don't see them so it's a dark world to them.* Line 89-91.

Interviewee MT3 seemed to suggest that the environment where this study was conducted lacked female professionals in the named disciplines to be role modelled by female students.

FT5: …*they opt for other things something else different because there is lack of exposure and in our socialisation the sciences are not introduced from a very tender age. Ok, so you find out that its rare maybe for those one or two, if you go around this school, we are closer to the hospital, but if you ask them, have you ever seen a female doctor? You will be surprised, a female engineer, you will be surprised, because to them they don't know that they are ladies who are involved in this field. We used to have a field day or a career guidance day where you call one of the artisans out there to come and address our girls. You will be surprised with the questions they ask, where you trained in Zimbabwe? …I think that's why I'm saying exposure itself, when they are* *exposed they know they are other girls doing it. I think that can encourage them.* Line 69-85.

The influence of role models in educational learning is best explained through the motivational theory of role modelling that draws its philosophy from the expectancy-value theories of Eccles (1983) as discussed in chapter 2 section 2.2.3. According to Morgenroth, Ryan and Peters (2015), the motivational theory of modelling influences the goals and motivation of an individual through inspiration, accepting a challenge to represent the possible and fuelling behavioural change. In a school situation for example female students who interact and are taught by a female physics teacher may experience inspiration. They may realise that it is possible to do the subject and when the students work harder and thrive to achieve higher they will be undergoing behavioural change from their previously held beliefs and perceptions. In other words, role models are inspirers because they provide an individual with a foundation to evaluate what makes a desirable character trait, value or aspiration. The role models represent successful members of one's own group and when people find themselves in threatening situations, they often look to role models for reassurance and inspiration (McIntyre, Paulson, Taylor, Morin, & Lord, 2011). Therefore, it starts with the perception of the role model through the eyes of the role aspirant passing through the role modelling process and culminating in behavioural change. Behavioural change in the individual is seen through the acquisition of skill(s), goal adoption and reinforcement and motivation.

5.4.4 Attitudes

The findings of this study revealed that attitudes influence performance was cited by 1 male participant and 2 female participants accordingly figure 5.5. A similar pattern (cf. Figure 5.2) was revealed by student interviewees where 12 male and 13 female participants cited attitudes as a factor that contributes to low choice and performance in natural sciences. The effects of attitudes on performance of natural sciences by the female students were articulated well in the following interview.

FT5: *Yah, I think so because they are certain subjects whereby, take for instance biology, where students just enjoy studying life but when you look at a science subject* *like physics, there are a lot of calculations, and normally our girls have a negative tendency towards maths and calculations so the moment that they come across calculations you will find that they close off. When they are closed off you find they give up. In fact, they don't take it very seriously, so it is an attitude. I can't say that science is a difficult subject. When they have an attitude towards a certain science that affects a lot on their performance because when you go through questions and problems solving them, you find that someone gets it. "I thought it was difficult. I thought it was like maths. I thought there were some difficult calculations." So, at times their attitude towards a certain subject affects how they tackle it. It affects the time they give to the subject so that is what normally happens.* Line 22-33.

The problem with a negative attitude is that it blocks the individual from thinking of other possible avenues that can help accomplish a given task. I am persuaded to agree with the views of FT5. A negative attitude is the nemesis of performance.

5.4.5 Parental discrimination

It emerged during teacher interviews that even a positive attitude towards natural sciences was not good enough on its own because the girl child faced and endured a lot of parental discrimination which catalysed the low performance in the subject. All the female teachers (5) who took part in the interviews agreed that the girl child was discriminated against by parents consciously or unconsciously and this affects her performance with her school work. Two of the male teachers were also of the same opinions figure 5.5. The most forwarded argument was the lack of trust and confidence in the girl child by parents. The parents were accused of overprotection of the girl to the detriment of her freedom of movement, association and choice. These same views were also echoed by the female students when they voiced that parents should empower them by giving them the chances to make their own independent decisions (cf FGD2: RF11) section 5.2.5. Teachers argued that parental discrimination subjected female students to unnecessary social pressure.

5.4.6 Social pressure

The negative impact social pressure has on the performance of natural sciences by female students was echoed by 3 female teachers and 1 male teacher, respectively. It came out that most of the child-headed families were headed by girls. At the time of the study, Zimbabwe was experiencing economic challenges and most households could not afford the basic needs of life. The situation was worse with child –headed families so claimed the teachers. Some girls resorted to prostitution to raise money to look after their siblings (Gubwe and Mago, 2015; Nxumalo, 2015; UNICEF, 2014). Most of the female students lived double lives; that of an adult and the other of a child it was alleged by FT2. The result was poor performance in school subjects. FT2'S quote below gives an insight into the effects of social pressure on the girl child.

FT2*: Well I'm saying it is more of a social thing and it's not much influenced by the school. There are certain things being experienced. These days we are experiencing something like they are child led families where they are just children and sometimes these children might not have enough basic things and that can maybe end up forcing these girl children to be involved in other things like prostitution to get basic things. But for the boys they won't be involved in things like that.* Line 75-80.

The social pressures experienced by the female students as indicated by one female interviewee are socio-economically induced.

5.4.7 Household duties

All the teachers (8) mentioned that household duties have a detrimental effect on to the performance female students, as shown in Figure 5.5 above. This is what they said.

MT1: *Household duties like for day scholars or for boarders, oh the household duties they really affect the performance negatively I think, because obviously when she comes from school she goes home, she begins cooking and doing the other household chores, she will be very…very tired. After that she needs to rest and then obviously she will go to sleep without studying because she will be very tired.* Line 109-114.

FT3: *Ahh, I think it does, because umm, sorry come again with your question. Ok if I got your question correctly. I think it does affect because you realise that if incorporated this gender thing the girls when they go home they start doing the cooking they start doing the housework whilst the boys are probably left to do whatever they want to do. So, it will mean that the boy will get more time to study than the girl who must cook for* *the whole family. After cooking the girl must do the dishes and there won't be enough time for the girl to do more work more study.* Line 54-61.

These results support Swainson's (1995) observation that the girl child's education was affected greatly by household chores. Dunne et al.'s (2005) study on gendered school experiences in Botswana and Ghana also revealed similar results. Stephens's (2017) study on confronting gender-based violence in the Caribbean Islands concluded that deeply entrenched gender norms and gender stereotyping perpetuated the problem of the negative stereotypes on the concept of masculinity and femininity. Gendered roles reflect deep rooted patriarchal ways of thinking.

The importance of the results is that they expose the current gender disparity situation in the learning of natural sciences in Makonde District. The implications of the results are that they appeal to the classroom practitioners, education policy makers, parents and the wider society at large to evaluate the current thinking and strategize new approaches to solving gender disparities in the study of natural sciences. The tragedy of these results is that it is the girl child who pays the penultimate prize of poor academic performance in the natural sciences. The repercussions are felt in the social and economic development of the country. Zimbabwe cannot afford such a luxury because females constitute the majority population (Zimbabwe National Statistics Agency, 2013). The more we have them in the economy's critical STEM disciplines the better for the country.

5.5 Conclusion

From this discussion it seemed like in Makonde District, girls' low performance in the natural sciences to a lower extent can be ascribed to cognitive factors like ability and low efficacy, but to a larger extent to environmental factors like parental discrimination, social pressure, household duties, stereotype beliefs and role models. Results of the research seemed to suggest that equal treatment of girls and boys existed in schools, but gender disparity practices existed in the homes of the students. The results of this study provide some indication that environmental and gender has a role to play on performance. Chapter five discussed and interpreted the findings of research question 2. . Nine factors that cause female students not to perform well in natural sciences were identified by the research question. These were ability, attitudes, self-efficacy, concentration span, household duties, parental discrimination, role models, stereotype beliefs and social pressure. The next chapter looks at research question 3 which focuses on whether students experience gender discrimination from teachers in the classrooms during the learning of natural science.

CHAPTER 6

Do students experience gender discrimination from the teachers in the learning of natural sciences?

6.0 Introduction

The previous chapter looked at factors that contribute to low choice and poor performance in natural sciences by female students. Nine factors that were identified and discussed, namely, ability, attitudes, self-efficacy, concentration span, parental discrimination, social pressure, household duties, stereotype beliefs and role models.. Chapter 6 analyses and discusses the results pertaining to the research question 3 that sought to establish whether students experienced gender discrimination from the teachers in the learning of natural sciences. To unpack the findings of research question 3 the subheadings which were used during lesson observations (Table 6.1) together with the quantitative results of Table 6.2 and selected quotes will constitute the core of discussion. The focus of the investigation was on the type of language of communication and its frequency as used by the teachers to the different sexes of the students. It was assumed that this gave an indication of whether gender discrimination was practiced or not. .

6.1 Background

Students come to school with different social backgrounds and social identities. Teachers interact with them almost daily and the teacher's language of communication will either build up or destroy the students' perceptions of gender stereotyping (Mackay & Parkinson, 2010). Teacher-student relationship is very critical in motivating a student. Studies done by Roorda, Koomen, Spilt and Oort (2011) and Van Ryzin(2011) established that positive interpersonal relationships between teachers and students increased classroom participation and academic performance. According to Hyman and Snook (1999), emotional abuse of students by teachers in schools is common but is not so publicized as sexual violence by researchers, educators and administrators.

It appears like these authors are blaming the researchers, educators and school administrators for not exposing the problem. . There is no consensus on the definition of emotional abuse among researchers and psychologists alike. However, this study adopted the definition of Osei-Hwedie and Hobona (2001, p. 112) who define it as “the constant use of verbally abusive language to harshly criticize and denigrate a child, placing excessive demands on a child’s performance and withholding warmth and affection.”

Key concepts to this investigation are abusive language and withholding warmth and affection in the form of negative comments. The definition of child abuse or gender discrimination is culturally driven and vary from culture to culture ((O’Hagan, 1993;; Nesbit & Philpott, 2002) The different forms of emotional abuse through abusive language which addressed the research question 3 include name-calling, demeaning remarks, labelling students and denying students’ feelings. These various forms are reflected in the items of Table 6.2. In analyzing Table 6.2, the heading zero times translated to disagree and few and many times were combined to mean agree like in the Likert-scale responses. This approach was adopted to simplify interpretation and understanding of the results. Having adopted this position, the learning experiences of the students were then used to explore whether gender disparities existed or not during teache4.9r-student interactions in the classrooms.

6.2 Abusive language

Key: Frq = frequency, LOMT1=lesson observation male teacher1, LOFT3 = lesson observation female teacher3 and so forth.

Table 6. 1 Lesson Observation Results-Qualitative

Teachers	**LOMT1**	**Frq**	**LOMT 4**	**LOFT 3**	**LOMT 5**	**LOFT 6**	**Total**	**%**
Abusive language	Boys	2	0	3	1	1	7	3.48
	Girls	1	0	1	1	0	3	1.49
Motivational Language	Boys	11	10	14	11	8	52	25.87
	Girls	15	11	10	12	10	58	28.86
Positive Feedback	Boys	6	4	9	5	3	28	13.93
	Girls	5	6	7	7	3	28	13.93
Negative Feedback	Boys	3	1	3	0	2	9	4.48
	Girls	1	1	0	2	2	6	2.99
Ignored	Boys	5	2	4	3	4	18	8.96
	Girls	3	5	2	3	2	15	7.46
Theory Lesson Participation	Boys	12	13	16	15	14	70	34.83
	Girls	15	12	14	13	12	66	32.84
Number of practical groups	5 (8*5=40)		45	6 (7*6=42)	38	6 (6*6=36)	201 students	
Sex of group leader.	Boys	3		3		4	10	8.47
	Girls	2		3		2	7	5.93
Dominant sex in the group	Boys	√		√		√		
	Girls			√				

In all the five lessons that were observed teachers used code-switching to explain difficult concepts in English using Shona (the mother tongue) and in passing remarks.

All the lessons that were observed lasted for about 40 minutes except for the practical work which lasted for an hour. The results of the lesson observations of teachers LOMTI and LOFT3 will be discussed in detail whilst those of the other teachers will be discussed as per Table 6.1 summary.

6.2.1 Analysis of LOMT1

The teacher who had 16 years of teaching experience was observed teaching a physics topic to a Form 3 class. The class had 22 boys and 18 girls. The students sat in mixed rows of a boy and a girl per desk and the classroom was fairly neat, but ventilation was poor because only two windows next to the teacher's desk in front were open. Upon greeting his class, the teacher introduced me to the class and explained the purpose of my visit. The lesson of that day was introduced by a recap of the previous lesson's concepts. Then the teacher asked a question.

Teacher: Who can tell us the name of the instrument used to measure voltage and its SI unit? "Yes Jane." The teacher picks up one of the first girls to raise her hand.

Jane: It is called a voltmeter and the unit is a volt.

Teacher: Excellent! Let us clap our hands for her. Bhuu-bhuu (the class clap hands). "Well done girl."

The teacher reinforces the earlier comment. At this point on time the teacher has used both motivational language and positive feedback to the students. The teacher then proceeded to draw a basic electric circuit diagram on the board whilst whispering goes on among the students as they discuss. After finishing the drawing diagram, the teacher requested for a volunteer to come to the board and label a cell, switch, voltmeter, bulb, resistor, ammeter and conductor. Tendai, a tall brown boy, runs to the board even before the teacher had appointed him. There were some grumblings and protests from other students and the teacher intervened.

Teacher: OK class. Let us give him the chance. But Tendai next time learn to wait to be picked up.

Tendai: Yes Sir!

There is evidence of a conducive learning environment. The students interact freely with their teacher and a lot of them are showing a lot of enthusiasm. Tendai then labelled the diagram correctly except for the resistor. The teacher makes a joke out of Tendai's one mistake.

Teacher: Tendai! God is for all of us. He has punished you after the class complained. That is why you got one answer wrong. (The whole class laughs.) Who can give us the correct answer?

A student from the floor gives a correct answer and the teacher acknowledges and proceeds to introduce the topic of that day which was on Ohm's Law. Teacher student-interaction goes on well until the teacher asked this question:

Teacher: Which three variables are investigated when defining Ohm's Law? (A short boy stands up and raises his hand.) Yes, Petros the teacher responded.

Petros: It is the battery, the resistor and the wire Sir.

Teacher: Ndokuti chii ikoko? Haiwavo tigarire pasi.

Literally translated it means "that is nonsense. Sit down." It was really a sad moment for the poor little boy who sat down very unhappy and withdrawn. To make matters worse the rest of the class laughed at him. It was really embarrassing even to me the observer. Apart from this incident, the rest of the lesson of teacher LOMT1 went well.

Table 6.1 shows that during the whole period only two boys and 1 girl were recipients of the abusive language from teacher LOMT1. The teacher used motivational language to 11 boys and 15 girls, positive feedback to 6 boys and 5 girls, negative feedback to 3 boys and 1 girl. The teacher ignored 5 boys and 3 girls throughout the lesson and had a total of 12 boys and 15 girls participating in the theory lesson. Evidence shows that there was variation in his teaching techniques. At the end of his lesson I asked for a brief interview with him to which he agreed. I wanted to follow up on the nasty incident involving Petros.

6.2.2 Brief interview with teacher LOMT1

Researcher: Thank you so much sir for allowing me to observe your lesson. I really did enjoy the lesson and gained some knowledge from your teaching strategies.

Teacher: You are welcome sir. You see our classes are big and paying attention to every pupil is somehow difficult although we try. In this class there are very good bright pupils as well as very naughty dull ones and clowns who are just there to add numbers.

Researcher: Yaah! It looks like it is really a tough and challenging job. If I may ask sir, why did you respond so harshly to that boy called Petros's incorrect answer?

Teacher: Ooh Petros! It is because you do not know him well. He is more of a clown and enjoys seeking attention from the rest of the class. He just answers without thinking.

Researcher: Ooh I understand but could you not have tried to motivate him like what you were doing with other students who gave wrong answers?

Teacher: I could have done that but with characters like Petros it does not work. I think what I did was the best option.

Researcher: Once more thank you for time.

The observation of this lesson and its unfolding events gave me an insight into the types of challenges teachers face daily in the classrooms. It also dawned on me that perhaps teachers commit emotional abuse without actually realizing that they are doing so and try to justify the actions.

A very surprising experience was witnessed in the class of male teacher LOMT4. The assistant researcher and I were not able to pick out some of the abusive language used by the teacher throughout the 40-minute period. The third lesson observation involved a female teacher LOFT3 whose analysis is shown next.

6.2.3 Analysis of LOFT3

Teacher LOFT3 had the least teaching experience of 15 years among all the teachers involved in this study (see Table 3.4). Her class had 42 students, that is, 20 boys and 22 girls. She was the class teacher of Form 4A and she also taught it Biology. The classroom was very neat, all the windows were open, and the desks were neatly arranged. However, most of the students in her class were seated according to gender. I only saw five mixed pairs, that is, a boy and a girl seated at the same desk.

The teacher and I entered the classroom first before the students had arrived. I sat in the middle of the classroom at the back. Students later on arrived and greeted their teacher upon entering the classroom and sat down. Teacher LOFT3 quickly marked her register amid some noise that came from the left corner at the back. When the teacher heard the noise, she interjected: “Hey there! Can you pay attention and listen to your names?” The students became quiet. After registration the teacher started her lesson. She did not introduce me to the class maybe she forgot.

Teacher: Our last lesson was on the characteristics of living things. Can someone state any two? Yes Tsitsi (name of a girl).

Tsitsi: Reproduction and respiration.

Teacher: Yes, that is correct. Any other?

Robert: Movement and nutrition.

Teacher: Good. Anymore?

Angela: Eating.

Teacher: No. That is senseless. Can you say plants eat the sun or carbon dioxide?

At that junction the whole class laughs He-he-he hiee. A student who was seated next to me shouts: “living things grow and excrete.”

Teacher: That is very correct. Wagona chaizvo Sarudzai (you did well Sarudzai-a Shona name meaning Select). Now today's lesson is on aerobic or cellular respiration. What is aerobic respiration? Yes John.

John: It something to do with living things.

Teacher: That is wrong you are not answering the question. Who can help him?

Chipo: It is a process that uses oxygen to burn the food that we eat to release energy.

Teacher: That is a much better answer. Did you hear that John?

A comprehensive definition of aerobic respiration is written on the board by the teacher and the students take notes. This was followed by a discussion of the importance of respiration and a comparison of photosynthesis and respiration. Chemical symbols of elements of the periodic table were briefly looked at. Then a boy called Raymond asked this question: "Madam, Chipo said the oxygen burns the food that we eat inside our bodies. Why is it that we do not get burnt ourselves or feel the fire burning inside us?"

Teacher: Who said there is fire in our bodies? Look at the definition that I have given you. Learn to think first before you just say anything. Do not expose how foolish you are?

An atmosphere of silence and some fear engulfed the class. At this stage, the teacher has already emotionally abused three students namely Angela, John and Raymond. Teacher LOFT3 then wrote both the word and chemical equations of the respiratory process on the board. But on second thought she writes a chemical equation that represents the reaction between magnesium and oxygen to form magnesium oxide. She explains how the chemical equation is balanced and students seem to be enjoying. The teacher then wrote the chemical equation representing the reaction of carbon and oxygen to form carbon dioxide and asked for a volunteer to balance the equation. "Yes Munya (name of a student)."

Munya: At the board explains: There is one carbon element on the left of the arrow and also one on the right, so the carbons are balanced. It is true for oxygen two on the left and two on the right, so they are balanced. This equation is balanced as it is.

Teacher: What a genius? That was very good. Let us give him a round of applause.

The whole class went into deafening applause until the teacher had to tap her desk to stop the ovation. The researcher also joined in the handclapping. Munya's explanation was really beyond his level.

Teacher: Once again well done Munya. Is there anyone who did not understand the explanation? No hand was up. "Good!" Anyone willing to come and balance the chemical equation for respiration?

A boy seated in front and close to the teacher's desk has his hand up but is ignored and the teacher chooses a girl called Priscilla who goes to the board, attempts to balance the equation but fails. It is at this point that the teacher saw a boy called Tambaoga who was seated in the of the classroom giggling. She picks him up to come and balance the equation and he too fails. The teacher then just lost her composure.

Teacher: Iwe! Undikwanire zvembanje dzako dzinongokusekesa pose pose uzvisiye kumba kwako. When literally translated it means "You! Behave like someone who is normal and not mad. Leave your cannabis (drug) addiction behaviour that makes you to giggle unnecessarily at your home."

The emotional abuse was so strong that the affected boy shed tears and was asked to go out of the class by the teacher. After this incident, the atmosphere in the class changed completely. The teacher later on balanced the equation after realizing that the students were no longer willing to participate probably for fear of humiliation if they failed. The lesson ended on a sad note. I persuaded the teacher for an interview with her and she accepted.

6.2.4 Brief interview with teacher LOFT3

Researcher: Good day madam. Thank you first for the lesson observation and secondly for this post lesson interview.

Teacher: It was my pleasure to have you sir. I hope it helped you get the information you were looking for.

Researcher: Indeed, it did, and I also enjoyed the lesson and learnt a lot. Your class I realise is big but you were having a good teacher student interaction until the incident of Tambaoga. Do you mind sharing with me why you acted that way?

Teacher: That episode was unfortunate but when dealing with pupils like Tambaoga it is sometimes unavoidable. He has a disciplinary problem and even the school headmaster and his deputy know about him. It looks like he comes from a broken home. I have never tried to find out, but his schoolmates say so. The other students claim that his best friends outside the school smoke mbanje (cannabis). One cannot refute the allegations because his behaviour is just not that normal like other pupils. Ange achida kuonererwa (he was seeking attention and showing off and therefore he deserved what I said to him).

Researcher: I am sorry to hear that. Have you or the school leadership ever to tried to help him by way of meeting his parents or guardians and also offering counselling to him?

Teacher: I tried to give him some counselling, but I think he has an element of despising female teachers. Female teachers in other subjects also complain about him. You can find out for yourself if you think I am lying. I cannot answer for the headmaster, but he knows about him.

Researcher: No. I am not saying you are lying I was just trying to find out. May I once more thank you sincerely for your time. I know you are very busy. I really appreciate.

Teacher: You are welcome sir good luck with your research.

Female teacher LOFT3, as indicated in the Table 6.1, emerged the main abuser among all the teachers who were observed. She directed abusive language to three boys and one girl within a period of 40 minutes. Such kind of behaviour in the classroom by some teachers was testified by students during interviews as revealed in the following testimony:

FGD3: RF6: *I think when someone is in a lesson I think it's comfortable to have a male teacher teaching in front of you because actually from my own opinion males and females in comparison females are slightly short tempered, not that much but slightly, if they explain to you something and you don't understand they are like "what don't you understand?" (laughing) and then you just go even if you don't understand, for a male teacher if he tries to be harsh he controls himself, males can control themselves and explain again but females just burst.* Line 149-161.

Although the incident in the class of FT3 was an isolated case during my lesson observations if practiced by many teachers the abuse may leave permanent emotional scars in most of the victims. Instead of school teachers playing the role of nurturing healthy productive future minds they may contribute consciously or unconsciously to the development of some emotionally scarred citizens.

The class of male teacher LOMT4 had one boy and one girl abused against only one boy in the class of female teacher LOFT6. All in all, a total of seven male students representing 3.5% were discriminated by way of abusive language against three female students (1.5%) who also experienced the same. A total of 201 students from five schools were observed being taught by five different teachers but only 10 out of 201 were witnessed being abused. The number that was abused and discriminated represents 0.05% of sample population observed.

Table 6. 2 Respondents by learning experiences (N=590)-Quantitative

		Male				Female				Total
Item No.	**Item Description**	**Zero times**	**Few times**	**Many times,**	**N**	**Zero times**	**Few times**	**Many times,**	**n**	**N**
15	Did not praise you when you had done well.	217 (63.6%)	75 (22.0%)	48 (14.1%)	341	147 (63.6%)	51 (22.1%)	33 (14.3%)	231	572
16	Made you believe that the subject was very difficult.	254 (74.5%)	60 (17.6%)	27 (7.9%)	341	160 (69.9%)	45 (19.7%)	24 (10.5%)	229	570
17	Embarrassed you in front of everyone when you gave a wrong answer.	272 (78.8%)	46 (13.4%)	27 (7.8%)	345	197 (84.2%)	20 (10.3%)	17 (7.3%)	234	579
18	Praised you for good performance.	52 (15.2%)	107 (31.3)	183 (53.5%)	342	45 (19.3%)	57 (24.4%)	131 (56.2%)	233	575
19	Called you humiliating names e.g. “dofo”(meaning a fool or idiot).	293 (85.7%)	22 (6.4%)	27 (7.9%)	342	205 (88.4%)	10 (4.4%)	17 (7.3%)	232	574
20	Discouraged you from doing science subjects at a higher level despite your good passes at lower level.	292 (86.1%)	23 (6.7%)	24 (7.1%)	339	207 (89.2%)	13 (5.6%)	12 (5.2%)	232	571
21	Praised a student with lower marks than yours.	253 (74.6%)	67 (19.7%)	19 (5.6%)	339	194 (84.0%)	29 (12.6%)	8 (3.5%)	231	570
22	Ignored your efforts most of the time.	276 (81.4%)	40 (11.8%)	23 (6.8%)	339	182 (80.2%)	28 (12.4%)	17 (7.5%)	227	566
23	Made you a leader of a science group or activity.	181 (53.2%)	97 (28.5%)	62 (18.2%)	340	129 (55.1%)	45 (23.5%)	50 (21.4%)	234	574

Items 17 and 19 looked for abusive language in the survey. Participants who chose zero times were disagreeing with the statement and those who opted for few and many times were agreeing with the statement. Table 6.2 indicates that 272(79%) male and 197(84%) female students refuted that they were emotionally abused through language by the teachers during natural sciences lessons (item 17). This was against 73(21%) and 37(18%) male and female students, respectively, who agreed that they had experienced embarrassment through abusive language. Responses to item 19 revealed that 296(86%) male and 204(88%) female students were never called humiliating names. Only 49(14%) of the male and 27(12%) of the female respondents agreed that they had been humiliated through name-calling. It is the same pattern that was observed where more boys (3.5%) than girls (1.5%) were abused (see Table 6.1). These results show that more male than female students were discriminated by teachers using abusive language. These findings concur with the findings of Magno and Silova (2007) who observed that boys, most of the time ,are chastised and given more attention while girls are instilled with a dependence syndrome.

A study conducted by Shumba (2002) in Zimbabwe involving teachers and teacher trainees to determine the form of emotional abuse happening in schools had two interesting findings. First, the study revealed that the most common forms of emotional abuse included labelling, shouting at, humiliating and using vulgar language towards students. Shumba's (2002) results are supported by the findings of this study as observed from our discussion with teachers MT1 & FT3. Secondly, the abused students, in most cases, did not perceive themselves as victims and the abusers most of the time were not aware or did not believe they were being abusive. When I asked FT3 after her lesson what she felt about the incident with the boy who cried in her lesson she seemed not bothered at all. Instead, she said "ange achida kuonererwa" meaning he was seeking attention and showing off therefore he deserved what was done to him. Shumba (2002) argued that it is one of the reasons why emotional abuse is underreported in schools. It seemed the teacher believed her actions were not out of order and could not consider herself an abuser. According to Miyake et al. (2010), if the social identity of a student is negatively erected through whatever remarks are said, the student is liable to underachieve in a way consistent with the remarks.

6.3 Motivational language

The indicators presented in Table 6.2 are that most of both males 217 (64%) & 147(64%) females 290 (85%) & 188 (81%) were given positive motivation for good performance by the teachers as shown by items 15 and 18, respectively. Item 15 was worded negatively and item 18 was phrased positively but both solicited for motivational behavior of the teachers.

This was done to check for the consistency in the pattern of responses. The results ratified the consistency for example responses of above 60% were obtained for item 15 for both male and female students. A similar trend of above 80% emerged for item 18. According to Gregory and Weinstein (2004), adolescents who felt that their teachers gave them praise, listened and were interested in their work, showed greater improvement in their mathematics achievement. Positive comments act as natural motivators. In everyday life, positive comments are often acknowledged by a smile from the praised. It was not established at the time of the study whether this group of students showed improvement in their natural sciences performance.

Table 6.1 demonstrates that more girls received motivational language from all the teachers except for teacher LOMT5. During the observation of LOMT4, I noted that he used the following language to motivate a girl who had answered correctly. “Haunzwezve! Womberai maoko chisikana ichi.” In English, it means well done clap hands for the girl for giving us a correct answer. The use of the term chisikana embodies passion and appreciation to the young girl. LOFT6 in probing for an answer from a young boy who seemed to know the answer but was struggling to express himself had this to say. “Your answer is not far from the truth, but can you explain a little bit more? Your thinking is along the correct line.” A total of 52 male students represented by 26% against 58 (29%) female students received motivational language from the teachers. It means that gender discrimination by the teachers on this aspect was done in favour of the female students. These qualitative results showed a different pattern from the survey results because in the survey (Table 6.2) more male (85%) than female (81%) participants said they received positive motivation for good performance from the teachers.

6.4 Positive feedback

Table 6.1 shows that teachers LOMT1 & LOFT3 gave positive feedback to boys more than girls during their lessons. Teachers LOMT4 and LOMT5 gave positive feedback more to girls more than boys during lessons. An equal number of boys and girls received positive feedback from teacher LOFT6. However, at the end of the 5 observed lessons, the same number (28) of boys and girls had received positive feedback accounting for 14% of the participating students. The terms and gestures which were frequently used by the teachers included excellent, well done, very good, smiling and nodding in agreement. Based on the total number of boys and girls who received positive feedback it can be suggested that there was no gender discrimination practiced by teachers involved in this study. These results seem to support the views of the quoted interviewee:

MT1: *We know that uh the girls normally they are in the class with boys normally they don't want to participate for the fear of being embarrassed when they fail to answer a question correctly. So, the professional teacher will just pick them even if they have not raised their hand and try to encourage them that failing to get a correct answer is not a crime that it is a learning process, so I think teachers at school I think uh well we are trying treat to them equally* (Line 103-108). *Uh it's not there, here in this school, it's not there; we don't have any disparities we don't have, we afford them the same opportunities.* Line 136-137

Several issues were raised by this teacher. The first issue is that of girls being sensitive to embarrassing remarks in a class where there are also boys. The second issue is that the teacher is acknowledging that teachers give embarrassing remarks to wrong answers. The third issue is the teaching style of the teacher that thrives to bring every student on board. The final issue is that of equal treatment of boys and girls at the school. The views raised by the teacher aligned well with all the attributes which were observed in the classrooms, namely, abusive language, motivational language, positive and negative feedback.

FT2: *Once they are at school, no problem, they are the same. The disparities might emanate from the home but here at school I think they are at par. I think there are very little or no disparities in the classrooms.* Line 148-150.

The opinions of this female teacher give support to the results presented in Chapter 5 on the reasons why girls perform lower than boys in natural sciences. Parental discrimination (see Section 5.2.1) was cited most frequently by the students who felt that parents did not treat boys and girls the same. Although MT1 emphatically denies that gender discrimination was practised at his school, FT2 conceded that at her school gender discrimination did exist but not much. However, for the teachers to categorically state that the students were treated equally in their schools should be viewed with suspicion. In a country like Zimbabwe where visitors or strangers are treated with suspicion because of the activities of the undercover state agents, the teachers could have told me what they considered to be safe to them. Notwithstanding my personal views of the last statement, the corroboration by the students to being treated equally gives the results from the teacher interviewees some credibility because usually young students in an open and conducive environment are very frank and honest with their views or opinions. This study was done in what I think was a conducive atmosphere.

FGD3: RM10: *Maybe that depends with the parents, it might differ sometimes, but I think it's quite the same how they take your education but only that they give preference to the one who seems more serious, like interest in the jobs that are more paying.* Line 61-64.

The impression given by RM10 was that girls were not serious with their education, but the views did not have backed evidence except to infer that they could have been prompted by gender stereotyped beliefs.

FGD4: RF10: *To me even the guys look down upon us and from that discouragement from them I think that's what makes us inferior, (laughing), well they actually have that ego that they are the best, once they see you on top they are trying to pull you down,* *they don't believe that girls can do better than them so most of them will start discouraging you, mocking you, looking down upon you, that's the reason why most girls perform different from the guys. Most of our teachers try their best to treat us the same at this school.* Line 125-131.

The above interview seems to suggest that the chief protagonists of gender discrimination in schools are boys, especially for students learning in co-educational environments. Hence, Feniger (2011) and Cherney and Campbell (2011) argued that girls-only schools produced consistently higher achievements in mathematics and science than co-educational schools. In girls-only schools, girls appear to be shielded from the negative effects and attitudes that boys would normally expose them to in co-educational schools.

The results in Table 6.2 item 16 show that 254(75%) of the male students and 160(70 %) of the female students were of the opinions that teachers did not portray natural science as a difficult subject. This represents the group that was probably enjoying and benefiting from the methods the subject was being taught by the teachers. There were 207 (89%) female and 292 (86%) male respondents who were encouraged to study the subject at a higher level by the teachers (item 20). Item 21 show that teachers praised 253 (75%) male students and 194 (84%) female students with high marks than those with lower marks. It appeared that the learning experiences of male and female students were different and gender discrimination is less on female students. Females receive more motivational language and positive feedback than males. .

6.5 Negative feedback

A total of 9 boys received negative feedback throughout the 5 lesson observations. This represented 4.5% of the total student population that was involved in the lesson observations. Fewer girls (6) than boys were subjected to negative comments and are represented by 3%. The frequently used feedback terms included a flat "No" without any explanation, "wrong answer" and "you are not thinking". Body language in the form of a frown and shaking the head sideways were employed by some teachers. Table 6.2 indicates that 87 (25%) of the male students and 69 (30%) female students said that teachers portrayed natural sciences in a negative way by making them believe it was a difficult subject (item 16). A total 25 (11%) female students and 47 (13%) male students were discouraged from pursuing natural sciences at a higher level by the teachers (item 20).

Table 6.2 also shows that there were 86 (24%) male and 37 (16%) female participants who believed that they did not get the praise they deserved for obtaining high marks (item 21). There was congruence between the perceived negative feedback from the survey and the observed negative feedback results from the teachers. More boys (9) than girls (6) received negative feedback (see Table 6.1). In each case, more male students than female students were affected. The reasons why more boys received negative feedback can be linked to the fact that more boys participated than girls during the lessons as shown under the subtitle theory lesson participation on table 6.1.

6.6 Ignored

This study discovered that the technique of ignoring was used by some teachers for two reasons. First, as a form of punishment to control unruly behaviour by students and, secondly, as a time out to avoid picking upon students whose hands were up and wanted to contribute to the discussion or question. I focused on technique 2 so that a comparative analysis could be done with item 22 of the student questionnaire on learning experiences. The results that are presented in Table 6.1 show that teachers LOMT1, LOFT3 and LOFT6 ignored more boys than girls during their lessons and teacher LOMT4 ignored more girls than boys in his lesson. Teacher LOMT5 ignored an equal number of boys and girls in his lesson. A total of 18 boys (9%) and 15 girls (7.5%) were ignored in the five lessons that were observed in this study. Quantitative findings of table 6.2 reveal that 276 (81%) and 182 (80%) of male and female participants, respectively, said that they were not ignored by the teachers during natural science lessons (item 22). Nonetheless, 63 (18.6%) of the male and 45 (20%) of the female students indicated that they had been ignored by teachers during lessons. Both qualitative and quantitative findings above seem to suggest that most of the teachers in this study did not rely on the technique of ignoring students as a form of punishment. These results support the observations by Costică in a (2014)’s study on rules, punishments and rewards in education. This study notes that120 teachers established that only 5% of the participants found the technique to be effective. In this study only 15 students out of 201 were ignored representing 7%. The average class size in this study was 40 suggesting that an average of 3 students were ignored during each lesson by the teachers.

6.7 Theory lesson participation

This was defined as the voluntary participation of students in the class activities in this study. The students had to raise their hands up and then picked upon by the teacher to contribute. Students who were picked upon by teachers without their consent were not included in this data. A school laboratory, like any classroom, is a place where formal learning activities take place. Therefore, a conducive learning environment is characterized by a two-way communication channel between teachers and students. The level of student participation in a lesson may be indicative of a conducive learning environment and the personality of the teacher. Table 6.1 shows that more boys than girls participated in the lessons conducted by all the teachers except teacher LOMT1. A total of 70 boys (35%) participated in the five lessons which were observed. This was against a total of 66 girls (33%) that were observed in the five lessons. All in all, 136 students participated in the 5 theory lessons that were observed translating into a 68% participation rate. These findings were not unique to Makonde District as earlier studies done by Howe (1997) in Scotland on gender and classroom interaction found out that boys dominated classroom discussions in co-education set up because teachers chose them more than girls. The participation by more boys than girls could have been also a reflection of the enrolment of the natural sciences students which had more male students than female students as revealed in the methodology chapter three. The widest gap in the participants (4) was witnessed in the lesson of teacher LOFT3 followed by LOMTI (3). Teacher LOFT3 had also the greatest number of participants (30) from a class of 42 students. The lessons of teachers LOMT5 and LOFT6 had a difference of two each whilst LOMT4 had one. Abdullah, Bakar and Mahbob (2012) studied students' participation in classroom and noted that the full integration participation of students in class discussions was mainly determined by the teacher's professional personalities. More than half of the students in each of the classes observed participated in the theory lessons. It seemed in this study, all the 5 teachers who were observed had good teaching skills which motivated the students to actively participate in their lessons.

6.8 Practical activities

The practical lesson observations were limited to three willing teachers the other two teachers declined to have their practical lessons observed. Surprisingly, only male teachers did not want their lessons to be observed.. The practical lesson of LOMT1 had 5 mixed groups of eight students per group. Three groups were led by boys and two groups by girls. The dominant sex in this lesson was boys. Teacher LOFT3's practical lesson comprised of six groups with seven students in each group. Leadership in the groups was divided equally and therefore there was no dominant sex in the class. Table 6.1 indicates that it was the practical lesson of teacher LOFT6 where group leadership was more gender biased in favour of the boys. A total of four groups were led by boys against two that were led by girls. The picture below shows one of LOFT5's practical groups doing an experiment on chemical reactions. The picture shows that the teacher did not prioritize laboratory safety much. A picture of a bridge model as well as student bags on the table where the experiment was being done can be seen.

The teachers differed in their approach to practical group leadership. Teachers LOMT1 and LOFT6 imposed leaders to the groups. They argued that practical work can be both fun and dangerous and therefore they entrusted those students whom they believed were capable to both direct the experiment and control the other group members. Teacher LOFT3 left the students to choose their own group leaders but insisted on loyalty from the other group members. Of the 17 practical groups which were observed 10 were led by boys (8%) and 7 (6%) out of a practical student population of 118.

Figure 6. 1 LOFT6 Students conducting practical work.

The survey results presented in Table 6.2 show that 181(53%) and 129 (55%) of male and female students respectively indicated that the teachers did not appoint them science group leaders (item 23). More male 159 (47%) than female students 95 (45%) agreed that they were made group leaders by the teachers. The same trend was witnessed during the practical lesson observations. These results suggest that the teachers in this study preferred boys to girls to be practical group leaders. This may also suggest that the boys imposed themselves as group leaders and the girls accepted to be led by the boys.

The implications of these results are that the dominance of boys as leaders in the practical work signal that leadership in natural sciences is a male domain. I suggest that practical group leaders be rotated so that every student gets a chance to show their potential in the natural sciences. The other advantage of this approach is that it boosts the confidence of shy students in the subject. This behaviour can be attributed to the new teacher training curriculum methods and the in-service workshops that were being conducted by the ministry of education as testified by the teachers.

The findings of this study indicate that both boys and girls studying natural sciences in Makonde District Zimbabwe did not experience gender discrimination due to classroom practices by the teachers. However, the study found out that the boys were the most aggressive transmitters of gender discrimination than girls in the learning of natural sciences. The significance of the findings is that while teachers appear to play an insignificant role in gender discrimination, boys appear to be the main culprits of advancing gender discrimination within the classroom and this affects the girl child's achievement in the sciences in co-educational schools, as demonstrated in the Makonde District.

The behaviour of the boys is best understood in the context of how they are brought up in a patriarchal society. In a society that practices patriarchal norms and values, men are considered the head and spokesperson of the family. Cultural beliefs expect men to dictate and dominate family events whilst women follow. According to Mutekwe and Mutekwe (2012), children learn at a very early age in their schooling to identify masculine and feminine roles particularly in relation to broad categories of behaviour, characteristics of the division of labour both in the home and in the occupational structure of society. The findings of Mutekwe and Mutekwe (2012) are echoed in the following extract:

FGD4: RM13: *I think that most girls think that they are being trained into getting into marriage when they are doing their chores at home because when comparing the two, the boys also do work like gardening, mowing the lawn, cutting the grass and the hedge, washing the cars and doing all the things outside and then the girls cook and do the other women chores, that's what they are expected to do by the parents and since they are going to be in a life of marriage later onwards they can have their occupation but they are supposed to do these things even when they are married. When the girl has become a doctor, or a female engineer she is still expected to do all those kinds of things in her own house, (laughing), that's not where I'm heading, I'm just saying that*

70% of this issue is where the story might end (laughing) almost every woman dreams of her big day of marriage. They do dream of becoming a Pharmacist but also dream about walking down the aisle. No! We dream of marrying but some of us must wash our own clothes and iron them. We do all sorts of things as bachelors obviously we will need the help, someone to comfort you, make you a cup of coffee for you (laughing), when you are making plans about the bridge you are going to construct. (Laughing) Line 141-156.

The views of the interviewee exhibit some stereotype beliefs on the roles of men and women in society. When the boys dominated in both theory lesson participation and leadership in practical groups they were reflecting what is expected of them by the society they live in. Boys and girls are socialized differently according to cultural expectations (Chinyani, 2007; Gordon, 1998; Leach et al., 2003). Although in this this study there was no conclusive evidence that teachers did or did not practice gender discrimination in the classrooms, previous research findings have revealed that teachers practiced gender bias based on stereotype beliefs in the classrooms particularly with regards to STEM subjects (Bar & Zussman, 2012; Burgess & Greaves, 2013; Hanna & Linden, 2012). Perhaps the impact of patriarchy is best summarized by Nhundu (2007) who argued that patriarchy is a set of social relations between men and women which has a material base and which, through a hierarchical system, creates interdependence and solidarity among men that enable them to dominate women. It is all about power and dominance.

6.9 Conclusion

The main findings that have been discussed in this chapter are as follows: First, the use of abusive language in the classrooms was not a very common practice by teachers in the schools which participated in this study. When used, it was mostly done to the boys. Second, the most frequently used means of communication between teachers and students were motivational language and positive feed backs. Girls received more motivational language and positive feedback than boys. Third, discouraging comments and ignoring of students were less frequently used techniques by teachers. Fourth, most teachers tried to treat boys and girls the same in the classrooms and firth, male students dominated both theory lessons and laboratory practical activities and displayed greater gender discriminatory practices. The chapter examined the learning experiences of students studying natural sciences to establish whether gender discrimination was practiced by the teachers as per the objective of research question 3. This was achieved through the analysis of items 15 to 23 of the survey and the seven variables of the lesson observation schedule. The results revealed that gender discrimination practices by teachers in the classrooms were not conclusively determined. However, the findings established that boys practiced gender discrimination in the classrooms. Plausible explanations were given by the researcher. The next chapter 7 analyses and interprets the results of research question.

CHAPTER 7

How does gender stereotyping manifests itself in schools?

7.0 Introduction

The focus of the previous chapter was on the analysis and interpretation of the results that addressed the research question 3 whose objective was to establish whether students experienced gender discrimination from the teachers in the learning of natural sciences. The results were inconclusive on teachers but revealed that male students practiced gender discrimination against the female students in the learning of natural sciences.

Chapter 7 presents the findings that addressed the research question 4 which sought to establish the agents of gender stereotyping manifestations. . Gender stereotyping is a generalization about the attributes of a specific group based on gender and is used to explain the differences in behaviour and ability and the roles in society an individual is expected to do (Fogliati & Bussey, 2013). Moloto, Brink and Nel (2014), in their study of exploring gender stereotypes in South African Higher Education Organisations, found out that the most prevalent stereotypes were based on gender, race, age, occupation and other work-related dimensions. Gender stereotyping continues to exist in society because of the various agents in which it manifests itself. One of the common goals of gender equality policies in education globally is to challenge traditional gender roles and stereotypes (Martín, 2011b).

There are various forms in which gender stereotyping manifests. This study looked at six, namely,the school environment, peers, teachers, parents, school set up (mono or co-education) and curriculum. The results of each are discussed in the following sections.

7.1 School environment

The first group of participants in this investigation were the school heads or principals. The findings show that the school environment is one of the main agents where gender stereotyping was manifested. Table 7.1 gives a detailed picture of the extent of gender stereotyping within the school environment.

Table 7. 1 School Profiles by Administration

School Code	A	B	C	D	E	Total	%
School Status	Registered	Registered	Registered	Registered	Registered		
Year Established	1971	1986	1960	1965	1979		
Highest Level Offered	Advanced	Advanced	Advanced	Advanced	Advanced		
Gender (Head)	Male	Male	Male	Male	Male	5	
Gender (Deputy Head)	Male	Male	Male	Male	Male	5	
Responsible Authority	Council	Government	Government	Council	Government		
Locality	Peri-Urban	Urban	Urban	Rural	Urban		
No. Of Teachers	28	81	53	36	106	304	
Teachers (Male)	15	35	32	19	53	154	50.7
Teachers (Female)	13	51	21	17	48	150	49.3
Science Teachers (Male)	2	5	5	3	13	28	9.2
Science Teachers(Female)	2	8	1	0	2	13	4.3
Responsibilities (Male)	4	6	3	8	14	35	11.5
Responsibilities (Female)	2	4	3	4	6	19	6.3
Total School Enrollment	665	2073	1320	853	3154	8065	
Enrollment (Male)	347	1022	652	445	1552	4018	49.8
Enrollment (Female)	318	1051	668	408	1601	4047	50.1
School Prefects (Male)	10	50	20	15	49	144	50
School Prefects (Female)	10	50	21	14	49	144	50
Class Representatives (M)	7	46	32	22	64	171	50
Class Representatives (F)	7	46	32	22	64	171	50
No. Of Classrooms	14	24	27	24	32	121	
Science Laboratories	2	2	6	3	4	17	
Science HOD’s	Male	Female	Male	Male	Male	5	
Computer Laboratories	1	1	1	1	1	5	
Natural Sciences Students	164	408	307	194	427	1500	18.6

Table 7.1 demonstrates that all the five schools, A, B, C, D and E, were not headed or deputized by female professionals. Interestingly, Mutangirwa (2016) found out that Zimbabwean women were marginalized in key decision-making positions due to the practice, attitudes and gender stereotypes of those in authority to appoint.

Appointment on merit was rarely used in most cases. The results are not unique to Zimbabwe alone. Research on Europe's education systems conducted by Forsthuber et al. (2010) found out that school leadership contained proportionally more men than women in principal ship, education inspectorate and assessment departments. School B had more female science teachers (61.5%) than male science teachers (38.5%) in its science department. The gender disparity was in favour of the female students since it provided them a source of motivation in the form of female role models. School E, with regards to female science teachers' role models, was not a good example with only two teachers out of fifteen total sciences teachers. They represented 13.3%.

The total female science establishment in the five secondary schools was half the establishment of male science teachers. The reasons for the discrepancies could not be unpacked during the time of study. However, if the results of Mutangirwa (2016) are to go by, it is most likely that the recruiting officials (school heads) could have been influenced by attitudes and gender stereotyping. The national shortage of science teachers in Zimbabwe, particularly females, due to their low uptake of STEM subjects both at high school and tertiary institutions cannot also be dismissed as a contributing factor. The five schools, A, B, C, D & E, had a total student population of 8065 but only 1500 (18.6%) were studying natural sciences.

The development of human capital through education has been widely acknowledged (Barro & Lee, 2013). But the economic and social development of any nation under modernity hinges on a solid scientific and technological base (Chikunda, 2014) and this is achievable by emphasizing the study of SMTs (Clegg, 2007).

Gender disparities within the school environments were not only confined to school headship but were also visible in other positions of responsibility within school setups, as shown in Table 7.1. Female teachers in administrative positions accounted for 6.3%

while11.5% represented male teachers. Specifically, only one female science teacher from school B was a head of department (HOD) from all the five schools that were studied. Notwithstanding the gender gaps among teacher leadership positions, Table 7.1 displays an equal distribution of leadership among students. The occupancy of leadership positions in the five school environments which were investigated appear to suggest a predominantly patriarchal society in which women in general have little space and power (Muringa & Makaudze, 2014) in Zimbabwe.

Informal observations made in the schools revealed that during assembly time boys and girls stood in separate lines. Girl prefects appeared to be concentrating their control and supervision among female students whilst the boy prefects were among all the students. In two of the five lessons which I observed the students sat according to gender. According to Trauth et al. (2008) the socialization theory argues that the task roles of males and females in society are the outcomes of sophisticated interactions between different cultural factors. Perhaps the behaviour of the students was a reflection of their cultural backgrounds. However, the practical groups that were observed had mixed gender. It is these findings together with the results of the composition of the school administrative structures that exposed the school environment as an agent of gender stereotyping manifestations. Peers, which are also believed to foster gender stereotype manifestations, are discussed, next.

7.2 Peers

Table 7. 2 Respondents by gender stereotyping beliefs

Item No.	Item Description	Male N = 343		Female N =233	
		Agree n = 184	Disagree n = 159	Agree n = 49	Disagree n =184
		%	%	%	%
1	Girls are not as good as boys in natural sciences.	53.6	46.4	21.0	79.0
		N = 566			
		n = 173	n = 164	n = 84	n = 145
9	Given a choice, I would rather be taught by a teacher of the same sex as myself.	51.3	48.7	36.7	63.3

Table 7.2 provides some indication of gender stereotyping which students hold among themselves concerning ability in natural sciences and the sex of the teacher that they prefer to teach them. There were more male students 184 (54%) against 49 21% of the female students who agreed that girls' ability in natural sciences was lower than that of the boys. Nevertheless, more female students 184 (79%) than male students 159 (46%) indicated that they were less able in natural sciences than the boys. The following extract shows the trend of the quantitative results.

FGD2: RM3: *I want to support the point of the other guy, even when we were created men had muscles and brain. We were made for tough jobs and women simple jobs, washing dishes, sweeping and washing clothes can't be hard, that's what they were created for. Men were created for harder jobs, so we should balance and assist each other. We should assist each other.* Line 125-130.

Deep-rooted gender stereotyping was evident in this extract. To this student, women cannot do tough tasks like studying natural sciences because they are not intelligen.t.

The strong beliefs that women are not intelligent suggest the influence of a strong patriarchal background. Mutekwe and Mutekwe (2012) noted that children growing up in a patriarchal society are taught from an early age to identify masculine and feminine roles. The boy's opinions add weight to the debate that cultural beliefs, norms and practices are difficult to change. The ones who benefit from the practices make sure that they transmit the beliefs to the next generations. More disturbing was the fact that the boy used his religious beliefs to justify the gender discrimination.

The implications of gender stereotyped beliefs assuming the status of religious beliefs in the classroom is worrisome because it stifles rational thinking at the expense of unquestionable faith. In my opinion a combination of unprogressive cultural and religious beliefs is an obstacle against the reduction of gender disparities in our schools and society at large. Equality in the status of men and women is basic to every society as argued in section 2.2.3 under the Gender and Development Theory (GAD). The abilities of both men and women must be strengthened to bring about social change argued (Currie & Vernooy, 2010). The battle can neither be won by men alone nor by women alone argue the advocates of the GAD theory (Connelly et al., 2000; Hendriks, 2005). The conqueror attitude only helps perpetuate gender discrimination from either side.

FGD3: RM3: *I think girls just lose focus, they (laughing) don't understand better than boys, I mean boys they understand Engineering better than girls.* Line 34-35.

Girls were perceived as unable to understand engineering better than the boys. Boys and girls interact with each other both at school and home and the influence they impose on each other is very effective. Peers use each other to assess their own achievement and career aspirations and endorse gender stereotypical behaviour and punish non-conformity (Hannover & Kessels, 2004). In short, peer friendships are built on voluntariness and coercion. According to Juvonen et al. (2011), peer friendships are products of both pro-social and anti-social ingredients. As the saying goes 'birds of the same feather fly together, peers become friends due to common interests and goals and vice versa'. The desire to belong to a group is very strong in children. Leaper et al. (2012) posited that girls valued more peer support to choose mathematics and science subjects through closer and smaller networks of friends than boys and boys who were not emotionally attached to the many wider networks of friends. It would appear that in the Makonde District most peer groups of girls were not in natural sciences since the number of girls who were studying the subjects was very small (Tables 1.2 to 1.5)..

Adolescents' academic achievement is greatly influenced by the norms and characteristics of peers (Eccles & Wang, 2012). In chapter 6, it was established that most male students practiced gender discrimination in the classrooms and such practices contribute to the girls' poor performance. The same observation was made in Mwamwenda's (2013) in South Africa on adolescents' gender stereotypes, differences and other aspects of behaviour. The study revealed that boys discriminated against girls in the learning of sciences because the boys believed that they were better than girls in such subjects.

FGD4: RF2: *Sciences are too hard, I'm doing Commercials because I had 2 Cs in Biology and Physics, so they are too hard. Boys are naturally good in sciences than girls.* Line 69-70

Gender stereotyping was apparent in some of the girls' sentiments. RF2 is one of the females who accepted the status quo and endorsed it. These are the girls who, despite of their ability to do sciences, would still refuse to study the subjects. As a result, becomes difficult to achieve gender equality in the choice and learning of natural sciences. Under such conditions, teachers are likely face a lot of resistance and may require to put a lot of effort to change the mindset of such students. Such negative stereotypes (Wang & Degol, 2013) aid discrimination.

. Table 7.2, item 9, indicates that that 173 (51%) of the male participants preferred a male teacher against 164 (49%) who disagreed. Most female participants 145 (63%) were neutral against 84 (37%) who preferred a female teacher. The results show that more male students preferred to be taught by the same sex than the female students who had a lower number preferring their own sex. The interview results showed compatibility with the survey results demonstrated in Figure 7.1. In this category, participants were asked to give a detailed explanation and justification of their choice of teacher.

N = 42: Females n = 24 & Males n = 18

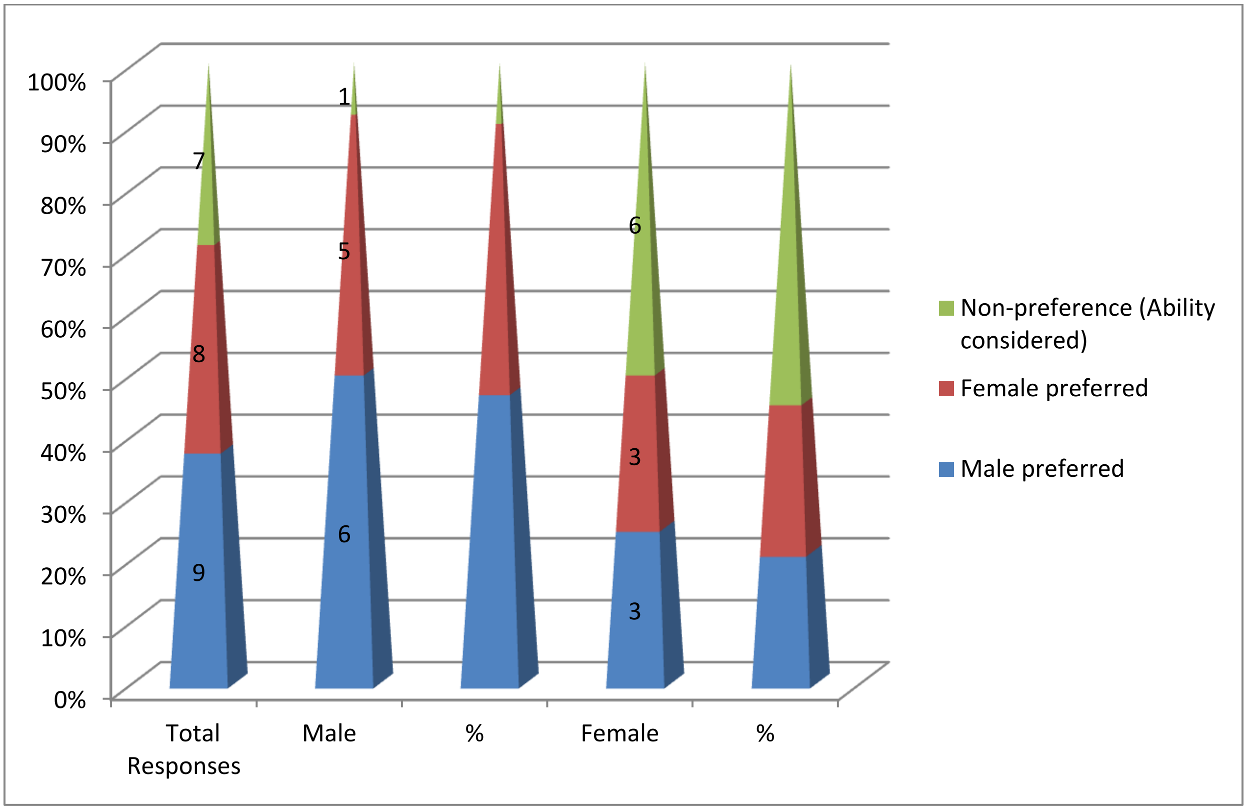


Figure 7. 1 Teacher preference by students

In question three of the semi-structured interview schedule, the participants was asked for their opinions on the gender of the teacher they would prefer to teach them natural sciences. The Figure shows that a total of 25 students were interviewed and 9 of them preferred to be taught by a male teacher, 8 by a female teacher and 7 preferred the ability of the teacher rather than the gender of the teacher. Out of the 9participants who preferred a male teacher, six were male students and three were female students. Five male students preferred a female teacher against three female students. Of the seven non-gender preference, six were female students and one male student. It appears male students exhibited gender bias towards their own sex. Various reasons were given, and some of them are shown in these quotes.

FGD1: RM6: *Laughing. The way I see it, science requires a male teacher because women are weak in doing experiments. I never did experiments in form1 and form 2 when taught by a female teacher but started doing experiments in F3 when taught by a male teacher. They are lazy. One would just read a book as they teach without any explaining and we end up not understanding the concepts.* Line 386-390.

Female teachers are portrayed as weak in conducting practical work and are classified as being lazy by RM6. The language used by RM6 shows some elements of bitterness and this may be due to what he had experienced as he was growing up. His generalizations display some deep ingrained gender stereotyping beliefs. The suggestion that he never did an experiment under the instruction of a female teacher appears far-fetched other than to assume that it was said out of contempt of female teachers.

FGD4: RM8: *It is true the female teachers would take students at heart when teaching natural sciences and the female teacher would have that motherly advice. But focusing on physics and chemistry most of the things we are learning there were discovered by the male scientists like Isaac Newton and many other laws we learn in chemistry and physics are linked to men, so I think it should be left to the men to teach sciences since they made most of the discoveries.* Line 211-216.

According to this interviewee, discoveries in natural sciences are attributed to men and not women. The views of RM8 support the survey findings of section 5.1.2 where most of the participants drew a scientist of their own perception as males and among the named famous scientists there was not a single female scientist and a black person.. The problem is not with the students but with the curriculum that has remained colonized and gender insensitive (Chikunda, 2014; Charles Chikunda & Chikunda, 2016; Chinyani, 2007; Gudhlanga et al., 2012).

Textbooks used in schools portray science as a male domain with great discoveries and inventions credited with men of Caucasian origin at the expense of other world races. Great female scientists are rarely included in the text books. Africa has produced world respected scientists of the likes of Professor Christopher Chetsanga of Zimbabwe a biochemist who discovered the two enzymes that are involved in repairing a damaged deoxyribonucleic acid (Zimbabwean scientists- Wikipedia) Kenya has Juliana Rotich accredited with the founding of the innovation hub (iHub) and South Africa has Kenneth Nkosana Makate who invented the please call me service for the Vodacom Company (Great African scientists- Wikipedia). Textbooks have remained archaic focusing on scientists who lived long ago at the expense of modern scientists.

Female teachers are said to be considerate and emotionally accommodating. They display motherly advice to students. The kind of motherly advice was not clarified. Female students who preferred male teachers had this to say:

FGD3: RF6: *I think when someone is in a lesson I think it's comfortable to have a male teacher teaching in front of you because actually from my own opinion males and females in comparison females are slightly short tempered, not that much but slightly, if they explain to you something and you don't understand they are like "what don't you understand" (laughing) and then you just go even if you don't understand, for a male teacher if he tries to be harsh he controls himself, males can control themselves and explain again but females just burst.* Line 149-161.

According to RF6, Female teachers have tempers. They shout at students instead of explaining. Male teachers can control their temper and have the patience to explain difficult concepts to the students. This type of gender stereotype is explained by McShane and Von Glinow (2014, p. 53) who note that "stereotyping is the perceptual process in which individuals assign characteristics to an identifiable group and then automatically transfer those features to anyone they believe is a member of that group". It is possible that the participant may have experienced this kind of behaviour with some female teacher or had been influenced by peer groups and was generalizing it to every other female teacher.

Figure 7.1 show that a total of eight participants indicated their preference to be taught natural science by a female teacher. Of these respondents, five were male students representing 62% and 3 were female students accounting for 38%. A variety of opinions and justifications were cited by the respondents as exposed in the following extracts.

FGD2: RM2: *Myself I would like to be taught by a female teacher, usually most of the times male teachers tend to get angry faster than females, us as students we take time to understand some concepts and male teachers are easily provoked and ends up calling you names but female teachers take their time explaining so that you understand the concept. I think being taught by a teacher of the same sex as your-self is not proper. (Laughs).* Line 331-336.

Issues raised include that male teachers easily get angry and emotionally abuse students through name calling. Female teachers are patient. These views are in contrast with the views of RF6 of FGD3 discussed earlier. The interviewees were from different schools and these results seem to reinforce the proposition that gender stereotyping manifestation is specific to groups and individual experiences.

FGD3: RM4: *Personally, I would prefer a teacher of the opposite sex like a female teacher male teachers teach natural sciences based on their terrible experiences which they had during their A levels and University, so they would like to teach us using the same methods under harsh conditions whereas female teachers take us bit by bit (laughing). They are patient, male teachers are not.* Line 140-144.

Male teachers are perceived as very strict and apply their terrible university experiences to teach. They are too fast and lack the patience to explain slowly which the female teachers have.

FGD3: RF1: *(Laughing) I prefer a teacher of the same sex, exactly because I'm not that free with male teachers, my father and my brothers yes, not my teachers, well I really don't know, I haven't thought about it, I'm just much free with female teachers than male teachers.* Line 123-126.

This data demonstrate the fact that some female students prefer female teachers to male teachers. Her sentiments appear to indicate a history of abuse of some sought which could be some form of sexual abuse or could have been told or read about male teachers abusing female students. Nonetheless, her views exhibit some elements of gender stereotyping. The third group of participants was comprised of students who did not regard the gender of the teacher as a criterion of choice but considered ability. Out of the seven respondents who preferred the ability of the teacher and not sex, only one male student (14%) and six (86%) female students showed non-preference. These results seem to suggest that female students were more objective in the choice of a teacher than the male students who prioritized gender over the ability of the teacher. The results indicate the different levels of maturity between boys and girls at the adolescent stage. The average age of the participants was 15.5 years with most of the respondents fitting into the adolescent stage. These are the views of some of the non-preference group.

FGD1: RF5: *I have the point that female teachers are not afraid of male students because we have subjects such as mathematics which is taught by lady teachers but in class nobody makes noise, as soon as she gets into class everyone becomes quiet, it just depends on who is teaching the sciences, if a lady teacher is lazy you might quit but if she has ability you won't quit. The sex of the teacher does not matter.* Line 377-381.

The message from the interview is that female teachers can be good classroom managers and can enforce discipline. Lazy teachers should not be chosen regardless of their sex. Ability of teacher is the important attribute which should be considered.

FGD4: RF7: *Yes, in my own opinion I prefer both teachers, male and female teachers it's all about experience about the subject and what he/she has in store for me and also whether he/she teaches me to be free to all the teachers and treat them the same and have that same respect and to love them equally whether male or female so to me male and female are okay. It is about whether the teacher can teach or not.* Line 206-210.

Teacher choice is based on the experience of the teacher (RF7). It is evident that the interviewee values her freedom to associate with all the teachers if it is guided by equal treatment, respect and love but her choice of teacher is determined by experience and ability of the teacher. These views seem to indicate some wisdom from the respondent.

FGD3: RM7: *It's just the same as guidance and counseling or going to see a doctor. You can be treated by a male or a female doctor because they are both qualified. So, if the teacher is qualified does it matter who teaches you? Myself, I will choose a teacher who knows the subject most. If the students fail every year ooh (laughing) I will not go* *into that class and if the headmaster forces me I will change the school. The sex of the teacher is not a problem.* Line 163-168.

RM7 responded that qualification and subject content knowledge influenced his decision concerning teacher preference. The lack of freedom to choose that was discussed in chapter 4 section 4.4 is repeated by the participant.

7.3 Teachers as agents of gender stereotyping

N = 8: Female n = 5 & Male n = 3

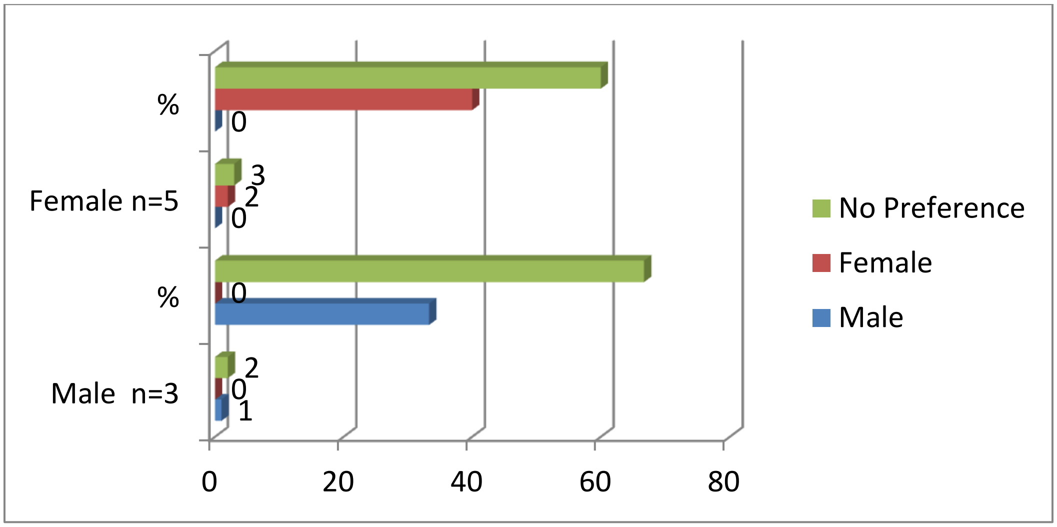


Figure 7. 2 Teacher preference by gender

Five female teachers were adamant that they did not want their own children to be taught natural sciences by a male teacher. Only one male teacher preferred his child to be taught natural sciences by a male teacher. As if it was tit for tat all the male teachers (3) did not want their children to be taught natural sciences by female teachers. All the teachers were interviewed separately and on different days eliminating chances of direct exchange of opinions. Two female teachers did not mind their child being taught natural sciences by another female teacher. The non-preference of a teacher due to sex was cited by 2 male and 3 female teachers. They considered the ability and not sex of the teacher as their guiding principle. The number of female teachers and female students who displayed a greater preference of teachers based on ability and not gender was more than that of the male teachers and male students. Only one male student out of seven interviewees cited ability and not gender of the teacher as a criterion for choice (Figure 7.1). The findings seem to suggest that male students were more gender stereotyped than the rest of the participants in the study.

The tacit assumptions about gender and the general lack of awareness by teachers on how they use gender as an organising and categorising tool have great effects on student behaviour (Tsouroufli, 2002). When asked: Which sex of teacher would you like to teach your son or daughter natural sciences? This is what some of the teachers said:

MT1: *Laughing. Males obviously, males I mean their masculinity and discipline, I think the students tend to you know. I don't know what you can say. They normally obey the male teachers more compared to their female teachers. Several times you must chip in when certain lady teachers at school are referred to. Uh I think it's both, uh maybe the feminists will kill me, but I think naturally uh ladies are not, women are not aah, that very what can we say? They are not that rough they are softer than their male counterparts; they would even be more lenient.* Line 140-146.

Teacher MTI started his response with laughter because he had been asked this question: Which sex of teacher would you prefer to teach your child natural sciences? The laughter was somehow sarcastic and seemed to imply that how could I ask such a question hence his answer "males obviously". The respondent was aware that his views were gender stereotyped and not factual. That is why he says: "maybe feminists will kill me". Allegations of women being softer and lenient than men when working with students were raised in this interview. The perceptions of the male teacher MT1 are most probably a reflection of the norms and values of a patriarchal society of which he was part of and may be explainable in that context. In a patriarchal culture, the boy child is socialised to behave like the head of the family and the protector of the weaker sex (females). Therefore, the head of a family and a protector for that matter cannot take orders from a female teacher. The decision to obey or not to obey a female teacher by a student depends on a lot of factors and cultural beliefs being one of them. A male student from a very conservative patriarchal culture may not respect a female teacher and may find it difficult to take instructions from her. The disrespect of the female teacher is not always intentional. It is how the student has been socialised. The same behaviour can also be displayed by female students with similar backgrounds because to them the female teacher irrespective of her level of education is obliged to respect the culture. It is really a clash of beliefs at interplay here. These results reinforce the argument of Charles Chikunda and Chikunda (2016) that curriculum re-orientation is not likely to be successful if it is done superficially without shaking the patriarchal roots that shape cultural values of the practitioners.

FT5: *Hey ha that's a difficult one (laughing) that's a difficult one ha because both are ok, but I would prefer the ladies because the ladies are more patient. As teachers of natural sciences, we have discovered that they have that motherly nurturing spirit. Umm males are good but most of the times they don't have time for nonsense but motherly nature in the females can help even those who do not have confidence, so I would prefer ladies yah.* Line 126-131.

The views of the female teacher FT5 are in sharp contrast with the opinions expressed earlier by the female student RF6 of FGD3 in Section 7.1. RF6 said that female teachers were short tempered and did not have the patience to explain difficult concepts and hence she preferred a male natural science teacher. However, FT5's views corroborated the views of FGD2-RM4, FGD3-RM4 and FGD4-RM8. FT5 argues that female teachers are endowed with motherly care and tolerance for nonsense. The views of the teachers and the students may be true or false but what is clear is that they provide evidence that teachers and students can be agents of gender stereotyping. According to Keller, (2013) a direct relationship exists between the emphasis on stereotyping math and science as a male domain by the teacher and the strength of endorsement of math and science gender stereotyping by the students. I believe that the more an idea or perception is repeated the greater the chances the perception becomes a reality to the recipient.

FT4: *Mmm, I have no preference, male or female if the teacher is committed. So, you really need someone who has passion for teaching someone who really wants to see his or her pupils pass. Someone who really wants to teach his or her subject not just there to work and earn money.* Line120, 126-128.

Respondent FT4's preference of a teacher was not guided by gender stereo typing but by other attributes like commitment and passion for the job. The opinions of FT4 represented the views of many teachers (67% males and 60% females as shown in Figure 7.2) who cited ability of the teacher as the yardstick for choice. The indicators are that modern life styles and integration of different cultures seem to have failed to change the deeply rooted gender stereotyped beliefs emanating from our patriarchal culture. The results of the study are consistent with the findings from Radu and Chekera's (2014) which concluded that the most common gender discrimination was gender stereotyping and it was committed by men but in this study it was the boys. The significance of these results is that they expose the need for the policy makers and curriculum designers to introduce gender education and human rights as examinable subjects from primary level upwards.

Apart from Zimbabwe, as shown by the results of this study, gender stereotypes and their agents in schools have been observed in other countries such as South Africa (Moletsane, 2010; Mwamwenda, 2013; Mwamwenda, 2011; Shepherd, 2017). In his study of South African Junior Secondary School teachers on teachers' gender stereotypes, Mwamwenda (2011) established that teachers favoured boys to study mathematics and science than girls and school activities were endorsed for males and females along gender stereotyped roles. Ifegbesan's (2010) study in Nigeria portrayed men as strong and intellectual and women as emotional and warmly and lacking competence. Teachers were found to be encouraging gender stereotypes in school subjects and academic performance. A study done in Kenya by Bosire, Mondoh and Barmao (2008) dismissed any link between Western civilization and gender stereotypes practised by Africans arguing that from time immemorial, African traditional education has been gender stereotyped. Still in Kenya, Okumu's (2013) study on factors influencing the choice of science subjects discovered that gender did not influence the choice of subjects, but the teachers influenced the choice of science subjects based on their gender stereotyped perceptions and backgrounds. A study noted by Terrier (2016) in the United States of America (USA) middle school teachers practised gender-biased grading in mathematics to favour the girls than the boys. This resulted in boys lagging in the subject and most of them opting not to pursue sciences at high school since they believed they were not very good in mathematics. From these results, it is evident that gender stereotypes of teachers have an impact on the choice and performance of a subject. The following section looks at parents as agents of gender stereotyping.

7.4 Parents

The 8 teachers who participated were assumed to be a fair representation of parents. The views of the parents were also indirectly obtained from the responses of the students. Gunderson et al.'s (2012) study on the role of parents and teachers in the development of gender related math attitudes affirmed that parental beliefs influenced the ability beliefs of the youth which in turn impacted their future achievement and career choices. In Chapter 5, the findings revealed that the parents discriminated against the girl child based on their cultural beliefs which mostly symbolize gender stereotyping. The traditional beliefs held by most of the parents were alleged to have disempowering effects on the freedom of choice, movement, association and independent decision making of the girl child. The teachers, through the views of MT2, acknowledged that they would not grant their girl child the same freedom of movement and choice as they would do to the boy child. Parents were cited as among some of the main propagators of gendered beliefs. The implication of the finding is that parents are the first educators of the child and the impact they have on the child may last longer.

7.5 School Setup (co-education)

The set-up of all the five participating schools was co-education. The lesson observation schedule of Chapter 6 served a dual purpose. It allowed me access to the lessons and helped in determining whether the co-education set up is an agent of gender stereotyping or not. Table 7.3 below summarises the lesson observations.

Table 7. 3 Teacher-student interaction

Variable	**Boys**	**Girls**
Abusive language	7	3
Motivational language	61	66
Positive feedback	28	28
Negative feedback	9	6
Class participation	60	55
Practical group leader	10	7
Dominant sex in group	3	1

There is no consensus on whether mixed or mono-sex classrooms perpetuate gender stereotyping manifestations or not. The position of the advocates of mono- sex settings Cherney and Campbell (2011); Feniger (2011),Huguet and Regner (2007) is that teachers in mixed-sex classrooms tend to give more attention to boys than girls. They argue that single-sex settings help girls overcome gender stereotypes and perform better than the girls at co-education schools. The results in Table 7.3 indicate that the boys receive more attention from the teachers in 5 of the 7 variables that were looked at. Girls received more attention than boys when being motivated and getting positive feedback. Probably, through experience, teachers had realized that girls perform better and develop interest in the subject through praising. Practical groups were led by more boys than girls by a ratio of 3 to 1. This demonstrate some gender disparities between teacher student interaction and appear to justify the notion that co-education schools act as agents of gender stereotyping..

The proponents of mixed-sex education argue that learning takes place in a normal and natural environment which enables both boys and girls to be inducted into the prescribed roles demanded by society (Martín, 2011b; Patterson & Pahlke, 2011; Yazilitas et al., 2013). These advocates believe single-sex schools do not prepare children for the real practical world where male and females live side by side. Isolating either sex is endorsing gender stereotypes (Patterson & Pahlke, 2011). The merits and demerits of the debate by either side seem to suggest that both types of school setup promote gender stereotyping.

7.5 Curriculum

The focus of this study was not on looking at the type of science curriculum offered in the Zimbabwean schools, but evidence has shown that there is lack of gender responsiveness in the pedagogy in schools (Chikunda, 2014; Mutekwe & Mutekwe, 2012) and textbooks used in schools are not gender-sensitive in terms of language and illustrations (Chinyani, 2007; Nhundu, 2007). Regardless of the claims of neutrality and lack of bias, assessment tools and procedures often have been found to be gendered (Forsthuber et al., 2010; Terrier, 2016). These findings are concurred by the results of section 5.1.2 in which most of the participants drew a scientist as a male and of Caucasian origin.

7.7 Conclusion

With regards to Makonde District high schools gender stereotyping in the learning of natural sciences manifested itself mostly in students but mainly the boys. Parents came out as major players in the transmission and enforcement of gender stereotyping. Teachers and girls did not show much gender stereotyping. The school environments of Makonde District high schools showed gendered patterns against the girl child in terms of role modelling and most likely influenced her negatively in the learning experiences of natural sciences.

The significance of the results is that they help interested stakeholders in education and the society at large to know the causes and propagators of gender disparities in the education system particularly in the uptake and performance in STEM subjects by female students. The problem of gender stereotyping requires a multi-sectoral approach where everyone is involved through civil society groups, churches, political rallies and other social groupings. The media, particularly radio and television, should aggressively be used. Schools are encouraged to offer relevant curricula and implemented through practical education policies. The emphasis should be on the importance of gender equality, respect for human rights and dignity and decision making based on scientific thinking and evidence. The chapter focused itself on the discussion of agents of manifestations of gender stereotyping in the schools under study. It analysed the opinions of students and teachers thereby accomplishing the research objective of question 4. Related literature on school setups and curriculum was discussed as it pertained itself to the objective of the research question. Chapter 8 focuses itself to conclusions, implications and recommendations.

Chapter 8

Conclusions, implications and recommendations

> I'm excited because earlier I didn't think about the issues between females and males in science. I see now that there's so much that can stop a woman from getting a career compared to a man. With men you're expected to do well and get the support, but for females, you have to sacrifice something in a different way from men, and I didn't realize that earlier. I think it's very important for other woman to see that I have had success. May-Britt Moser, neurologist and winner of the 2014 Nobel Prize in Physiology as quoted in (BUSTLE).

8.0 Introduction

This study set out to explore gender disparities in the learning experiences of students studying natural sciences in selected high schools of Makonde District in Zimbabwe. Chapter 8 concludes this journey that started with chapter 1. I started Chapter 1 by introducing myself and articulated the motivation behind the study that there are gender disparities in science education in the background of the study. Literature indicated that despite efforts advocated f by interested stakeholders, gender inequality in education and particularly in science education continues to exist. In my research, I set out to investigate and understand the dynamics behind gender disparities in natural sciences education in Makonde District in an effort to contribute towards the solving of the problem. Through the guidance and use of the Micro, Macro and Institutional (MMI) theoretical framework, I adopted the Mixed Method Research (MMR) methodology in pursuit of the set objectives.

Chapter 8 underlines the summary of the methodological findings of each research question. Significant contributions to new knowledge, recommendations, implications and limitations where they prevail, will be highlighted within the discussion. An end message concludes the chapter. This study was driven by the main research question "What factors influence gender disparities in the learning experiences of students studying natural science subjects in selected high schools of Makonde District?” The key question was divided into four sub-research questions:

- What factors influence choice in natural sciences?
- Which factors contribute to the low choice and performance in natural sciences by female students and why?
- Do students experience gender discrimination from the teachers in the learning of natural sciences?
- How does gender stereotyping manifest itself in schools?

To address these questions, I adopted a socio-psychological approach to investigate the gender disparities in the schools using a pragmatism paradigm. Based on the findings of this study, I am inclined to believe that the adoption of the MMR methodology in combination with the MMI framework is the new approach to understand comprehensively gender disparities in education. I believe it is a holistic approach to study gender issues in society than using either masculinist or feminist approaches separately. This method demonstrates the importance of using both sociological and psychological theories in researching problems which constitute complex gender issues in a less subjective way.

A beginning researcher like me in pursuance of a Doctor of Philosophy might not have done much justice to the ideas enshrined in this methodology. However, to reduce the limitation, I read the literature on sociological and psychological theories on gendered patterns on educational choices and performance extensively. I also presented my ideas through publications, conference presentations hosted by the Southern African Association for Research in Mathematics, Science and Technology Education to get feedback from experienced researchers and colleagues. It is in this regard that I put together this methodology which this study adopted, and I believe it may be used by other researchers in further investigations in this area. The story that I am telling in this thesis is by its nature very amusing, informative and intriguing.

8.1 Overview of my findings

The pieces of evidence that emanated from this study suggest that gender disparities in the learning experiences and study of natural sciences by students is a culmination of intertwined internal and external factors of socio-psychological origins. The findings revealed the existence of gender disparities in natural sciences learning. It was also found that male and female students' learning experiences were different from each other. These findings agreed with those of Jones, Howe, and Rua (2000), Jadidi, Karimi, Lietz, and Wagner (2017) and Reiss and Mujtaba (2017) who established that sciences learning experiences are related to gender. Gender stereotyping and discrimination by male students were found to be rife in the classrooms. Female students perceived their classrooms to be gender biased.

A number of issues like the STEM project emerged from the investigation and did not appear to directly address the research questions but their discussion was included in this report in line with the requirements of the pragmatism research paradigm that was adopted in this study. It was found out that the interplays result from complex interaction of factors influenced by micro, macro and institutional environments. These findings illuminate the challenges faced by interested stakeholders in area of gender and science education and the broader society at large on trying to attain or reduce gender inequality in education in general and science education in particular. In the next sections, I present the conclusions on the findings of each research question.

8.2 Summary conclusions of each research question's findings

8.2.1 Research question 1: What factors influence choice in natural sciences?

The research objective of question 1 identified eight factors which are: Interest, social benefits, ability, school policy ability, career, funding, role models and stereotype beliefs. There was no evidence of gender disparities or disagreements in the choice of the 8 factors of natural sciences. Gender disparity manifested itself in the prioritization of the career choice factor. Male students considered career a more important factor than female students and this confirms findings from numerous earlier studies (Ceci & Williams, 2010; Mellors-Bourne et al., 2011; Reiss & Mujtaba, 2017; Wang & Degol, 2013). Factors such as interest, social benefits, ability and stereotype beliefs were given high priority by both male and female students whilst school policy ability and role models factors were lowly prioritized.

Students considered the use of the school policy ability (SPA) by schools in enforcing the choice of natural sciences as an infringement of their basic right to freedom of choice enshrined in the Constitution of Zimbabwe on human rights. The STEM project introduced by government in 2016 was viewed as a good project by most of the teachers but was criticized for lack of proper planning and consultation with interested stakeholders.

It appears like students involved in this study chose natural sciences based on their own adequate knowledge notwithstanding the interference from the school authorities through the SPA. The implementation and enforcement of the school-based policies that curtail the freedom of choice of students in science and technology-based subjects has wider implications in the attainment of science and technology education in future. This challenge is much greater for Sub-Saharan Africa, Zimbabwe included, where gender disparities are much wider and have been shown to impede economic growth and empowerment (Hakura, Hussain, Newiak, Thakoor, & Yang, 2016).

8.2.2 Research question 2: Which factors contribute to the low choice and poor performance, in natural sciences by female students and why?

In this study, nine factors were established and these comprised of 4 internal factors (ability, attitudes, self-efficacy and concentration span) and 5 external factors (parental discrimination, social pressure, household duties, stereotype beliefs and role models).

Female students did not believe that ability in natural sciences and self-efficacy had much influence in their low choice and performance of natural sciences. These findings concurred with the results of the study done by Christensen et al. (2014) and the report in the Guardian (2013). However, the female students conceded that negative attitudes and a lower concentration span affected their performance in natural sciences.

External factors have the greatest impact on the choice and performance of natural sciences by female students. Parental discrimination and household duties factors contributed most to the problem of low choice and poor performance. Parents were accused of giving different treatment to the male and female child. It was alleged that parents favoured the male child over the female child through selective support and encouragement. Freedom of choice and movement was not very restrictive with the males as it was with the females. Female students spent most of their study time doing household duties than the male students and this affected their performance of the subject.

Female students experienced and succumbed more to social pressure than male students. Stereotype beliefs disadvantaged the female student more than the male student in both attitudes towards and performance of natural sciences. This finding resonated well with the findings of Fogliati and Bussey (2013), Miyake et al. (2010) on the effects of stereotype beliefs on choice and performance of STEM subjects. Lack of or presence of few female role models negatively affected the female students' uptake and performance of natural sciences.

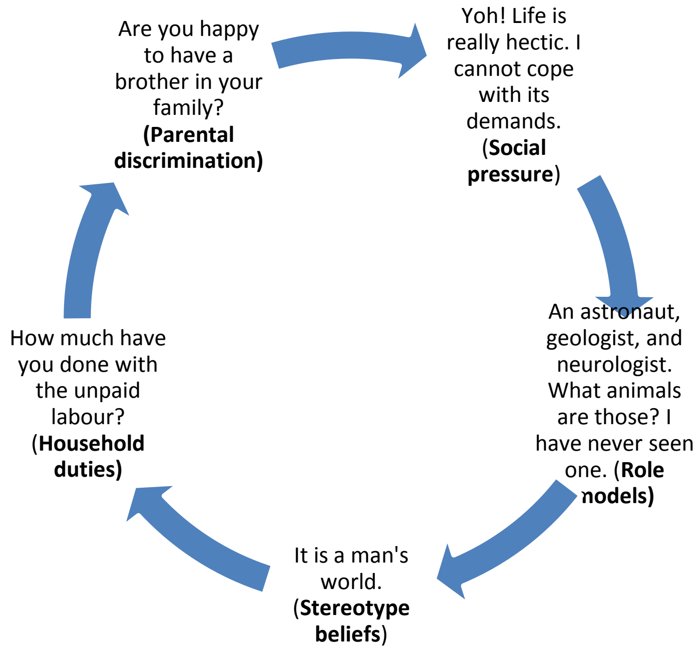


Figure 8. 1 Conversation-Concept Model of FPPR

After analyzing the results and listening to the interviews related to research question 2, I came up with what I term a conversation concept model (CCM) to illustrate the factors behind the females' poor performance, as shown in Figure 8.1.I maintain that this model can be useful to teachers and presenters at workshops in highlighting the challenges faced by female students in the choice, learning and performance of natural sciences in particular and other subjects in general in a humorous and participative way.

The findings of this study illuminate how gender interplays with other environmental, behavioural and personal factors are related to high school female students' perceptions of what militates against their performance in natural sciences. It did also establish that both internal and external factors influence choice of natural sciences by both male and female students. Such observations have been made in the United States of America (USA)(Hill et al., 2010; Ing, 2014). In Zimbabwe, researches done by Dube(2015), Masinire (2011), Mutangirwa, (2016) and Mutekwe et al. (2012) provided similar evidence. Jansen et al.'s (2015) study conducted in Germany on students' self-concept and self-efficacy in the sciences identified a similar trend.

The significance of the results is in highlighting some of the critical challenges confronted by the female students on a daily basis both at school and at home in the pursuance of education in general and STEM subjects in particular. The findings also reveal a paradigm shift in the thinking and perceptions of female students towards natural sciences (Christensen et al., 2014). The small numbers of female students studying STEM subjects has wider ramifications in the economic and social development of Zimbabwe. It is well documented that women play a pivotal role in the economic growth of a nation (Hakura et al., 2016). Therefore, the negative socio-economic implications of the underrepresentation of women in STEM related disciplines which are some of the key drivers of a country' economy should not be underestimated.

8.2.3 Research question 3: Do students experience gender discrimination from the teachers in the learning of natural sciences?

This study established that the sampled teachers and students held mixed views and practices on all the nine aspects investigated in the survey for students and lesson observations for teachers. Notwithstanding this, certain trends did emerge leading to the following conclusions.

The practice of gender discrimination in the classroom by most teachers was not prevalent and apparent in this study. These results contradict the findings of previous studies (Bar and Zussman, 2012; Burgess & Greaves, 2013; Hanna & Linden, 2012; Ifegbesan, 2010; Mwamwenda, 2011) which revealed that gender discrimination based on stereotype beliefs was practiced by teachers in the classroom particularly in science, technology, engineering and mathematics (STEM) subjects where teachers favoured boys over girls to do the subjects. The use of motivational language as a teaching technique or strategy was the most adopted by teachers in this study as indicated in the following rankings.

1) Motivational language……….63.1%
2) Positive feedback……………28.0%
3) Ignoring………………………16.4%
4) Negative feedback……………7.5
5) Abusive language……………5.0%

Theory lessons by the teachers were done under conducive learning environments as indicated by more than half of the students (57.2%), shown in Table 6.1 who voluntarily participated in the lessons. However, more male (29.9%) than female (27.3%) students participated. The findings of this study corroborated the results of the study done in Scotland by Howe (1997) on gender and classroom interaction. The study concluded that boys dominated classroom discussions in co-education set ups. Laboratory activities had more male students as group leaders than female students who dominated the conduct of experiments.

Male students emerged as the main perpetrators of gender discrimination in the classrooms and laboratories than the female students and teachers. The dominance of male students in both theory lessons and practical activities did not surprise me at all. In my culture, which is patriarchal, socialization of girls and boys is different from an early age. Boys are socialized to be aggressive, dominant and be prepared to head and provide for the family whilst girls are taught to be meek, feminine and good followers and respecters of males including their brothers who may be younger than themselves (Chinyani, 2007; Leach et al., 2003; Mutekwe et al., 2012; Nhundu, 2007; Radu & Chekera, 2014).

The implication of the dominance of male students in laboratory practical work leadership and class participation is that it appears to send wrong signals and to create an impression that leadership in natural sciences is a male domain which may necessarily not be true. The findings perhaps give some indicators on the extent to which gender stereotype beliefs on gender roles and equality are entrenched in society as reflected in the responses of the young male students in this study. The beliefs held by the young male students who represent the future generations of the country have the potential to drag the nation backwards socially and economically.

The significance of the findings is that while teachers appear to play an insignificant role in gender discrimination, boys appear to be the main culprits of advancing gender discrimination within the classroom and this affects the girl child's achievement in the sciences in co-educational schools, as demonstrated in Makonde District.

8.2.4 Research question 4: How does gender stereotyping manifests itself in schools?

This study further identified and analyzed how gender stereotyping manifested itself in schools. As I explored the gender disparities in the learning experiences of students studying natural sciences in Makonde District and navigated through the journey, I identified six main agents of gender stereotyping and concluded the following:

School environment: Gender stereotyping in the school environment manifested itself through administrative and staffing structures (see Table 7.1). The school environments which were highly gendered against the female students fell short of providing the students the much-needed role models. The results agree with the findings of previous studies (Dunne et al., 2005; Muringa & Makaudze, 2014; Mutangirwa, 2016) done in Botswana and Ghana and Zimbabwe, respectively. Martín's (2011b) study conducted in Europe disclosed a similar trend of results. Peers: The manifestations of gender stereotyping were significantly apparent in male students than in female students. Most male students wanted to be taught natural sciences by male teachers and not female teachers (see Figure 7.1). More than half of the sampled male students believed that they were better than the female students in natural sciences (see Figures 5.2, 5.3 & Table 7.2.) These findings concur with the results of the study done Gudyanga, Adam, and Kurup (2015) on Zimbabwean female participation in physics at A- level which revealed that attitudes of male peers in the classes at O- level influenced the female students' participation in physics at A- level. These results are not unique to Zimbabwe. In South Africa, Mwamwenda's (2013) study on adolescents' gender stereotypes, differences and other aspects of behaviour revealed that girls interact with other peers better than boys and the boys believed that they were smarter than girls in sciences.

Teachers: The majority of the teachers in the study did not display obvious gender stereotyping manifestations. Results indicated that the teachers tried to treat male and female students equally at school. In contrast, (Okumu, 2013) in Kenya found that teachers influenced the choice of sciences by students based on their gender stereotyped beliefs and backgrounds. Parents who in this study were assumed to be represented by the sampled teachers exhibited deep rooted gender stereotyping with regards to gender roles and freedom of movement of the girl child at home. It seemed like the teachers displayed double behaviour because at school the teachers tried to treat male and female students the same but at home, as parents they treated the same students differently. I was left puzzled by these observations and could only assume that at school the teachers tried to abide by the laws of the country so as to safeguard their work.

School set up: In terms of teacher student interaction, the co-education set up of the schools showed inconclusive evidence of gender stereotype manifestations. Curriculum: Review of documented literature in (Chikunda, 2014; Gudhlanga et al., 2012; Mutekwe et al., 2013); Nhundu, 2007) disclosed that the Zimbabwean school curriculum especially textbooks is gendered against the female student. Studies done in the European Union (EU by Forsthuber et al. (2010) Hanna and Linden (2012)) and Terrier (2016) USA found that assessment tools and procedures were gendered.

The importance of these results is that they assist academics and other stakeholders realize that, in spite of many initiatives done in Zimbabwe and globally, gender disparities in science education continue to be a major challenge (Larivière, Ni, Gingras, Cronin, & Sugimoto, 2013). The observations and evidence from this study that school environments, male students and school curricula are in the forefront in propagating gender stereotyping is a cause for concern for educationists and other like-minded progressive thinkers.

8.3 Interactions among the investigated variables

From Chapters 4, 5, 6 & 7, it was clear that the interactions of micro, macro and institutional variables which were investigated were neither a direct nor a simplified straightforward relationship of factors, but a complicated unit influenced by other dynamics. It was the adoption of the MMI theoretical model in this study that helped contextualize the problem at hand and through the use of the pragmatism paradigm I managed to put together some conclusions emanating from the results. Students and teachers' understandings and perceptions of natural sciences choice factors, reasons for the low uptake and poor performance of the sciences by female students, gender discrimination practices and learning experiences of the students were influenced by a plethora of factors.

The MMI theoretical model has profound implications for the researcher of gender related issues because it requires the researcher to shy away from using feminist or masculinist epistemologies and methodologies in isolation in studying gender problems. The adoption of feminist or masculinist epistemology and methodology on its own appears to encourage the blame game syndrome at the expense of focusing on the problem under investigation. The model drives its strength from its balanced and flexible approach to issues that are under investigation. The model makes use of the strengths of feminist and masculinist theories as well as the sociological and psychological theories under a single framework when trying to unravel the problem(s) under study (see Figure 2.1). I believe this theoretical framework is applicable to other areas of study besides gender areas. The model provides a significant contribution to the academic pool of knowledge.

8.4 Recommendations as per the findings of each research question

8.4.1 What factors influence choice in natural sciences?

Students at different levels of schooling, like any other citizens, have a constitutional right to freedom of choice. The freedom of choice includes the right to choose subjects of study at high school level within minimum interference from teachers, parents and schools. While the school policies were not gender biased their practices were found to be gender discriminatory. Based on the findings of this study it is suggested that school-based policies on subject choice should be guided by a centralized policy framework from the Education Ministry. This might help prevent and reduce the use of policies that are not focused to the needs of the students with regards to their future career aspirations.

The government is encouraged to deploy qualified guidance and career counsellors in schools or at least per cluster of schools on fulltime basis. It was a missing link in all the five schools under study. Career counsellors help students to choose subjects that are relevant to their career path trajectories from an informed position (Vanin, 2015). Alternatively, the ministry of education with the assistance of other interested stakeholders should identify interested teachers from schools with the required qualifications for training as career and guidance counsellors.

8.4.2 Which factors contribute to the low choice and poor performance in natural sciences by female students and why?

The identified factors that contributed to low choice and poor performance in natural sciences by female students were parental discrimination, household duties, social pressure, role models and stereotype beliefs. Parents were accused of practicing gender biased preferential treatment of the boy child over the girl child. The biased parental upbringing and treatment of the girl child impacts negatively on her choice and performance of the subject (Gunderson et al., 2012; Mutekwe et al., 2012; Mutekwe & Mutekwe, 2012). The feelings of the female students over this issue were very strong as shown in this quote: FGD2-RF17 …. "We girls need encouragement on the importance of sciences but then there is lack of trust from our parents. They really don't trust us. Line 282 – 284." High uptake and subject performance might be boosted by parents encouraging female students to consider careers that involve natural sciences, offering similar support to both boys and girls and reducing the burden of household duties on girls.

The girl child's education is greatly affected by household chores (Swainson, 1995); (Dunne et al., 2005) and the stereotype beliefs of the parents have an impact on the child's beliefs (Simpkins et al., 2012; Stephens, 2017; Tomasetto et al., 2011). This recommendation can be achieved when school leadership through school development associations (SDAs) in government schools and school development committees (SDCs) in non-government schools establish what can be termed as every child matters (ECM) forums. It is hoped that, through such platforms, parents will robustly and frankly discuss gender equality issues among themselves and their children. The involvement of respected people from the society such as local councilors, chiefs, politicians, church leaders, and specialists like psychologists, sociologists, educationists and social workers may make a difference in the quality and dissemination of relevant accurate information. A mind set shift from what is viewed as unprogressive cultural beliefs, values and norms might reduce gender disparities in education.

Social pressure which affected more female students than male students might be reduced by counselling provided for free by qualified staff employed at the schools. Lack of female role models in the short term could be addressed by having regular invitations of skilled prominent female staff working in STEM related disciplines visit the schools and address students. In the long term the government should increase the intake of female students doing sciences at high school level and tertiary institutions through deliberate affirmative policies and actions such as selective funding and lowering of entry requirements. These strategies were adopted in countries such as Tanzania (Bipa, 2010), some selected countries in Africa (Masanja, 2010) and in the USA (Hill et al., 2010) and are said to have worked in narrowing the gender disparities in science education.

8.4.3 Do students experience gender discrimination from the teachers in the learning of natural sciences?

That the male students were found to be the main perpetrators of gender discrimination is not only alarming but suggests that in their teaching teachers should do more to implement approaches that promote gender equity. Science teachers could do more to ensure that the future society is not heavily polarized in terms of gender equality in science education. Positive interpersonal relationships between teachers and students increase student motivation, participation and performance of a subject (Roorda et al., 2011; Van Ryzin, 2011). Political will and support is required to educate society on the need to discard cultural beliefs which work against the girl child. Given the startling evidence of gender discrimination practices by male students, one wonders what it is that can be done to change their stereotype beliefs. Perhaps at school level clubs or groupings should be formed by the students themselves which are called “she is your sister and an equal (SYSE)”. Such platforms may assist the students understand and appreciate the importance of equality between men and women (Zimbabwe National Statistics Agency, 2016). Interested teachers should provide with guidance only and the clubs should be run by students and if need be financial support should come from the school leadership. Female students value more peer support than male students in choosing subjects such as science and mathematics (Campbell Leaper et al., 2012). Therefore, if more male students regard their female classmates as equals and give them the moral support they need, an increase in the uptake and performance in sciences by female students may probably occur.

8.4.4 How does gender stereotyping manifests itself in schools?

School administrations and teaching structures were found to be gender biased. A shift in the policy of appointment of school heads and heads of departments which is based on affirmative action is suggested to narrow the present gaps that exist in most schools. Mutangirwa (2016) found that merit is rarely used to promote Zimbabwean women by those who have the authority to appoint. Promotion using affirmative policies may help overcome this challenge. Deployment of female science teachers could be done on a proportional representation basis. For example, school B had 8 female teachers whilst school D had 0 female teachers among the schools that were involved in the study (see

Table 7.1). Obviously female students at school D had no female role models in the sciences and were most likely to endorse the stereotype beliefs that sciences are a male domain. Progress in closing gender disparities in education can be made if the school curricula are designed to be gender responsive in particular the textbooks. Most of the textbooks used in the schools describe inventions and discoveries made by male scientists. The lack of gender responsiveness in pedagogy is a major cause of poor performance and low retention of female students in schools (Chetcuti & B. Kioko, 2012). A search on the internet will reveal that there are so many great women scientists in this world who have contributed immensely to the wellbeing of the humankind. The contribution of these great women scientists and academics is hardly reflected in both primary and high school curriculum. A curriculum starting at teacher education institutions which includes gender studies, human rights and scientific literacy and also done at primary and secondary level education may help solve the problem of gender stereotyping in the long run and particularly in the future generations. The education institutions should place greater emphasis in these courses in order to instill interest in teachers and students. These courses should be examined at the end of each cycle for example at grade 7 and form 4. Probably this may make both the teachers and students take the courses seriously and hopefully acquire the knowledge necessary to bring about the desired objectives. Teachers need to recognize themselves as agents of change in society either for the good or the bad.

There is a need to go beyond the formulation of policies on gender equality in education, but to empower and support both the teachers and students with values and knowledge (Charles Chikunda & Chikunda, 2016; Chinyani, 2007). The organisation of workshops and in-service teacher training programmes on a new curriculum which is relevant and gender responsive can go a long way towards assisting teachers to scrutinize their values and practices. It is assumed the students will naturally benefit from the values and knowledge of the teachers.

8.4.5 The STEM project

Teachers were of the opinion that it was a good government initiative to increase the uptake of sciences and the other related subjects. However, the project can become a success story if the government, through the responsible ministry, consults extensively and comprehensively with all the stakeholders to address the problems that are being experienced by the project. It appears like not enough consultation was done before the launch of the project.

8.4.6 Overall recommendation

Consequently, the reduction of causes and perceptions driving gender disparities in education require an interdisciplinary, holistic, integrated and comprehensive approach. Piece meal interventions and strategies may not solve the problems. The involvement of all stakeholders at national and global level is necessary. These stakeholders include governmental and non-governmental organisations, civil society pressure groups, public and private media, men and women, boys and girls.

8.5 Recommendations for future research

The school-based policy ability (SPA) appeared to be an imposed policy on both teachers and students. It would be interesting for further research to be done which will investigate why schools have the policies, who formulates the policies and what are the perceptions of students and teachers on SPAs. Although students raised the issue of violation of their freedom of choice, Reiss and Mujtaba(2017) concede that students do not always make school subject choices freely but are sometimes constricted by circumstances beyond their control. Perhaps the SPA is one such example of a confining force in the schools that were studied.

Parental discrimination and household duties emerged as the two most mentioned reasons for the low uptake and poor performance in natural sciences by female students. A follow up study on the cultural views of highly educated working parents and non-working less educated parents would be interesting. The investigation would try to find out whether the level of education and working influences cultural beliefs on gender roles and support given to the girl child attending a non-boarding school. Reports and previous studies by (Dunne et al., 2005; Swainson, 1995; UNGEI, 2012; UNICEF, 2014; M. T. Wang & Eccles, 2012; Watt, 2006) highlight some of contributing factors to the problem of low choice and performance in the subject.

Another possible area of research is too look into the causes of gender stereotyping among peers at high school level and the impact this has on their learning experiences. The study may explain why the boys in this study practiced gender discrimination more than the girls and teachers. This study was conducted in a rural town and the surrounding areas. The majority of the respondents were most likely of rural background where cultural beliefs, norms and values are greatly revered and enforced by traditional leaders. It would be interesting to carry out a similar research in a metropolitan city like Harare and compare the results. Comparative analysis of results may give a true picture of gender stereotyping trends among student populations in Zimbabwe.

8.6 Reflecting back on the study.

In chapter 1, I described my own life experiences which I brought into this study. My own life experiences proved useful in this study for many a times I drew on them to guide my relationships with students, teachers and others involved in the study. Undertaking this research made me learn quite a lot.

Firstly, I learnt that a PhD study is a journey full of challenges; some stressful and others heartening. I had somehow under estimated the difficulty of obtaining information from government officials. Despite having official clearance letters, some officials were just uncooperative. Appointments would just be cancelled at the last minute. Some did not have the required information regardless of the policy requiring them to have and to produce when officially requested. The worst situation was when an education district official kept on giving me different dates that spread over a month to collect the information that I wanted. My effort and patience were not yielding any results and thus when I realized that I was flogging a dead horse I had to look for another source of data.

I also encountered criticisms, particularly at research weekends gatherings, from colleagues and attendants of which some were warranted and some not. Some negative comments included those which said the topic was un researchable and the mixed method approach was not relevant. Positive comments liked the choice and application of my data analytical tools. At the end I learnt that both criticisms and critiques are necessary to a researcher to develop intellectually.

Secondly, I also got to appreciate that the phrasing of research and interview questions was an ongoing exercise within the research process. Thirdly, I learnt the importance of patience and flexibility. As a pragmatist (Cameron, 2011; Sweetman et al., 2010) I responded appropriately and navigated through the research process.

Fourthly, I got to understand that the life concerns of participants are a critical aspect of research outcomes. When I went out to Makonde District I was searching for knowledge on gender disparities and the learning experiences of students studying natural sciences. However, when I came out of the district I was both a male in a female and a female in a male in my understanding of gender inequality issues. The passion of both male and female participants in expressing their views and articulating their arguments shaped the study context and assisted me greatly analyse and interpret the data contextually which an outside reader may not necessarily understand.

Fifthly, I learnt that the real research methodology is the field and not in the research proposal. Initially I had planned to work with minimum recommended and tested numbers of participants in my focus group discussions (FGDs). In the end I had to accommodate maximum recommended numbers due to the overwhelming interest to participate shown by the students.

Lastly, I came to realise that a proposal is just a proposal as it says. I have learnt to appreciate that a study can assume its own course and as long as it reflects and answers the preliminary goals, the original proposal should not restrict the path to be taken by the researcher. In my case, because I was using pragmatism as my research paradigm I found it easier to adjust. By the end of it all, I was left wondering whether it was really essential and necessary for fulltime PhD students at my university to take on average of a year to have their proposals passed and accepted into candidature.

8.7 Conclusion

In this chapter, I have highlighted the major findings of this study. The conclusions and recommendations were aligned to the research questions' results. Implications of the findings and limitations of the study were also summarized. This exploratory and descriptive study sought to investigate the gender disparities and the learning experiences of students studying high school sciences in Zimbabwe. The results show that the choice factors for the subjects were similar to both male and female students. Female students endured more parental discrimination than male students as well as doing more household duties than male students. This gender-biased application of parental love and distribution of household chores appears to have an influence in the choice and performance of natural sciences by female students. Findings of gender discrimination practices in the classroom by teachers were inconclusive. Male students emerged as the main perpetrators of gender discrimination practices in the classroom. The investigation also revealed that school administrations and science teaching staff were gender biased.

When the interactions between variables were considered after triangulation, both survey and qualitative data showed some similar trends in most of the responses of the participants. This shows the relevance and application of the research methodology adopted. Recommendations were made for each research question's findings as well as future research proposals.

8.8 Final remarks

I am encouraged by the effort and volume of research on gender and science education in particular and other gender related issues in general done so far by those who have a passion in this area. My hope is that their findings, inclusive of mine, will one day convince man and women to judge each other through ability and not through gender. I conclude by saying that: "those who know do and those who understand teach." This research has helped me understand the complexity and dynamics of gender disparities in natural sciences in particular and education in general. I now believe I am in a better position than before to share my knowledge with others in this specific area.

References

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Abd-El-Khalick, F., & Lederman, N. G. (2000). The influence of history of science courses on students' views of nature of science. *Journal of Research in Science Teaching, 37*(10), 1057-1095.

Abdullah, M. Y., Bakar, N. R. A., & Mahbob, M. H. (2012). Student's Participation in Classroom: What Motivates them to Speak up? *Procedia-Social and Behavioral Sciences, 51*, 516-522.

Adams, R. ((2015, March 5)). Girls lack self-confidence in maths and science. The Guardian Online. Retrieved from http://www.theguardian.com/education/2015/mar/05/girls-lack-self-confidence-maths-science-oecd-school-engineering.

Ahmed, W., & Bruinsma, M. (2006). A Structural Model of Self-concept, Autonomous Motivation and Academic Performance in Cross-cultural Perspective.

Akhtar, Z., & Aziz, S. (2011). The Effect of Peer and Parent Pressure on the Academic Achievement of University Students. *Language in India, 11*(6).

Antwi, S. K., & Hamza, K. (2015). Qualitative and quantitative research paradigms in business research: A philosophical reflection. *European Journal of Business and Management, 7*(3), 217-225.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2010). “Doing” science versus “being” a scientist: Examining 10/11-year-old schoolchildren's constructions of science through the lens of identity. *Science Education, 94*(4), 617-639.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2014). *ASPIRES. Young People’s science and career aspirations, age 10–14*. London: Kings College London: Department of Education & Professional Studies.

Areepattamannil, S., & Freeman, J. G. (2008). Academic achievement, academic self-concept, and academic motivation of immigrant adolescents in the greater Toronto area secondary schools. *Journal of Advanced Academics, 19*(4), 700-743.

Asimeng-Boahene, L. (2006). Gender inequity in science and mathematics education in Africa: The causes, consequences, and solutions. *Education, 126*(4), 711-729.

Baadjies, L. (2004). *Self-concept and academic achievement of grade 9 pupils* (Masters' thesis). Retrieved from https://ujdigispace.uj.ac.za/bitstream/handle/10210/1407/Frontpage.pdf.

Babbie, E., & Mouton, J. (2001). The Practice of Social Research (Cape Town: Oxford University Press South Africa).

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*: Englewood Cliffs, NJ, US: Prentice-Hall, Inc.

Banning, J., & Folkestad, J. E. (2012). STEM education related dissertation abstracts: A bounded qualitative meta-study. *Journal of Science Education and Technology, 21*(6), 730-741.

Bar, T., & Zussman, A. (2012). Partisan grading. *American Economic Journal: Applied Economics, 4*(1), 30-48.

Baram-Tsabari, A., & Yarden, A. (2011). Quantifying the gender gap in science interests. *International Journal of Science and Mathematics Education, 9*(3), 523-550.

Baram-Tsabari, A., Sethi, R. J., Bry, L., & Yarden, A. (2009). Asking scientists: A decade of questions analyzed by age, gender, and country. *Science Education, 93*(1), 131-160.

Barker, G., & Ricardo, C. (2005). *Young men and the construction of masculinity in sub-Saharan Africa: implications for HIV/AIDS, conflict, and violence*: World Bank Washington, DC.

Barnes, B. R. (2012). Using mixed methods in South African psychological research. *South African Journal of Psychology, 42*(4), 463-475.

Barro, R. J., & Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of development economics, 104*, 184-198.

Bashir, M., Afzal, M. T., & Azeem, M. (2008). Reliability and validity of qualitative and operational research paradigm. *Pakistan journal of statistics and operation research, 4*(1).

Baumert, J., & Köller, O. (1998). *Interest research in secondary level I: An overview.* Paper presented at the Seeon Conference on Interest and Gender.

Bem, S. L. (1993). *The lenses of gender: Transforming the debate on sexual inequality*: Yale University Press.

Bennet, J. (2017). *Engaging young people with STEM subjects: what research has to show? A paper presented at the 25th annual conference of Southern African Association for Research in Mathematics, Science and Technology Education. 17-20 January, Bloemfontein, South Africa.*

Bennett, J., & Hogarth, S. (2009). Would you want to talk to a scientist at a party? High school students' attitudes to school science and to science. *International journal of science education, 31*(14), 1975-1998.

Bezzi, A. (1999). What is this thing called geoscience? Epistemological dimensions elicited with the repertory grid and their implications for scientific literacy. *Science Education, 83*(6), 675-700.

Bhana, D., & Pattman, R. (2009). Researching South African youth, gender and sexuality within the context of HIV/AIDS. *Development, 52*(1), 68-74.

.

Bhusumane, D., B. (1993). Teacher and administrator attitudes and strategies towards the advancement of women in educational administration in Botswana. *Unpublished MA Thesis). University of Alberta, Canada*.

Biesta, G. (2010). *Pragmatism and the philosophical foundations of mixed methods research. Sage handbook of mixed methods in social and behavioral research (2) 95-118.*

Bipa, S. D. (2010). *Participation of women in science education: trends and issues in higher education in Tanzania (Master's thesis). Retrieved from http://www.duo.uio.no/bitstream/handle/10852/.../MASTERxTHESISx2010.pdf?...1.*

Bøe, M. V., Henriksen, E. K., Lyons, T., & Schreiner, C. (2011). Participation in science and technology: young people's achievement-related choices in late-modern societies. *Studies in Science Education, 47*(1), 37-72.

Bosire, J., Mondoh, H., & Barmao, A. (2008). Effect of streaming by gender on student achievement in mathematics in secondary schools in Kenya. *South African journal of education, 28*(4), 595-607.

Brink, P. J. (1991). Issues of reliability and validity. *Qualitative nursing research: A contemporary dialogue*, 164-186.

Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching, 43*(5), 485-499.

Brogan, C. (1998). The interaction between self-esteem and academic achievement: A review of selected studies: EdD https://books. google. co. uk/books.

Brown, C. S., & Leaper, C. (2010). Latina and European American girls' experiences with academic sexism and their self-concepts in mathematics and science during adolescence. *Sex roles, 63*(11-12), 860-870.

Bryman, A., Bell, A., Hirschsohn, P., Dos Santos, A., Du Toit, J., Masenge, A., & Wagner, C. (2017). *Research Methodology. Business and Management Contexts. (7th impression.). Cape Town: O.U.P.*

Buccheri, G., Gürber, N. A., & Brühwiler, C. (2011). The impact of gender on interest in science topics and the choice of scientific and technical vocations. *International journal of science education, 33*(1), 159-178.

Burgess, S., & Greaves, E. (2013). Test scores, subjective assessment, and stereotyping of ethnic minorities. *Journal of Labor Economics, 31*(3), 535-576.

Bursztyn, L., & Jensen, R. (2015). How Does Peer Pressure Affect Educational Investments? *The quarterly journal of economics, 130*(3), 1329-1367.

Bussey, K., & Bandura, A. (1999). Social cognitive theory of gender development and differentiation. *Psychological Review, 106*(4), 676.

BUSTLE. Empowering quotes by women scientists, because it's important to celebtrate the pioneers, 11th February (2016). Retrieved from http//www.bustle.com/articles/141181-11-empowering-quotes-by-women-scientists-because-its-important-to-celebrate-the-pioneers.

Cameron, R. (2011). Mixed Methods Research: The Five Ps Framework. *Electronic Journal of Business Research Methods, 9*(2).

Camfield, L. (2011). 'A girl never finishes her journey': mixing methods to understand female experiences of education in contemporary Ethiopia. *Research Papers in Education, 26*(4), 393-412.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological bulletin, 56*(2), 81.

Carson, D., Gilmore, A., Perry, C., & Gronhaug, K. (2001). *Qualitative marketing research*: Sage.

Caruth, G. D. (2013). Demystifying Mixed Methods Research Design: A Review of the Literature. *Online Submission, 3*(2), 112-122.

Ceci, S. J., & Williams, W. M. (2010). Sex differences in math-intensive fields. *Current Directions in Psychological Science, 19*(5), 275-279.

Ceci, S. J., & Williams, W. M. (2011). Understanding current causes of women's underrepresentation in science. *Proceedings of the National Academy of Sciences, 108*(8), 3157-3162.

Ceci, S. J., Williams, W. M., & Barnett, S. M. (2009). Women's underrepresentation in science: sociocultural and biological considerations. *Psychological bulletin, 135*(2), 218.

Chabaya, O., Rembe, S., & Wadesango, N. (2009). The persistence of gender inequality in Zimbabwe: Factors that impede the advancement of women into leadership positions in primary schools. *South African Journal of Education, 29*(2), 235-251.

Chamberlam, K. (2004). 5 QUALITATIVE ANALYSIS OF EXPERIENCE: GROUNDED THEORY AND CASE STUDIES. *Research methods for clinical and health psychology*, 69.

Chapman, J. W., & Tunmer, W. E. (1995). Development of young children's reading self-concepts: An examination of emerging subcomponents and their relationship with reading achievement. *Journal of Educational Psychology, 87*(1), 154.

Charles, M., & Bradley, K. (2002). Equal but separate? A cross-national study of sex segregation in higher education. *American Sociological Review*, 573-599.

Cherney, I. D., & Campbell, K. L. (2011). A league of their own: Do single-sex schools increase girls' participation in the physical sciences? *Sex roles, 65*(9-10), 712.

Cheryan, S., Siy, J. O., Vichayapai, M., Drury, B. J., & Kim, S. (2011). Do female and male role models who embody STEM stereotypes hinder women's anticipated success in STEM? *Social Psychological and Personality Science, 2*(6), 656-664.

Chetcuti, D., A,, & Kioko, B. (2012). Girls' attitudes towards science in Kenya. *International journal of science education, 34*(10), 1571-1589.

Chetcuti, D. A., & Kioko, B. (2012). Girls' attitudes towards science in Kenya. *International journal of science education, 34*(10), 1571-1589.

Chikunda, C. (2014). Identifying tensions around gender-responsive curriculum practices in science teacher education in Zimbabwe: an activity theory analysis. *African Journal of Research in Mathematics, Science and Technology Education, 18*(3), 264-275.

Chikunda, C., & Chikunda, P. (2016). Patriarchy Rules: Transforming resistance to gender inequalities in science teacher education in Zimbabwe. *Cultural and Pedagogical Inquiry, 8*(2).

Chinyani, H. (2007). Beyond the rhetoric of gender equality: Is the school system an agent of change. *Journal of Sustainable Development in Africa, 12*(7), 30-45.

Chipman, S. F. (2005). Research on the women and mathematics issue. *Gender differences in mathematics: An integrative psychological approach*, 1-24.

.

Chipunza, L. (2003). Equal Opportunities in Educational Management in Institutions of Higher Learning: An Agenda for Gender. *Zambezia, XXX (i)*.

Chisamya, G., DeJaeghere, J., Kendall, N., & Khan, M. A. (2012). Gender and Education for All: Progress and problems in achieving gender equity. *International journal of educational development, 32*(6), 743-755.

Christensen, R., Knezek, G., Tyler-Wood, T., & Gibson, D. (2014). Longitudinal analysis ofcognitive constructs fostered by STEM activities for middle school students. . *Knowledge Management & E-Learning, 6*(2), 103–122.

Christidou, V. (2011). Interest, Attitudes and Images Related to Science: Combining Students' Voices with the Voices of School Science, Teachers, and Popular Science. *International Journal of Environmental and Science Education, 6*(2), 141-159.

Clegg, A. (2007). Girls into science: a training module: UNESCO Paris.

Clough, P., & Nutbrown, C. (2012). *A student's guide to methodology. Thousand Oaks, California.*: SAGE.

Co-operation, O. f. E., & Development. (2010). *PISA 2009 results: what students know and can do: student performance in reading, mathematics and science (Volume I)* (9264091440).

Cohen, D., & Crabtree, B. (2006). Qualitative research guidelines project.(July) Retrieved December 13, 2013 from http://www. qualres. org. *HomeDisp-3831. html*.

Cohen, L., Manion, L., & Morrison, K. (2000). Naturalistic and ethnographic research. *Research methods in education, 5*, 137-157.

Cohen, L., Manion, L., & Morrison, K. (2013). *Research methods in education*. London, United Kingdom.: Routledge.

Colclough, C. (2004). Achieving Gender Equality in Education: What Does It Take? *Prospects, 34*(1), 3-10.

Collins, C., W,, McLeod, J., & Kenway, J. (2000). *Factors influencing the educational performance of males and females in school and their initial destinations after leaving school*: Department of Education, Training and Youth Affairs Canberra.

Collis, J., & Hussey, R. (2013). *Business research: A practical guide for undergraduate and postgraduate students*: Palgrave macmillan.

Connelly, M. P., Li, T. M., MacDonald, M., & Parpart, J. L. (2000). Feminism and development: Theoretical perspectives. *Theoretical perspectives on gender and development*, 51-159.

Costică, S. E. (2014). About rules, punishments and rewards in education. *Procedia-Social and Behavioral Sciences, 112*, 1160-1166.

Cozby, P. (2009). *Methods in behavioral research (10th ed.) Boston: McCraw-Hill.*

Crawley, F. E., & Black, C. B. (1992). Causal modeling of secondary science students' intentions to enroll in physics. *Journal of Research in Science Teaching, 29*(6), 585-599.

Creswell, J. W. (2014). *A concise introduction to mixed methods research*. Thousand Oaks, California.: SAGE.

Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research.* Thousand Oaks, California.: SAGE.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches.* Thousand Oaks, California.: SAGE.

Creswell, J. W., & Plano Clark, V. (2011). Best practices for mixed methods research in the health sciences, *Bethesda (Maryland): National Institute of Health,*2013, 541-545.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). *Advanced Mixed Methods Research Designs: Handbook of Mixed Methods in Social and Behavioral Research.* Thousand Oaks, California.

Cronbach, L., & Quirk, T. (1976). In International Encyclopedia of Education: New York: McGraw-Hill.

Crul, M., & Heering, L. (2008). *The position of the Turkish and Moroccan second generation in Amsterdam and Rotterdam: The TIES study in the Netherlands*: Amsterdam University Press.

Currie, D. H., & Vernooy, R. (2010). Social and gender analysis in development practice: Lessons from the field. *Gender, Technology and Development, 14*(1), 1-23.

Cvencek, D., Meltzoff, A. N., & Greenwald, A. G. (2011). Math–gender stereotypes in elementary school children. *Child development, 82*(3), 766-779.

Dambudzo, I. I. (2009). *The relationship between learner self-concept and achievement in secondary schools in Zimbabwe* (Doctoral thesis). Retrieved from uir.unisa.ac.za/handle/10500/2393.

Delport, C., & Roestenburg, W. (2011). *Quantitative data-collection methods: questionnaires, checklists, structured observation and structured interview schedules. Research at Grass Roots for the Social Sciences and Human Service Professions Pretoria: Van Schaik Publishers, Fourth.*

Denzin, N. K., & Lincoln, Y. S. (2011). *The Sage handbook of qualitative research.* Thousand Oaks, California.: SAGE.

Dick, T. P., & Rallis, S. F. (1991). Factors and influences on high school students' career choices. *Journal for Research in Mathematics Education*, 281-292.

Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking congruity between goals and roles: A new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science, 21*(8), 1051-1057.

Dillon, J. (2009). On Scientific Literacy and Curriculum Reform. *International Journal of Environmental and Science Education, 4*(3), 201-213.

Dolan, E., & Grady, J. (2010). Recognizing students' scientific reasoning: A tool for categorizing complexity of reasoning during teaching by inquiry. *Journal of science teacher education, 21*(1), 31-55.

Drudy, S. (2008). Gender balance/gender bias: The teaching profession and the impact of feminisation. *Gender and Education, 20*(4), 309-323.

Du Plooy-Cilliers, F., Davis, C., & Bezuidenhout, R. (2014). *Research Matters.* Cape Town, South Africa.: Juta and Company Ltd.

Dube, T. (2015). Gender Disparities in Educational Enrollment and Attainment in Sub-Saharan Africa. *Journal of Educational and Social Research*, 5(3) 279-283.

Dunne, M., Leach, F., Chilisa, B., Maundeni, T., Tabulawa, R., Kutor, N., . . . Asamoah, A. (2005). *Gendered School Experiences: the impact on retention and achievement in Botswana and Ghana*: DfID London.

Dweck, C. (2008). Mindsets and math/science achievement. Prepared for the Carnegie Corporation of New York-Institute for Advanced Study Commission on Mathematics and Science Education.

Eccles, J. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist, 44*(2), 78-89.

Eccles, J., & Wang, M. (2012). So what is student engagement anyway: Commentary on Section I. *S., Christenson, AL, Reschy, C. Wylie,(Eds.), Handbook of research on student engagement. New York, NY: Springer, 10*, 978-971.

Eccles, J., Wigfield, A., Harold, R. D., & Blumenfeld, P. (1993). Age and gender differences in children's self-and task perceptions during elementary school. *Child development, 64*(3), 830-847.

Eccles, J. S. (1983). *Expectancies, values, and academic behaviors. In J.T. Spence (Ed.). Achievement and achievement motives: Psychological and Sociological Approaches (75-146). San Francisco, CA: Free man.*

Eccles, J. S. (2005). Subjective task value and the Eccles et al. model of achievement-related choices *Handbook of competence and motivation* (pp. 105-121).

Egan, S. K., & Perry, D. G. (2001). Gender identity: a multidimensional analysis with implications for psychosocial adjustment. *Developmental psychology, 37*(4), 451.

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of advanced nursing, 62*(1), 107-115.

Else-Quest, N. M., & Grabe, S. (2012). The political is personal: Measurement and application of nation-level indicators of gender equity in psychological research. *Psychology of women quarterly, 36*(2), 131-144.

Else-Quest, N. M., Hyde, J. S., & Linn, M. C. (2010). Cross-national patterns of gender differences in mathematics: a meta-analysis. *Psychological bulletin, 136*(1), 103.

Ely, R. J. (1995). The power in demography: Women's social constructions of gender identity at work. *Academy of Management journal, 38*(3), 589-634.

Faitar, G., & Faitar, S. (2013). Teachers' influence on students' science career choices. *American International Journal of Social Science, 2*(5), 10-16.

FAWE. (2011). *Strengthening gender research to improve girls' and women's education in Africa*. Retrieved from Nairobi:

Feniger, Y. (2011). The gender gap in advanced math and science course taking: does same-sex education make a difference? *Sex roles, 65*(9-10), 670-679.

Floyd, J., & Fowler, J. (2009). *Survey research methods. Survey Research Methods (4th ed.). SAGE Publications, Inc. Thousand Oaks, CA: SAGE Publications, Inc.*

Fogliati, V. J., & Bussey, K. (2013). Stereotype threat reduces motivation to improve: Effects of stereotype threat and feedback on women's intentions to improve mathematical ability. *Psychology of women quarterly, 37*(3), 310-324.

Forsthuber, B., Horvath, A., & Motiejunaite, A. (2010). *Gender differences in educational outcomes: Study on the measures taken and the current situation in Europe. Education, Audiovisual and Culture Executive Agency* (9292010808).

Fouad, N. A. (2007). Work and vocational psychology: Theory, research, and applications. *Annu. Rev. Psychol., 58*, 543-564.

Fouché, C., & Schurink, W. (2011). *Qualitative research designs. de Vos, AS.*

Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. (2010). Development of mathematics interest in adolescence: Influences of gender, family, and school context. *Journal of Research on Adolescence, 20*(2), 507-537.

Frome, P. M., & Eccles, J. S. (1998). Parents' influence on children's achievement-related perceptions. *Journal of personality and social psychology, 74*(2), 435.

Furnham, A., Pallangyo, A. E., & Gunter, B. (2001). Gender-role stereotyping in Zimbabwean television advertisements. *South African Journal of Psychology, 31*(2), 21-29.

Ganley, C. M., & Vasilyeva, M. (2011). Sex differences in the relation between math performance, spatial skills, and attitudes. *Journal of Applied Developmental Psychology, 32*(4), 235-242.

Gardner, P. L. (1975). Attitudes to science: A review. Retrieved from http://www.tandfonline.com/doi/pdf/10.1080/03057267508559818.

Gill, J., Sharp, R., Mills, J., & Franzway, S. (2008). I still wanna be an engineer! Women, education and the engineering profession. *European Journal of Engineering Education, 33*(4), 391-402.

Glick, P., & Fiske, S. T. (1999). Gender, power dynamics, and social interaction. *Revisioning gender, 5*, 365-398.

Good, T. L., & Lavigne, A. L. (2017). *Looking in classrooms*. London, United Kingdom.: Routledge.

Gordon, R. (1998). 'Girls cannot think as boys do': Socialising children through the Zimbabwean school system. *Gender & Development, 6*(2), 53-58.

Gratton, C., & Jones, I. (2010). *Research methods for sports studies*. London, United Kingdom.: Routledge.

Gravetter, F. J., & Forzano, L.-A. B. (2018). *Research Methods for the Behavioral Sciences. Cengage Learning.* . Cape Town, South Africa.: PASA.

Grbich, C. (2012). *Qualitative data analysis: An introduction*. Thousand Oaks, California: SAGE.

Greene, J., & Jori, N. (2010). Dialectics and Pragmatism: Being of Consequence. *Abbas Tashakkori y Charles Teddlie (coords.), Handbook of Mixed Methods in Social and Behavioral Research, 2a ed., Thousand Oaks, Sage*, 119-143.

Greene, J. C., & Caracelli, V. J. (1997). *Advances in mixed-method evaluation: The challenges and benefits of integrating diverse paradigms*: Jossey-Bass Publishers.

Greene, J. C., & Caracelli, V. J. (2003). Making paradigmatic sense of mixed methods practice. *Handbook of mixed methods in social and behavioral research, 9*, 91-110.

Gregory, A., & Weinstein, R. S. (2004). Connection and regulation at home and in school: Predicting growth in achievement for adolescents. *Journal of Adolescent Research, 19*(4), 405-427.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research.*Handbook of qualitative research*, 2(163-194), 105. .

Gudhlanga, E., Chirimuuta, C., & Bhukuvhani, C. (2012). Towards a gender inclusive curriculum in Zimbabwe's education system: opportunities and challenges. *Gender and Behaviour, 10*(1), 4533-4545.

Gudyanga, A., Adam, K., & Kurup, R. (2015). Zimbabwean female participation in physics: The influence of context on identity formation. *African Journal of Research in Mathematics, Science and Technology Education, 19*(2), 172-184.

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex roles, 66*(3-4), 153-166.

Hackett, G., & Campbell, N. K. (1987). Task self-efficacy and task interest as a function of performance on a gender-neutral task. *Journal of vocational behavior, 30*(2), 203-215.

Hakura, M. D. S., Hussain, M. M., Newiak, M. M., Thakoor, V., & Yang, M. F. (2016). *Inequality, Gender Gaps and Economic Growth: Comparative Evidence for Sub-Saharan Africa*: International Monetary Fund.

Hampden-Thompson, G., & Bennett, J. (2013). Science teaching and learning activities and students' engagement in science. *International journal of science education, 35*(8), 1325-1343.

Hanna, R. N., & Linden, L. L. (2012). Discrimination in grading. *American Economic Journal: Economic Policy, 4*(4), 146-168.

Hannover, B., & Kessels, U. (2004). Self-to-prototype matching as a strategy for making academic choices. Why high school students do not like math and science. *Learning and Instruction, 14*(1), 51-67.

Hattie, J. A. (2009). Visible learning: A synthesis of 800+ meta-analyses on achievement. *Abingdon: Routledge*.

Hendley, D., Stables, S., & Stables, A. (1996). Pupils' subject preferences at key stage 3 in South Wales. *Educational studies, 22*(2), 177-186.

Hendriks, S. E. (2005). Advocates, adversaries, and anomalies: the politics of feminist spaces in gender and development. *Canadian Journal of Development Studies/Revue canadienne d'études du développement, 26*(sup1), 619-632.

Henning, E., Van Rensburg, W., & Smit, B. (2004). *Finding your way in qualitative research*: Van Schaik Pretoria.

Hennink, M. (2014). *Understanding Qualitative Research: Focus Group Discussions.* New York, New York.: Oxford University Press.

Herbert, J., & Stipek, D. (2005). The emergence of gender differences in children's perceptions of their academic competence. *Journal of Applied Developmental Psychology, 26*(3), 276-295.

Herz, B. K., & Sperling, G. B. (2004). *What works in girls' education: Evidence and policies from the developing world*: Council on foreign relations.

Hesse-Biber, S. (2010). *Emerging Methodologies and Methods Practices in the field of Mixed Methods Research.* Los Angeles, California.: SAGE.

Hidi, S. (2000). An interest researcher's perspective: The effects of extrinsic and intrinsic factors on motivation. *Task· contingent rewards (co/lti" ued), 328*, 83.

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111-127.

Hill, C., Corbett, C., & St Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*. Retrieved from https://eric.ed.gov/?id=ED509653.

Hoadley, U. K. (2005). *Social class, pedagogy and the specialization of voice in four South African primary schools (Doctoral thesis). Retrieved from https://open.uct.ac.za/handle/1142/8659*

Hoepfl, M. C. (1997). Choosing qualitative research: A primer for technology education researchers. *Journal of Technology Education*, 9(1) 47-63.

Hofstein, A., Eilks, I., & Bybee, R. (2011). Societal issues and their importance for contemporary science education—a pedagogical justification and the state-of-the-art in Israel, Germany, and the USA. *International Journal of Science and Mathematics Education, 9*(6), 1459-1483.

Holdsworth, V. (2007). Schooling beyond gender stereotypes. *Commonwealth Quarterly, 13*.

Hollins, M., Murphy, P., Ponchaud, B., & Whitelegg, E. (2006). *Girls in the Physics Classroom: A Teachers' Guide for Action*. London, United Kingdom: Institute of Physics.

Hornberger, N. H., & McKay, S. (2010). *Sociolinguistics and Language Education.* Bristol, United Kingdom.: Multilingual Matters.

House, J. S., & Williams, D. R. (2000). Understanding and reducing socioeconomic and racial/ethnic disparities in health. *Promoting health: Intervention strategies from social and behavioral research,* 81, 125.

Howe, C. (1997). *Gender and classroom interaction.* Edinburg, Scotland: SCRE.

Hudson, L. A., & Ozanne, J. L. (1988). Alternative ways of seeking knowledge in consumer research. *Journal of consumer research, 14*(4), 508-521.

Huggins, A., & Randell, S., K. (2007). *Gender equality in education in Rwanda: What is happening to our girls.* Paper presented at the South African Association of Women Graduates Conference. South Africa: Cape Town.

Huguet, P., & Regner, I. (2007). Stereotype threat among schoolgirls in quasi-ordinary classroom circumstances. *Journal of Educational Psychology, 99*(3), 545.

Hulleman, C. S., Godes, O., Hendricks, B. L., & Harackiewicz, J. M. (2010). Enhancing interest and performance with a utility value intervention. *Journal of Educational Psychology, 102*(4), 880.

Hutter, R., Oldenhof-Veldman, T., Pijpers, J., & Oudejans, R. R. (2017). Professional development in sport psychology: Relating learning experiences to learning outcomes. *Journal of Applied Sport Psychology, 29*(1), 1-16.

Huyer, S. (2015). Is the gender gap narrowing in science and engineering? Retrieved from unesdoc.unesco.org/Ulis.pl?catno=235447&set...0_466. (9231001299).

Hyde, J., S,, & Kling, K., C. (2001). Women, motivation, and achievement. *Psychology of women quarterly, 25*(4), 364-378.

Hyman, I. A., & Snook, P. A. (1999). *Dangerous schools: What we can do about the physical and emotional abuse of our children.* San Francisco, California.: Jossey-Bass

Ifegbesan, A. (2010). Gender-stereotypes belief and practices in the classroom: The Nigerian post-primary school teachers. *Global Journal of Human-Social Science Research, 10*(4).

Illeris, K. (2003). Learning, identity and self-orientation in youth. *Young, 11*(4), 357-376.

Ing, M. (2014). Gender differences in the influence of early perceived parental support on student mathematics and science achievement and STEM career attainment. *International Journal of Science and Mathematics Education, 12*(5), 1221-1239.

Inglehart, R., & Norris, P. (2003). *Rising tide: Gender equality and cultural change around the world*: Cambridge University Press.

Jacobs, J. E. (2005). Twenty-five years of research on gender and ethnic differences in math and science career choices: What have we learned? *New directions for child and adolescent development, 2005*(110), 85-94.

Jadidi, M., Karimi, F., Lietz, H., & Wagner, C. (2017). Gender Disparities in Science? Dropout, Productivity, Collaborations and Success of Male and Female Computer Scientists. *Advances in Complex Systems*, 1750011.

Jansen, M., Scherer, R., & Schroeders, U. (2015). Students' self-concept and self-efficacy in the sciences: Differential relations to antecedents and educational outcomes. *Contemporary Educational Psychology, 41*, 13-24.

Jawirtz, J., & Case, J. (1998). Exploring the reasons South African students give for studying engineering. *International Journal of Engineering Education, 14*(4), 235-240.

Jeynes, W. H. (2010). The salience of the subtle aspects of parental involvement and encouraging that involvement: Implications for school-based programs. *Teachers College Record*.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational researcher, 33*(7), 14-26.

Jones, G., Taylor, A., & Forrester, J. H. (2011). Developing a scientist: A retrospective look. *International journal of science education, 33*(12), 1653-1673.

Jones, M. G., Howe, A., & Rua, M. J. (2000). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Science Education, 84*(2), 180-192.

Joppe, M. (2000). The Research Process. Retrieved from www.academia.edu/930161/The_research_process.

Joyce, B. A., & Farenga, S. J. (2000). Young girls in science: Academic ability, perceptions and future participation in science. *Roeper Review, 22*(4), 261-262.

Juvonen, J., Wang, Y., & Espinoza, G. (2011). Bullying experiences and compromised academic performance across middle school grades. *The Journal of Early Adolescence, 31*(1), 152-173.

Kalu, I. (2005). Classroom interaction behaviours in physics lessons, relative to students' sex. *African Journal of Research in Mathematics, Science and Technology Education, 9*(1), 55-66.

Kauffmann, P., Hall, C., Batts, D., Bosse, M., & Moses, L. (2009). *Factors influencing high school students career considerations in STEM fields.* Paper presented at the American Society for Engineering Education.

Keller, C. (2001). Effect of teachers' stereotyping on students' stereotyping of mathematics as a male domain. *The Journal of Social Psychology, 141*(2), 165-173.

Keller, E., G. ((2013, February 05).). Girls and Science: Why the gender gap exists and what to do about it. The Guardian Online. Retrieved from http://.theguardin.com/world/us-news-blog/2013/feb/05/girls-science-gap-fix.

Kinyota, M. (2013). Students’ perceptions of factors influencing choice of science streams in Tanzania secondary schools. *Master's Capstone Projects*.

Klopfer, L., & Cooley, W. (1961). *Test on understanding science, Form W*. Princeton, New Jersey.: Educational Testing Services.

Köller, O., Baumert, J., & Schnabel, K. (2001). Does interest matter? The relationship between academic interest and achievement in mathematics. *Journal for Research in Mathematics Education*, 448-470.

Kolodziejczyk, I. (2015). Mixed methods for study of gender issues in access, application, and attitudes toward ICT in higher education institutions in Papua New Guinea. *Sage Open, 5*(2).

Krueger, R. A., & Casey, M. A. (2002). Designing and conducting focus group interviews. Retrieved from www.eiu.edu/ihec/Krueger-FocusGroupInterviews.pdf.

Kurtz-Costes, B., Rowley, S. J., Harris-Britt, A., & Woods, T. A. (2008). Gender stereotypes about mathematics and science and self-perceptions of ability in late childhood and early adolescence. *Merrill-Palmer Quarterly, 54*(3), 386-409.

Kutnick, P., Jules, V., & Layne, A. (1997). *Gender and School Achievement in the Caribbean. Education Research Paper*: ERIC.

Lacobucci, D., & Churchill, G. (2010). *Marketing research: Methodological foundations*.

Larivière, V., Ni, C., Gingras, Y., Cronin, B., & Sugimoto, C. R. (2013). Bibliometrics: Global gender disparities in science. *Nature News, 504*(7479), 211.

Lau, K.-L., & Chan, D. W. (2001). Motivational characteristics of under-achievers in Hong Kong. *Educational Psychology, 21*(4), 417-430.

Leach, F., Fiscian, V., Kadzamira, E., Lemani, E., & Machakanja, P. (2003). *An investigative study of the abuse of girls in African schools (No. 12849). Department for International Development (DFID)(UK)*

Leaper, C., Farkas, T., & Brown, C. S. (2012). Adolescent girls' experiences and gender-related beliefs in relation to their motivation in math/science and English. *Journal of Youth and Adolescence, 41*(3), 268-282.

Leaper, C., & Friedman, C. K. (2007). *The socialization of gender. Handbook of socialization: Theory and research, 561-587*.

Lederman, N., Wade, P., & Bell, R. L. (1998). Assessing understanding of the nature of science: A historical perspective *The nature of science in science education* (pp. 331-350): Springer.

Lederman, N. G., Lederman, J. S., & Antink, A. (2013). Nature of science and scientific inquiry as contexts for the learning of science and achievement of scientific literacy. *International Journal of Education in Mathematics, Science and Technology, 1*(3).

Lee, S. M., & Kushner, J. (2008). Single-parent families: the role of parent's and child's gender on academic achievement. *Gender and Education, 20*(6), 607-621.

Leedy, P., & Ormrod, J. (2010). *Practical Research planning and design 9th edition Boston: Pearson Education International*.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of vocational behavior, 45*(1), 79-122.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of psychology*.

Lincoln, Y. S., Lynham, S. A., & Guba, E. G. (2011). Paradigmatic controversies, contradictions, and emerging confluences, revisited *The Sage handbook of qualitative research* (Vol. 4, pp. 97-128).

Livesey, D., Lum Mow, M., Toshack, T., & Zheng, Y. (2011). The relationship between motor performance and peer relations in 9-to 12-year-old children. *Child: care, health and development, 37*(4), 581-588.

Lynch, K., & Feeley, M. (2009). *Gender and education (and employment): Gendered imperatives and their implications for women and men: Lessons from research for policy makers*.

Macia, M., Maharaj, P., & Gresh, A. (2011). Masculinity and male sexual behaviour in Mozambique. *Culture, Health & Sexuality, 13*(10), 1181-1192.

Mackay, J., & Parkinson, J. (2010). Gender, self-efficacy and achievement among South African Technology teacher trainees. *Gender and Education, 22*(1), 87-103.

MacPhee, D., Farro, S., & Canetto, S. S. (2013). Academic self-efficacy and performance of underrepresented STEM majors: Gender, ethnic, and social class patterns. *Analyses of Social Issues and Public Policy, 13*(1), 347-369.

Magno, C., & Silova, I. (2007). Teaching in transition: Examining school-based gender inequities in central/southeastern Europe and the former Soviet Union. *International journal of educational development, 27*(6), 647-660.

Mahoney, J. (2000). Path dependence in historical sociology. *Theory and society, 29*(4), 507-548.

Maree, K. (2016). *First steps in research (3rd ed.). Pretoria: Van Schaik Publishers*.

Marsh, H. W., Craven, R., & Debus, R. (1998). Structure, stability, and development of young children's self-concepts: A multicohort–multioccasion study. *Child development, 69*(4), 1030-1053.

Marsh, H. W., Ellis, L. A., & Craven, R. G. (2002). How do preschool children feel about themselves? Unraveling measurement and multidimensional self-concept structure. *Developmental psychology, 38*(3), 376.

Martín, Y. B. (2011a). EURYDICE. Gender differences in educational outcomes: Study on the measures taken and the current situation in Europe. *Revista Iberoamericana de Educación, 55*(2), 1-3.

Martín, Y. B. (2011b). EURYDICE. Gender differences in educational outcomes: Study on the measures taken and the current situation in Europe. *Iberoamerican Journal of Education*, 55(2), 1-3. Retrieved from https://rieol.org/RIE/article/view/1619. (1681-5653).

Masanja, V. (2004). *Bridging the gender gaps in science and mathematics education* (No. 2003.10). HakiElimu Working paper Series.

Masanja, V. G. (2010). *Increasing women's participation in science, mathematics and technology education and employment in Africa.* Paper presented at the United Nations Division for the Advancement of Women: Expert group meeting: Gender, science, and technology. Butare, Huye, Rwanda: National University of Rwanda & University of Dar es Salaam.

.

Masinire, A. (2011). *Interplay of masculinity and schooling in rural Zimbabwe (Doctoral thesis). Retrieved from http://ir.lib.uwo.ca/cgi/viewcontent.cgi?article=1390&context=etd.*

Mavhunga, P. J., Madondo, M., & Phiri, M. (2009). Education for all in Zimbabwe: A Mirage? *Zimbabwe Journal of Educational Research*, 21(1), 25-47.

Maxwell, J. A., & Mittapalli, K. (2010). Realism as a stance for mixed methods research *Handbook of mixed methods in social & behavioral research* (pp. 145-168).

McGartland, R. (2005). Content validity. Encyclopedia of social measurement: Elsevier Inc, Pittsburgh.

McIntyre, R. B., Paulson, R. M., Taylor, C. A., Morin, A. L., & Lord, C. G. (2011). Effects of role model deservingness on overcoming performance deficits induced by stereotype threat. *European Journal of Social Psychology, 41*(3), 301-311.

McMillan, J. H., & Schumacher, S. (2010). *Research in Education: Evidence-Based Inquiry, MyEducationLab Series.* Johannesburg, South Africa: Pearson.

McShane, S., & Von Glinow, M. (2014). *Organizational behaviour (2nd ed.). New York, NY: McGraw-Hill Higher Education.*

Meece, J. L., Glienke, B. B., & Burg, S. (2006). Gender and motivation. *Journal of school psychology, 44*(5), 351-373.

Mellors-Bourne, R., Connor, H., & Jackson, C. (2011). STEM graduates in non-STEM jobs. Retrieved from from https://www.gov.uk/government/.../system/.../11-771-stem-graduates-in-non-jobs.p...

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation.* Hoboken, New Jersey.: John Wiley & Sons.

Mertens, D. M. (2010). *Divergence and mixed methods*. Thousand Oaks, California.: SAGE

Mertens, D. M. (2012). Transformative mixed methods: Addressing inequities. *American Behavioral Scientist, 56*(6), 802-813.

Metz, S. S. (2007). Attracting the engineers of 2020 today. *Women and minorities in science, technology, engineering, and mathematics: Upping the numbers*, 184-209.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Thousand Oaks, California.: SAGE.

Miller, M., J. (2009). Reliability and Validity. Retrieved June 2, 2015, from Western International University. Retrieved from https://www.michaeljmillerphd.com/res500_lecturenotes/reliability_and_validity.pdf.

MOESAC, (2011). *Education Medium Term Plan. Harare, Government Printers.*

MOESAC, (2014). *Makonde District O-Level Sciences Registration. Harare, Government Printers.*

Minstry of Education, Sport, Arts and Culture. (2013). Education Medium Term Plan.

Miyake, A., Kost-Smith, L. E., Finkelstein, N. D., Pollock, S. J., Cohen, G. L., & Ito, T. A. (2010). Reducing the gender achievement gap in college science: A classroom study of values affirmation. *Science, 330*(6008), 1234-1237.

Moakler, M. W., & Kim, M. M. (2014). College major choice in STEM: Revisiting confidence and demographic factors. *The Career Development Quarterly, 62*(2), 128-142.

Moghaddam, F. M., Walker, B. R., & Harre, R. (2003). *Cultural distance, levels of abstraction, and the advantages of mixed methods. In A. Tashakkori & C. Teddlie (Eds.), Handbook of mixed methods in social and behavioral and social sciences (pp.51-89). Thousand Oaks, CA: Sage*

Moletsane, R. (2010). *Gender review in South African basic education. Pretoria: Department of Basic Education.*

Moloto, G. R., Brink, L., & Nel, J. A. (2014). An exploration of stereotype perceptions amongst support staff within a South African higher education institution. *SA Journal of Human Resource Management, 12*(1), 1-12.

Moore, J. (1985). Development of a questionnaire to measure secondary school pupils' attitudes to computers and robots. *Educational studies, 11*(1), 33-40.

MOPSE, . (2015). *National O-Level Pass Rate by Gender. Harare, Government Printers.*

MOPSE, (2016). *Makonde District A-Level Results. Harare, Government Printers.*

Morgan, D. L. (2007). Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods. *Journal of mixed methods research, 1*(1), 48-76.

Morgan, D. L., & Spanish, M. T. (1984). Focus groups: A new tool for qualitative research. *Qualitative sociology, 7*(3), 253-270.

Morgan, S. L., Gelbgiser, D., & Weeden, K. A. (2013). Feeding the pipeline: Gender, occupational plans, and college major selection. *Social Science Research, 42*(4), 989-1005.

Morgenroth, T., Ryan, M. K., & Peters, K. (2015). The motivational theory of role modeling: How role models influence role aspirants' goals. *Review of general psychology, 19*(4), 465.

Morna, C., L;, & Jmbaya-Nyakujara, L. (2011). *SADC Gender Protocol Barometer.* Retrieved from genderlinks.org.za/programme.../sadc-gender-protocol-2011-barometer-2011-08-05/.

Morse, J. (2010). Procedures and practice of mixed method design; Maintaining control, rigor, and complexity *SAGE handbook of mixed methods in social & behavioral research* (pp. 339-352).

Muringa, T., & Makaudze, G. (2014). Tradition or misconception?: Contemporary perceptions about working women in Midlands Province in Zimbabwe. *European Journal of Humanities and Social Sciences, 29*(1), 1536-1553.

Mutangirwa, J. (2016). *Socio-cultural challenges to women's participation in leadership positions in Manicaland. (Unpublished master's research report, Midlands State University, Gweru).*

Mutekwe, E., Maphosa, C., Machingambi, S., Ndofirepi, A. P., & Wadesango, N. (2013). Exploring the Teachers' Role in the Social Construction of Gender through the Hidden Culture Curriculum and Pedagogy: A Case of Zimbabwe. *Journal of Social Sciences, 37*(3), 307-318.

Mutekwe, E., Modiba, M., & Maphosa, C. (2012). Female students' perceptions of gender and academic achievement: a case of sixth form girls in Zimbabwean school. *Journal of Social Sciences, 32*(1), 111-120.

Mutekwe, E., & Mutekwe, C. (2012). Manifestations of the gender ideology in the Zimbabwean school curriculum. *Journal of educational and instructional studies in the world, 2*(3), 193-207.

Mutua, K., & Swadener, B. B. (2004). *Decolonizing research in cross-cultural contexts: Critical personal narratives*: SUNY press.

MWAGCD. (2013). *National gender policy. Harare, Government Printers.*

Mwamwenda, T. (2013). Adolescents' gender stereotypes, differences and other aspects of behaviour in the Eastern Cape Province, South Africa. *The Independent Journal of Teaching and Learning, 8*(1), 54-70.

Mwamwenda, T. S. (2011). Teachers' Gender Stereotypes in South Africa: A Case Study. *Journal of Psychology in Africa, 21*(4), 611-613.

Mzuza, M. K., Yudong, Y., & Kapute, F. (2014). Analysis of factors causing poor passing rates and high dropout rates among primary school girls in Malawi. *World Journal of education, 4*(1), 48.

Ndalichako, J. L., & Komba, A. A. (2014). Students' Subject Choice in Secondary Schools in Tanzania: A Matter of Students' Ability and Interests or Forced Circumstances? *Open Journal of Social Sciences*(08), 49.

Nesbit, W., & Philpott, D. F. (2002). Confronting Subtle Emotional Abuse in Classrooms. *Guidance & Counseling, 17*(2), 32-38.

NESSE, . (2011). *Table 290, Bachelors', Masters' and Doctors' degrees conferred by degree-granting institutions, by sex of student and discpline division: 2009-2010. Retrieved from nces.ed.gov/programs/digest/d12/tables/dt12_317.asp*. Retrieved from

Neuman, W. L. (2013). *Social research methods: Qualitative and quantitative approaches.* Johannesburg, South Africa.: Pearson

Nhundu, T. J. (2007). Mitigating gender-typed occupational preferences of Zimbabwean primary school children: The use of biographical sketches and portrayals of female role models. *Sex roles, 56*(9-10), 639-649.

Nordenmark, M., & Nyman, C. (2003). Fair or unfair? Perceived fairness of household division of labour and gender equality among women and men: The Swedish case. *European Journal of Women's Studies, 10*(2), 181-209.

Nosek, B. A., & Smyth, F. L. (2011). Implicit social cognitions predict sex differences in math engagement and achievement. *American Educational Research Journal, 48*(5), 1125-1156.

Nunnally, J. C. (1994). *Psychometric theory*. New York, New York.: McGraw Hill.

O'Hagan, K. (1993). *Emotional and psychological abuse of children*: Open University Press.

Obura, C., & Ajowi, J. O. (2012). Gender and students' perceptions of career aspirations in secondary schools. *Academic Journal of Interdisciplinary Studies, 1*(2), 149-164.

Ochse, C. (2003). Are positive self-perceptions and expectancies really beneficial in an academic context?: perspectives on higher education. *South African Journal of Higher Education, 17*(1), 67-73.

Okumu, J. O. (2013). *Factors influencing the choice of science subjects in Kenya's secondary schools: a case study of Langata High School in Nairobi County* (Doctoral thesis). Retrieved from erepository.uonbi.ac.ke/handle/11295/56523.

Ornstein, A. C., & Hunkins, F. (1993). *Curriculum: Foundations, Principles, and Theory.* Boston, Massachusset.: Allyn and Bacon.

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International journal of science education, 25*(9), 1049-1079.

Osei-Hwedie, K., & Hobona, A. K. (2001). Secondary school teachers and the emotional abuse of children: A study of three secondary schools in Gaborone, Botswana. *Journal of Social Development in Africa, 16*(1).

Padgett, D. K. (2016). *Qualitative methods in social work research.* Thousand Oaks, California.: Sage

Pajares, F. (2005). Gender differences in mathematics self-efficacy beliefs. *Gender differences in mathematics: An integrative psychological approach*, 294-315.

Parpart, J. L., Connelly, P., & Barriteau, E. (2000). *Theoretical perspectives on gender and development*: IDRC.

Patrick, H., Ryan, A. M., & Kaplan, A. (2007). Early adolescents' perceptions of the classroom social environment, motivational beliefs, and engagement. *Journal of Educational Psychology, 99*(1), 83.

Patterson, J. V., & Johnson, A. T. (2017). High School Girls' Negotiation of Perceived Self-Efficacy and Science Course Trajectories. *Journal of Research in Education, 27*(1), 79-113.

Patterson, M. M., & Pahlke, E. (2011). Student characteristics associated with girls' success in a single-sex school. *Sex roles, 65*(9-10), 737-750.

Patton, M., Q,. (2015). *Qualitative reseach and evaluation methods: Integrating theory and practice: The definite text of qualitative inquiry framworks and options.*

Patton, M., Q. (2002). Qualitive research & evaluation methods. 3. painos: Thousand Oaks: Sage.

People, S. P. (2008). Public Perceptions of Physics, London: Institute of Physics.

Pietersen, J., & Maree, K. (2007). *First Steps in Research.* . Pretoria, South Africa.: Van Schaik.

PISA, O. (2007). *Science Competencies for Tomorrow's World. Retrieved from https://eric.ed.gov/?id=ED504064*. Retrieved from

Ponce, O. A., & Pagán-Maldonado, N. (2015). Mixed methods research in education: Capturing the complexity of the profession. *International Journal of Educational Excellence, 1*(1), 111-135.

Powell, A., Dainty, A., & Bagilhole, B. (2012). Gender stereotypes among women engineering and technology students in the UK: lessons from career choice narratives. *European Journal of Engineering Education, 37*(6), 541-556.

Proctor, A., & Phimister, I. (1995). *People and Power Book 1. Harare, Academic Books.*

Radu, W. S., & Chekera, Y. T. (2014). Power, Patriarchy and Gender Discrimination in Zimbabwean Newsrooms: Harare: Media Monitoring Africa.

Rarieya, J., Sanger, N., & Moolman, B. (2014). Gender inequalities in education in South Africa. *Policy Brief Paper. Human Sciences Research Council. HSRSC: Pretoria*.

Räty, H., Vänskä, J., Kasanen, K., & Kärkkäinen, R. (2002). Parents' explanations of their child's performance in mathematics and reading: A replication and extension of Yee and Eccles. *Sex roles, 46*(3), 121-128.

Reiss, M. J., & Mujtaba, T. (2017). Should we embed careers education in STEM lessons? *The Curriculum Journal, 28*(1), 137-150.

Ridgeway, C. L. (2006). Gender as an organizing force in social relations: Implications for the future of inequality. T*he declining significance of gender*, 265287. .

Roorda, D. L., Koomen, H. M., Spilt, J. L., & Oort, F. J. (2011). The influence of affective teacher–student relationships on students' school engagement and achievement: A meta-analytic approach. *Review of educational research, 81*(4), 493-529.

Rubin, A., & Babbie, E. R. (2012). *Essential Research Methods for Social Work. Cengage Learning:* . Pacific Grove, California: Brooks Cole.

Runhare , T., & Gordon, R. (2004). *The comprehensive review of gender issues in the education sector. Harare: UNICEF.*

Ryu, Y. S., & Smith-Jackson, T. L. (2005). *Development of usability questionnaire items for mobile products and content validity.* Paper presented at the Proceedings of HCI International.

Sadler, P. M., Sonnert, G., Hazari, Z., & Thi, R. (2014). The role of advanced high school coursework in increasing STEM career interest. *Science Educator, 23*(1), 1.

Salehjee, S., & Watts, M. (2015). Science Lives: School choices and 'natural tendencies'. *International journal of science education, 37*(4), 727-743.

Salkind, N. J. (2016). *Statistics for people who (think they) hate statistics.* Thousand Oaks, California: Sage

Saucerman, J., & Vasquez, K. (2014). Psychological barriers to STEM participation for women over the course of development. *Adultspan Journal, 13*(1), 46-64.

Sax, L. J. (1994). Mathematical self-concept: How college reinforces the gender gap. *Research in Higher Education, 35*(2), 141-166.

Scharmann, L., & Smith, M. (2001). Defining versus describing the nature of science: A pragmatic analysis for classroom teachers and science educators. *Science Education, 85*(4), 493-509.

Schoonenboom, J. (2016). The Multilevel Mixed Intact Group Analysis: A Mixed Method to Seek, Detect, Describe, and Explain Differences Among Intact Groups. *Journal of mixed methods research, 10*(2), 129-146.

Schreiner, C. (2006). *Exploring a ROSE garden: Norwegian youth's orientations towards science: seen as signs of late modern identities*. Retrieved from https://www.duo.uio.no/handle/10852/32331.

Schreiner, C., & Sjøberg, S. (2004). Sowing the seeds of ROSE: Background, rationale, questionnaire development and data collection for ROSE: *A comparative study of students' views of science and science education.* Retrieved from Acta didactica http://urn. nb. no/URN: NBN: no-14449.

Schreiner, C., & Sjøberg, S. (2007). 16. SCIENCE EDUCATION AND YOUTH'S IDENTITY CONSTRUCTION-TWO INCOMPATIBLE PROJECTS? *The re-emergence of values in science education* 231.

Schunk, D. H., & Pajares, F. (2010). Self-efficacy beliefs.

Schurink, W., Fouché, C., & De Vos, A. (2011). Qualitative data analysis and interpretation *Research at grass roots: For the social sciences and human service professions* (Vol. 4, pp. 397-423).

Schütz, G., Ursprung, H. W., & Wößmann, L. (2008). Education policy and equality of opportunity. *Kyklos, 61*(2), 279-308.

Schwandt, T. A., Lincoln, Y. S., & Guba, E. G. (2007). Judging interpretations: But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New directions for evaluation, 2007*(114), 11-25.

Scott, D., & Morrison, M. (2005). *Key ideas in educational research*. London, England: A&C Black.

Scott, D., & Usher, R. (2010). *Researching education: Data, methods and theory in educational enquiry*. London, England.: Bloomsbury Publishing.

Sekaran, U., & Bougie, R. (2010). *Research methods for business: A skill building approach . Chichester: John Willey & Sons Ltd*.

Sewell, W. H. (1996). Three temporalities: Toward an eventful sociology. *The historic turn in the human sciences*, 245-280.

Shapka, J. D. (2009). Trajectories of math achievement and perceived math competence over high school and postsecondary education: Effects of an all-girl curriculum in high school. *Educational research and evaluation, 15*(6), 527-541.

Share, F., & Nherera, D. ((2015, February 10).). Best 100 O-Level schools named. *The Herald Online*. Retrieved from http://www.herald.co.zw/best-100-o-level-schools-named/.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for information, 22*(2), 63-75.

Shepherd, D. L. (2017). *Gender, Self-concept and Mathematics and Science Performance of South African Grade 9 Students (No. 11/2017).*

Shumba, A. (2002). Teacher conceptualization of child abuse in schools in the new millennium. *Journal of interpersonal Violence, 17*(4), 403-415.

Simon, S., Hoyles, C., Mujtaba, T., Farzad, B., Reiss, M., Rodd, M., & Stylianidou, F. (2012). Understanding participation rates in post-16 mathematics and physics (UPMAP). *AERA, April*, 13-17.

Simpkins, S. D., Fredricks, J. A., & Eccles, J. S. (2012). Charting the Eccles' expectancy-value model from mothers' beliefs in childhood to youths' activities in adolescence. *Developmental psychology, 48*(4), 1019.

Simpson, J., & Weiner, E. S. (1989). *The Oxford English Dictionary: an online adventure.* . Oxford, England.: Oxford University Press.

Singleton, R. A., & Bruce, C. (1993). Straits, and Margaret Miller Straits. *Approaches to Social Research*, 260-277.

Sjaastad, J. (2012). Sources of Inspiration: The role of significant persons in young people's choice of science in higher education. *International journal of science education, 34*(10), 1615-1636.

Smeding, A. (2012). Women in science, technology, engineering, and mathematics (STEM): An investigation of their implicit gender stereotypes and stereotypes' connectedness to math performance. *Sex roles, 67*(11-12), 617-629.

Snyder, T. D., & Dillow, S. A. (2012). *Digest of education statistics 2011*: National Center for Education Statistics.

Spera, C. (2005). A review of the relationship among parenting practices, parenting styles, and adolescent school achievement. *Educational psychology review, 17*(2), 125-146.

Steele, C. M., & Aronson, J. (2005). Stereotypes and the fragility of academic competence, motivation, and self-concept *Handbook of competence and motivation* (pp. 436-455).

Stenbacka, C. (2001). Qualitative research requires quality concepts of its own. *Management decision, 39*(7), 551-556.

Stephens, C. (2017). Confronting gender based violence: Gender stereotyping and its impact and consequences for women within the Caribbean and particularly Trinidad and Tobago and the need for reform of policy and the law to afford greater protection to women. *International Journal of Scientific and Engineering Research,*((2)), 186-196.

Stuckey, M., Hofstein, A., Mamlok-Naaman, R., & Eilks, I. (2013). The meaning of 'relevance'in science education and its implications for the science curriculum. *Studies in Science Education, 49*(1), 1-34.

Su, R., Rounds, J., & Armstrong, P. I. (2009). Men and things, women and people: a meta-analysis of sex differences in interests. *Psychological bulletin, 135*(6), 859.

Sumsion, J., Roberts, S., & Lee-Thomas, K. (2005). Teacher understandings of and commitment to gender equity in the early childhood setting. *Australian Journal of Early Childhood, 30*(1), 21.

Swainson, N. (1995). *Redressing Gender Inequalities in Education. A Review of Constraints and Priorities in Malawi, Zambia, and Zimbabwe.*

Swainson, N. (2000). Knowledge and power: the design and implementation of gender policies in education in Malawi, Tanzania and Zimbabwe. *International journal of educational development, 20*(1), 49-64.

Sweetman, D., Badiee, M., & Creswell, J. W. (2010). Use of the transformative framework in mixed methods studies. *Qualitative inquiry, 16*(6), 441-454.

Tashakkori, A., & Teddlie, C. (2010). *Sage Handbook of Mixed Methods in Social & Behavioral Research.* Thousand Oaks, California.: SAGE.

Teddlie, C., & Tashakkori, A. (2003). Major issues and controversies in the use of mixed methods in the social and behavioral sciences. *Handbook of mixed methods in social & behavioral research*, 3-50.

Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences.* Thousand Oaks, California.: SAGE.

Teddlie, C., & Yu, F. (2007). Mixed methods sampling: A typology with examples. *Journal of mixed methods research, 1*(1), 77-100.

Terrier, C. (2016). *Boys Lag Behind: How Teachers' Gender Biases Affect Student Achievement*. Retrieved from https://ideas.repec.org/p/izadps/dp10343.html.

Thomson, S. (2008). Examining the evidence from TIMSS: Gender differences in Year 8 science achievement in Australia. *Studies in Educational Evaluation, 34*(2), 73-81.

Tiedemann, J. (2000). Gender-related beliefs of teachers in elementary school mathematics. *Educational Studies in Mathematics, 41*(2), 191-207.

Tobin, K., & Fraser, B. J. (1998). Qualitative and quantitative landscapes of classroom learning environments. *International handbook of science education, 1*, 623-640.

Tomasetto, C., Alparone, F. R., & Cadinu, M. (2011). Girls' math performance under stereotype threat: The moderating role of mothers' gender stereotypes. *Developmental psychology, 47*(4), 943.

Trauth, E. M., Quesenberry, J. L., & Huang, H. (2008). A multicultural analysis of factors influencing career choice for women in the information technology workforce. *Journal of Global Information Management, 16*(4), 1.

Tsouroufli, M. (2002). Gender and teachers' classroom practice in a secondary school in Greece. *Gender and Education, 14*(2), 135-147.

UNGEI, (2012). *Gender review of education in Zimbabwe: A summary report.* Harare, Zimbabwe:

UNICEF. (1990). World Conference on Education for All. Meeting Basic Learning Needs: Jomtien, Thailand.

UNICEF, (2014). *Zimbabwe Country Office Gender Review Report.* New York, NY.:

Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of educational research, 78*(4), 751-796.

Vaismoradi, M., Salsali, M., & Marck, P. (2011). Patient safety: nursing students' perspectives and the role of nursing education to provide safe care. *International Nursing Review, 58*(4), 434-442.

Valian, V. (2007). *Women at the Top in Science--And Elsewhere.* Washington, D.C.: American Psychological Association.

Van Maanen, J. (1979). *Qualitative methodology.* Thousand Oaks, California.: Sage Publications, Inc.

Van Ryzin, M. J. (2011). Protective factors at school: Reciprocal effects among adolescents' perceptions of the school environment, engagement in learning, and hope. *Journal of Youth and Adolescence, 40*(12), 1568-1580.

Vanin, G. (2015). *The role of a career counsellor in enhancing the career development process of secondary school students (Doctoral thesis Australian Catholic University). Rertieved from* http://doi.org/10.4226/66/5a9cbc13bob93

Varley, J., Murphy, C., & Veale, O. (2008). Science in primary schools, Phase 1. Final report. *National Council for Curriculum and Assessment (NCCA).* Retrieved from https://www.researchgate,net/.../228378242_Science_in_primary_schools_Phase_1_Fina...

Vosloo, J. J. (2014). A sport management programme for educator training in accordance with the diverse needs of South African schools. Retrieved from https://repository.nwu.ac.za/handle/10394/12269.

Wang, M.-T., & Degol, J. (2013). Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields. *Developmental Review, 33*(4), 304-340.

Wang, M.-T., & Eccles, J. S. (2013). School context, achievement motivation, and academic engagement: A longitudinal study of school engagement using a multidimensional perspective. *Learning and Instruction, 28*, 12-23.

Wang, M.-T., & Holcombe, R. (2010). Adolescents' perceptions of school environment, engagement, and academic achievement in middle school. *American Educational Research Journal, 47*(3), 633-662.

Wang, M. T., & Eccles, J. S. (2012). Social support matters: Longitudinal effects of social support on three dimensions of school engagement from middle to high school. *Child development, 83*(3), 877-895.

Watling, R., James, V., & Briggs, A. (2012). Qualitative Data Analysis: Using NVivo. *Research Methods in Educational Leadership & Management 3rd ed. London: SAGE,* 381-396. : .

Watt, H. M. (2006). The role of motivation in gendered educational and occupational trajectories related to maths. *Educational research and evaluation, 12*(4), 305-322.

Welman, C., Kruger, F., & Mitchell, B. (2009). *Research Methodology* (3rd ed.). Cape Town: Oxford University Press, Southern Africa.

Welman, K. (2005). *Research Methodology.* Oxford, UK.: Oxford University Press.

Wheeler, S. (2014). Educating Females in Mozambique: The Significance of Maternal Literacy (Masters' thesis). Retrieved from https://www.du.edu/korbel/media/documents/ipps/wheelermemo2014.pdf.

Wigfield, A., Battle, A., Keller, L. B., & Eccles, J. S. (2002). Sex differences in motivation, self-concept, career aspiration, and career choice: Implications for cognitive development. *Biology, society, and behavior: The development of sex differences in cognition, 21*, 93-124.

Wilson, L. L. (1954). A study of opinions related to the nature of science and its purpose in society. *Science Education, 38*(2), 159-164.

Woessmann, L. (2009). International evidence on school tracking: A review. *CESifo DICE Report, 7*(1), 26-34.

Wubbels, T., & Brekelmans, M. (2005). Two decades of research on teacher–student relationships in class. *International Journal of Educational Research, 43*(1-2), 6-24.

Wubbles, T., & Levy, J. (1993). Do you know what you look like: London: Falmer Press.

Yara, P., O. (2010). Students' self-concept and mathematics achievement in some secondary schools in southwestern Nigeria. *European Journal of Social Sciences, 13*(1), 127-132.

Yazilitas, D., Svensson, J., de Vries, G., & Saharso, S. (2013). Gendered study choice: a literature review. A review of theory and research into the unequal representation of male and female students in mathematics, science, and technology. *Educational research and evaluation, 19*(6), 525-545.

Yusuf, A. (2002). Interrelationships among academic performance, academic achievement and learning outcomes. *Journal of curriculum and Instruction, 1*(2), 87-96.

Yvonne Feilzer, M. (2010). Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. *Journal of mixed methods research, 4*(1), 6-16.

Zeldin, A. L., Britner, S. L., & Pajares, F. (2008). A comparative study of the self-efficacy beliefs of successful men and women in mathematics, science, and technology careers. *Journal of Research in Science Teaching, 45*(9), 1036-1058.

Zhakata, I. (2016). Free education for STEM pupils at public schools. *Herald Online*.

Zimbabwe National Statistics Agency, . (2002). *Zimbabwe Population Census 2002. Harare, ZIMSTAT.*

Zimbabwe National Statistics Agency, . (2016). *Understanding Equality in Zimbabwe: Women and Men Report. Harare, ZIMSTAT.*

ZIMSEC, (2014). *National O-Level Results. Harare, ZIMSEC.*

ZIMSEC, (2015). *National Gender Statistics for O-Level Sciences. Harare, ZIMSEC.*

ZIMSTART. (2013). *Zimbabwe population census 2012*. Harare, ZIMSTAT.

APPENDICES

A- Research Instruments

Please kindly answer this questionnaire to the best of your ability. Section A is about your personal information. Section B requires your opinions about your learning experiences in connection with how boys and girls make choices and perform in natural science subjects. Your identity is protected and will remain anonymous because your name is not required. The information you give will remain confidential.

SECTION A

Personal information

Please tick (√) in the right circle.

1. What is your sex?

A Male ◯

B Female ◯

2. Which is your age group?

A 13-15 year ◯

B 16-18 years ◯

C Over 18 years◯

3. What form are you in?

A 3 ◯

B 4 ◯

C 5 ◯

D 6 ◯

4. What is the gender of your teacher?

A Male ◯

B Female◯

5. State the science subjects that you do.

A---

B---

C---

D---

Section B

B1. In the space below please draw your own scientist--

B2. Describe your scientist--

B3. Are you interested in learning science?

A Yes ◯

B No ◯

B4. Who influenced you most to choose science?

A Myself ◯

B Parents ◯

C Friends ◯

D Teacher ◯

E Media (Television, Radio and Newspapers) ◯

B5. Give one (1) reason why you like to learn science?---

B6. It is made up of 23 items. Opposite each item you will find opinions from which you are required to (✓) tick in one box. The scoring is as follows; 1- Agree (A) 2- Strongly Agree (SA) 3- Disagree (D) and 4- Strongly Disagree (SD)

		A	SA	D	SD
Perceptions.					
1.	Girls are not as good as boys in sciences.				
2.	Equal treatment of boys and girls both at home and school helps in subject choice and performance.				
3.	Household duties after school affect my performance.				
4.	Science subjects are difficult.				
5.	I learn interesting things in science.				
6.	I do not like reading about science.				
7.	I will not use science in many ways in my adult life.				
8.	The way a teacher teaches influences my behavior, subject choice and performance.				
9.	Given a choice, I would rather be taught by a teacher of the same sex as myself.				
Benefits of science (Utility values).					
10.	Science helps me to solve problems properly				
11.	New knowledge in science and technology usually bring social benefits to society.				
12.	Science helps me to make sensible decisions.				

13.	Knowledge of science does not help me to protect the environment.				
14.	Science does not open for me many opportunities in life after school.				
Learning experiences. How many times has your science teacher done or said the following to you.					
		Zero (0) times	1 or 2 times	Few times	Many times,
15.	Did not praise you when you had done well.				
16.	Made you believe that the subject was very difficult.				
17.	Embarrassed you in front of everyone when you gave a wrong answer.				
18.	Praised you for good performance.				
19.	Called you humiliating names e.g. “dofo”.				
20.	Discouraged you from doing science subjects at a higher level despite your good passes at lower level.				
21.	Praised a student with lower marks than yours.				
22.	Ignored your efforts most of the time.				
23.	Made you a leader of a science group or activity.				

THANK YOU

APPENDIX A -02 Student interview schedule

Student Interview Schedule- Focus Discussion Groups (FDG's).

Introduction

Good morning/afternoon participant. As indicated in my introduction letter, I am here to do an interview with you as outlined in my letter of introduction. Feel free to respond to my questions honestly and let me know if the question is not very clear from the start.

Questions

4 Which natural science subjects are you studying and why are you doing the subjects? Probe for reasons for the choice in terms of influence, perceptions and utility values/relevance.

5 Research has shown that fewer girls than boys choose natural sciences at O and A level in Zimbabwe. What do you think are the reasons? Probe for learning experiences, treatment, household chores, self-efficacy, ability and attitudes.

6 Would you like to be taught natural sciences by a teacher of the same sex as you? Probe for reasons.

Thank you.

APPENDIX A -03 Teachers’ interview schedule

Teacher interview schedule

Bio data

Gender: Male Female

School Type: G C

Job Responsibility: H.O.D Class Teacher

Age: -------

Introduction

Good morning/afternoon participant. As indicated in my introduction letter, I am here to do an interview with you as outlined in my letter of introduction. Feel free to respond to my questions honestly and let me know if the question is not very clear from the start.

Questions

1. In your view what do you consider to be the factors that affect choice of natural sciences by students? Encourage the listing and justification of the factors.(RQ1)
2. Do you think the way the students perceive natural science subjects influence their performance in the subject? Probe for perceptions and how they impact on performance.(RQ2)
3. Research has shown that fewer girls than boys choose natural sciences at O and A level in Zimbabwe. What do you think are the reasons? Probe for learning experiences, treatment, household chores self- efficacy, ability and attitudes (RQ1,3 & 4)
4. Given a choice, which gender of teacher would you like to teach your son or daughter natural sciences? Justify your choice.(RQ4)
5. In February 2016 the government launched the STEM project to encourage more students to do sciences at “A” Level. Are you aware of this project and if so what are your views? Probe for implementation strategies and challenges of the project.

Thank You

APPENDIX A -04 Questionnaire -administrators

School Administrators (Head or D/Head) Questionnaire

Key to abbreviations on school types

REG- registered, **STE**- satellite, **M**- church, **G**- government, **C**- council & **P**- private

School status REG ◯ STE ◯

Year established………………………

Highest level offered by school: O Level ◯ A Level ◯

Gender of the School Head: Male ◯ Female ◯

Deputy Head: Male ◯ Female ◯

1. Responsible Authority Code

M ◯ G ◯ C ◯ P ◯

2. Locality

Urban ◯ Rural ◯ Peri-Urban ◯ Growth point ◯

3. Teaching Staff.

Total number of teachers………………

Teachers by gender: Male…………….. Female……………

Science teachers by gender: Male…………. Female………..

Teachers with administrative responsibilities: Male………….. Female……….

Number of qualified science teachers: Male……….. Female……………

4. Students.

Total school enrolment……………

Enrolment by gender: Male…………. Female…………

School prefects: Male………….. Female……………..

Class prefects/representatives: Male………… Female………..

5. School Infrastructure and Resources.

Total number of classrooms……. Science laboratories……… Libraries………. Computer laboratories………

Do you have enough of the following listed in the table?

	YES	NO
School furniture		
Textbooks		
Science equipment and chemicals		
Science portable kits		

6. School Performance in External Final Examinations.

"O" Level Pass Rate %

SUBJECT	GENDER	2012	2013	2014	2015
Integrated science	Male				
	Female				
Biology	Male				
	Female				
Chemistry	Male				
	Female				
Physics	Male				
	Female				
Physical science	Male				
HSB	Male				
	Female				

"A" Level Pass Rate %

SUBJECT	GENDER	2012	2013	2014	2015
Biology	Male				
	Female				
Chemistry	Male				
	Female				
Physics	Male				
	Female				

Thank you for your time.

APPENDIX A – 05 Classroom observation schedule

Classroom Observation Schedule

Name of school……………………………………………. Class………………………………….

Name of teacher………………………… Gender……………Teaching experience…………………….

Highest qualification………………………………….

Date……………………………………………… Time……………………

Subject………………………………Topic.……………………... ....

Total no. of students………………. Girls……………… Boys……………

Classroom organization.

Is space enough? How are the students seated? What is the rationale behind the sitting arrangement? Pictures and diagrams necessary.

Aspects to be observed.

1. **Teacher Activity:**

Voice (loud, soft, shouts, intimidates, abusive language, motivational and coercive, positive and negative feedback.)

Position (is the teacher static or moves around the class?)

Communication (what kind of questions, to whom and how often? Is the feedback in the form of rebuffs or praise, to whom and how frequent? Does the teacher use verbal or physical discipline and to whom? Does the teacher display a supportive or intimidating character?

2. **Student Activity:**

Do students work in groups or individually? If in groups how do they interact among themselves? Who leads the group? Is it a boy or a girl? Which sex dominates the talking? Is the sharing of ideas across sex lines? Are the groups of mixed gender or not? Is the culture of respect and tolerance shown among the group members? If the activity is an experiment, which gender leads the assembling of apparatus and conducting the experiment?

3. **Teacher Student Interaction:**

Does the learning environment allow the students to initiate discussion and ask the teacher questions or vice-versa? How does the teacher respond to girls and boys questions?

Lesson Observation Schedule

TEACHER ACTIVITY		TO WHOM?	FREQUENCY
Voice & Language	Abusive	Boy	
		Girl	
	Motivational	Boy	
		Girl	
Feedback on Questions & Answers	Positive	Boy	
		Girl	
	Negative	Boy	
		Girl	
	Ignored	Boy	
		Girl	
STUDENT ACTIVITY			
Theory Lessons	Participants	Boy	
		Girl	
Practical Lessons 1.Number of groups------ 2. Sex of group leader---------- 4. Dominant sex in the group-----			

B- Analysis Tools

ITEMS	N	Cronbach's Alpha
B6-1 - Girls are not as good as boys?	590	.768
B6-2 - Equal treatment of boys and girls both at home and school helps in subject choice and performance.	590	.790
B6-3 - Household duties after school affect my performance.	590	.828
B6-4 - Science subjects are difficult.	590	.734
B6-5 - I learn interesting things in science.	590	.776
B6-6 - I do not like reading about science.	590	.751
B6-7 - I will not use science in many ways in my adult life.	590	.764
B6-8 - The way a teacher teaches influences my behavior subject choice and performance.	590	.761
B6-9 - Given a choice I would rather be taught by a teacher of the same sex.	590	.779
B6-10 - Science helps me solve problems properly.	590	.859
B6-11 - New knowledge in science and technology usually bring social benefit to society.	590	.798
B6-12 - Science helps me to make sensible decisions.	590	.749
B6-13 - Knowledge of science does not help me to protect the environment.	590	.776
B6-14 - Science does not open for me many opportunities in life after school.	590	.732
B6-15 - Did not praise you when you had done well	590	.826
B6-16 - Made you believe that the subject was very difficult	590	.789
B6-17 - Embarrassed you in front of everyone when you gave a wrong answer	590	.797
B6-18 - Praised you for good performance	590	.821
B6-19 - Called you humiliating names e.g. "dofo"	590	.797
B6-20 - Discouraged you from doing science subjects at a higher level despite your good passes at lower level	590	.799
B6-21 - Praised a student with lower marks than yours	590	.791
B6-22 - Ignored your efforts most of the times	590	.796
B6-23 - Made you a leader of a science group or activity	590	.865

B – 02 KMO.MSA - Bartlett's Validity T

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.734
Bartlett's Test of Sphericity	Approx. Chi-Square	2129.723
	Df	253
	Sig.	.000

ITEMS	Initial	Extraction
B6-1 - Girls are not as good as boys?	1.000	.664
B6-2 - Equal treatment of boys and girls both at home and school helps in subject choice and performance.	1.000	.430
B6-3 - Household duties after school affect my performance.	1.000	.592
B6-4 - Science subjects are difficult.	1.000	.586
B6-5 - I learn interesting things in science.	1.000	.569
B6-6 - I do not like reading about science.	1.000	.513
B6-7 - I will not use science in many ways in many ways in my adult life.	1.000	.489
B6-8 - The way a teacher teaches influences my behaviour subject choice and performance.	1.000	.558
B6-9 - Given a choice I would rather be taught by a teacher of the same sex.	1.000	.634
ITEMS	Initial	Extraction
B6-10 - Science helps me solve problems properly.	1.000	.573
B6-11 - New knowledge in science and technology usually bring social benefit to society.	1.000	.619
B6-12 - Science helps me to make sensible decisions.	1.000	.558
B6-13 - Knowledge of science does not help me to protect the environment.	1.000	.651
B6-14 - Science does not open for me many opportunities in life after school.	1.000	.706

ITEMS	Initial	Extraction
B6-15 - Did not praise you when you had done well	1.000	.423
B6-16 - Made you believe that the subject was very difficult	1.000	.520
B6-17 - Embarrassed you in front of everyone when you gave a wrong answer	1.000	.548
B6-18 - Praised you for good performance	1.000	.628
B6-19 - Called you humiliating names e.g. "dofo"	1.000	.596
B6-20 - Discouraged you from doing science subjects at a higher level despite your good passes at lower level	1.000	.569
B6-21 - Praised a student with lower marks than yours	1.000	.518
B6-22 - Ignored your efforts most of the times	1.000	.547
B6-23 - Made you a leader of a science group or activity	1.000	.663

B- 03 Chi square Analysis Test of Indepe

Item description		Males		Females		df	2-tailed sig (p=.05)
		A (n/%)	DA (n/%)	A (n/%)	DA (n/%)		
1	Girls are not as good as boys.	184	159	49	184	1	.000<p
		53.6	46.4	21.0	79.0		
2	Equal treatment of boys and girls helps in subject choice & performance.	261	76	211	22	1	.000<p
		77.4	22.6	90.6	9.4		
3	Household duties affect my school performance.	127	200	116	115	1	.008<p
		38.8	61.2	50.2	49.8		
4	Science subjects are difficult	74	251	62	171	1	.297>p
		22.8	77.2	26.6	73.4		
5	I learn interesting things in science.	311	30	224	11	1	.059>p
		91.2	8.8	95.3	4.7		
6	I do not like reading about science	28	316	24	212		.401>p
		8.1	91.9	10.2	89.8	1	
7	I will not use science in many ways in my adult life.	51	290	27	208		.232>p
		15.0	85.0	11.5	88.5	1	
8	The way a teacher teaches influences my behaviour, subject choice and performance	254	80	185	45		.218>p
		76.0	24.0	80.4	19.6	1	
9	Given a choice, I would rather be taught by a teacher of the same sex as myself.	173	164	84	145	1	.001<P
		51.3	48.7	36.7	63.3		
10	Science helps me to solve problems properly	282	62	197	32	1	.200>p
		82.0	18.0	86.0	14.0		

11	New knowledge in science and technology usually bring social benefits to society.	327	16	224	9			1	.643>p
		95.3	4.7	96.1	3.9				
12	Science helps me to make sensible decisions	298	34	214	17			1	.241>P
		89.8	10.2	92.6	7.4				
13	Knowledge of science does not help me to protect the environment.	36	305	12	219			1	.023<p
		10.6	89.4	5.2	94.8				
14	Science does not open for me many opportunities in life after school.	27	313	12	220			1	.197>p
		7.9	92.1	5.2	94.8				
		ZT	FT	MT	ZT	FT	MT		
15	Did not praise you when you had done well.	217	75	48	147	51	33		
		63.6	22.0	14.4	63.6	22.1	14.3	4	.953>p
16	Made you believe that the subject was very difficult.	254	60	27	160	45	24	3	
		74.5	17.6	7.9	69.9	19.6	10.5		.040<P
17	Embarrassed you in front of everyone when you gave a wrong answer.	272	46	27	197	20	17	3	.325>p
		78.8	13.4	7.8	84.2	8.6	7.3		
18	Praised you for good	52	107	183	45	57	13	3	.269>p

	performance.						1		
		15.2	31.3	53.5	19.3	24.4	56.2		
19	Called you humiliating names e.g. “dofo” (meaning a fool or idiot).	293	22	27	205	10	17		
		85.7	6.4	7.9	88.4	4.4	7.3	3	.623>p
20	Discouraged you from doing science subjects at a higher level despite your good passes at lower level.	292	23	24	207	13	12	3	.436>P
		86.1	6.7	7.1	89.2	5.6	5.2		
21	Praised a student with lower marks than yours.	253	67	19	194	29	8		.064>P
		74.6	20.2	5.6	84.0	12.6	3.5	3	
22	Ignored your efforts most of the time.	276	40	23	182	28	17		.488>p
		81.4	13.8	6.8	80.2	12.4	7.4	3	
23	Made you a leader of a science group or activity.	181	97	62	129	55	50		
		53.3	28.5	18.2	55.1	23.5	21.4	3	.517>p

B-04 ANOVA – Mean, standard deviation

Key; N= number of responders, Sig= significance

No.	Item description	Gender	N	Std. Deviation	Mean	Sig.
1	Girls are not as good as boys in sciences.	Male	343	.499	1.46	.000
		Female	233	.408	1.79	
2	Equal treatment of boys and girls both at home and school helps in subject choice and performance.	Male	337	.419	1.23	.000
		Female	233	.293	1.09	
3	Household duties after school affect my school performance.	Male	327	.488	1.61	.008
		Female	231	.501	1.50	
4	Science subjects are difficult.	Male	325	.420	1.77	.298
		Female	233	.443	1.73	
5	I learn interesting things in science.	Male	341	.284	1.09	.059
		Female	235	.212	1.05	
6	I do not like reading about science.	Male	344	.274	1.92	.401
		Female	236	.303	1.90	
7	I will not use science in many ways in my adult life.	Male	341	.357	1.85	.233
		Female	235	.320	1.89	
8	The way a teacher teaches influences my behavior, subject choice and performance.	Male	334	.427	1.24	.218
		Female	230	.398	1.20	
9	Given a choice, I would rather be taught by a teacher of the same sex as myself.	Male	337	.501	1.49	.001
		Female	229	.483	1.63	
10	Science helps me to solve problems properly.	Male	344	.385	1.18	.200
		Female	229	.347	1.14	
11	New knowledge in science and technology usually bring social	Male	343	.211	1.05	.644
		Female	233	.193	1.04	

	benefits to society.					
12	**Science helps me to make sensible decisions.**	Male	332	.304	1.10	.242
		Female	231	.262	1.07	
13	**Knowledge of science does not help me to protect the environment.**	Male	341	.308	1.89	.023
		Female	231	.222	1.95	
14	**Science does not open for me many opportunities in life after school.**	Male	340	.271	1.92	.198
		Female	232	.222	1.95	
15	**The teacher did not praise you when you had done well.**	Male	341	1.122	1.75	.919
		Female	231	1.124	1.76	
16	**The teacher made you believe that the subject was very difficult.**	Male	341	.922	1.48	.066
		Female	229	1.050	1.63	
17	**The teacher embarrassed you in front of everyone when you gave a wrong answer.**	Male	345	.891	1.41	.309
		Female	234	.849	1.33	
18	**The teacher praised you for good performance.**	Male	342	1.125	3.10	.832
		Female	233	1.195	3.08	
19	**The teacher called you humiliating names e.g. “dofo” meaning a fool or idiot.**	Male	342	.861	1.32	.579
		Female	232	.830	1.28	
20	**The teacher discouraged you from doing science subjects at a higher level despite your good passes at lower level.**	Male	339	.845	1.32	.200
		Female	232	.723	1.23	
21	**The teacher praised a student with lower marks than yours.**	Male	339	.877	1.46	.012
		Female	231	.718	1.28	
22	**The teacher ignored your efforts most of the time.**	Male	339	.842	1.36	.904
		Female	227	.848	1.37	
23	**The teacher made you a leader of a science group or activity.**	Male	340	1.168	1.94	.861
		Female	234	1.219	1.94	

B- 05 Principal Component Analysis

	Component							
	1	2	3	4	5	6	7	8
B6-1 - Girls are not as good as boys?	.016	.088	.106	-.067	-.044	.101	.782	.128
B6-2 - Equal treatment of boys and girls both at home and school helps in subject choice and performance	.090	-.172	.086	.573	-.126	.173	-.087	.052
B6-3 - Household duties after school affect my performance.	-.085	-.078	.080	.007	.022	.002	.111	.748
B6-4 - Science subjects are difficult	-.082	.113	-.180	.044	-.027	.655	.180	.265
B6-5 - I learn interesting things in science	.085	-.011	.139	.670	.089	-.049	.229	-.173
B6-6 - I do not like reading about science	-.154	.530	-.257	.123	.079	-.014	.332	.103
B6-7 - I will not use science in many ways in many ways in my adult life	-.043	.536	-.280	.062	.110	-.104	.082	.298
B6-8 - The way a teacher teaches influences my behavior , subject, choice and performance	.025	.139	.032	.708	.055	-.033	-.140	.110
B6-9 - Given a choice ,I would rather be taught by a teacher of the same sex	-.014	.052	.152	.035	.143	.746	-.042	-.167
B6-10 - Science helps me solve problems properly	.042	-.150	.693	.195	-.121	.006	.126	-.016
B6-11 - New knowledge in science and technology usually bring social benefit to society	.166	.084	.627	.042	.122	.132	-.109	.381
B6-12 - Science helps me to make sensible decisions	.028	.191	.709	.051	.056	-.061	.074	-.058
B6-13 - Knowledge of science does not help me to protect the environment	-.042	.765	.161	-.073	.078	.137	-.009	-.089

B6-14 - Science does not open for me many opportunities in life after school	-.077	.776	.231	-.049	-.043	.096	-.066	-.161
B6-15 - Did not praise you when you had done well	.320	-.262	.185	.046	.228	-.072	.306	-.255
B6-16 - Made you believe that the subject was very difficult	.626	-.079	.134	-.132	.085	-.055	.215	-.173
B6-17 - Embarrassed you in front of everyone when you gave a wrong answer	.692	-.050	-.050	.160	-.084	-.094	.133	-.064
B6-18 - Praised you for good performance	-.129	.219	-.052	-.060	.722	.154	-.110	-.007
B6-19 - Called you humiliating names eg "dofo"	.745	.053	-.031	.021	-.059	-.151	-.065	.079
B6-20 - Discouraged you from doing science subjects at a higher level despite your good passes at lower level	.699	-.143	.136	.019	-.014	-.034	-.201	.018
B6-21 - Praised a student with lower marks than yours	.697	-.003	.003	.070	.109	.062	-.094	.047
B6-22 - Ignored your efforts most of the times	.692	-.085	.084	.071	-.062	.160	.100	-.098
B6-23 - Made you a leader of a science group or activity	.084	-.055	.042	.062	.800	-.013	.076	.044

C- Sample of Qualitative interview
Transcripts- FGD-3

Question 1. Which natural sciences are you studying and why are you doing the subjects?

RM1. Well I'm doing A level Biology, Chemistry and Mathematics, mostly I chose the Biology part of it because well I had a passion for Biology, I love Biology, I enjoy everything in it, mostly the content, the vocabulary, the diversity of things you find in Biology. Oh, it was my choice because of interest. Well the subject is not that hard, but it seems mostly because of the interest it makes it easy, so due to interest it makes it easy. Well I would love to do medicine and become a doctor.

RF2. Well I'm currently studying Biology, Mathematics and Food Science. Why? It is because I have interest in all my subjects, Biology I love, Math's I love, Food science, I love to deal with food. I love everything that concerns food that is why I'm studying these subjects. I don't think there is a subject which is difficult, I think it all depends on your interest and what you like to do and what you do not like and what you prefer so I prefer to do these subjects and I find them quite enjoyable. Well I am planning to be a food technologist if everything goes well.

RM3. I'm studying O level Chemistry, Biology and Mathematics, I particularly like Chemistry, I need to pursue Chemistry, the reason being I have interest in Chemistry and I really want to make some new inventions. It is out of interest that I do it.

RF4. I'm doing Biology, Physical Science and Mathematics at O level, I would like to pursue to do Physical Science and Mathematics at A level because I've always have an ambition to be a Medical Doctor because my Great Grandfather motivates me. He was Mr. Mutsvanga.

Question 2. Research has shown that fewer girls than boys choose natural sciences at O and A level in Zimbabwe. What do you think are the reasons?

RF1. I think it's because of fear of failing them for example my personal example I did not take Chemistry because I thought I would not be able tackle it so therefore I did not take it, instead I took Food science, I thought that would be easier than Chemistry.

RF2. It's because ummh many girls have just this feeling that science subjects they are difficult and that girls usually they tell themselves that they are inferior to boys as a result you find there are fewer girls doing these subjects, Maths, Physics, Biology and Chemistry because they are afraid.

RM3. I think girls just lose focus, they (laughing) don't understand better than boys, I mean boys they understand Engineering better than girls.

RF4. I think like what he said it's that kind of mind set that influences other girls to think that Sciences are not for them. There is this kind of rumor that actually boys are better in science subjects than girls, so I think it's just mindset ye the person like let's say uumh if a girl right, really puts her mind on to something, she wants to do sciences and does them without that kind of mindset that boys are better than girls. I think they can do better, it's just the mindset and influences from other people that sciences are hard for girls and boys are meant for sciences.

RF5. I think ummh girls right, they think that sciences are meant for boys because usually If you look at the past most of the scientists are male, fewer female and for that reason some believe that maybe it was just meant for the boys.(laughing)

RM6. There is another problem, girls think that they are too smart (laughing) because sciences involve dirty chemicals what? (Laughing)

RM7. Yah I get his point, let's say in terms of Engineering the past where you get, to work with metal and in Chemistry you get to work with Chemicals you know so they will be like I don't want to get my hands dirty. (Laughing)

RF8. (Laughing) No it's not true, I think it's mostly based on misconception like girls are inferior girls should be lower than boys, girls shouldn't do this, girls shouldn't that, I think it's because they see themselves and feel inferior to boys, and generally it's kind of because of fear per say.

RM9. It comes from long back, back in the time when parents would say the girl child should stay home and educate the boys, its useless to send the girl child to school because she will only get married after school, so some are still living in that time, (laughing). Yes, its different father daughter, mother son, fathers like daughters more than sons, mothers like sons more than daughters (laughing), when it comes to school they all support. Yah.

RM10. Maybe that depends with the parents, it might differ sometimes, but I think it is quite the same how they take your education but only that they give preference to the one who seems more serious, like interest in the jobs that are more paying. The treatment we get at the school from our teachers is almost the same but not equal.

RM11. The female, the girl, well we said due to the cultural beliefs and stuff that the girl is supposed to be doing the household chores and stuff like that so at home I wouldn't expect my dad to call me to come wash the plates, I would expect him to say go do the garden, go wash the car so we classify ourselves according to the chores we are expected to be doing.

RM12. If you check the chores that are done by the males right, mostly the garden stuff, its hard work, it requires energy and stuff so if you are a guy doing those jobs let's say today you might be doing it for 2 hours, after those 2 hours you will be tired, you will go to sleep of which the female she might work for 5 hours, washing plates, sweeping the house and it would require that much of energy, less than the guy if you get where I'm coming from, (laughing).

RF13. It doesn't depend on how much energy it needs because you only rest one day and the next day you will be so active, for the girls you do it like regularly, each and every day, I don't know for how many hours. No it's not like that, if you have little siblings also you have to take care of them, supper you have to cook, lunch you have to so many things, you don't want to know, (laughing) and for you guys it's like for one day, once in week, once in a month you have to like wash the car or go to the garden, who has got fewer hours to read now?

RM14. Girls are more confident than boys, (laughing), problem inoitika ndeyekuti vakomana vanonyara kudarika vasikana, (laughing) vanofunga kuti inoda simba rakawanda, (laughing), kusimudza like mentality iripo ndeyekuti engineering pane zvakawanda zvinoda kusimudzwa simudzwa and vasikana hana dzavo hadzina kusimba, havakwanise kuona munhu akauya kuchipatara, instead kuti arape munhu ndiye akutorwara (laughing), ndosaka vachizorapwa na doctor (laughing). (Girls are more confident than boys, but they think that engineering involves a lot of physical hard work and energy. They also have weak hearts and are easily frightened.)

RF15. I think in terms of confidence girls are less confident than boys because it's the girls naturally depend on other people's opinion like in terms of everything like girls are supposed to be this. Most of the times you can't, people don't really say this boy is ugly but for girls you can say the girl is ugly (laughing) serious because for girls you have to be perfect, you have to be this and that, for boys it's to a lesser extend so I think for confidence girls have less because everything they do, they get commented but for boys it's not usually commented.

RM16. Most of the negatives are from the girls, some of the reasons have been mentioned before, and we said girls want to be smarter, they think sciences are difficult, they just believe that boys are able to do it better than them, I can't remember all the points, but these are some of them.

RM17. Well bringing back the issue of household chores (laughing), okay basically the girls gives them excuses so because of that they get this negative attitude, no I can't do this, I can't do this if you get what I mean, they just makeup excuses, they get negative.

RF18. I think it depends on ambition, cause whether you are a guy or girl as long as you've got something to do in life, that depends on your attitude on a subject Science, Commercially or Art, let us just say someone wants to be an Accountant in life, you can't put 100% focus on Chemistry when you know that you want to be an Accountant, put 100% focus in Accounts so it depends, your attitude depends on ambition. Yes, true. It is not like that but its just natural that most of the girls don't, are not into science that much, they are really hard.

RM19. I wanted to say girls, generally are not serious, they have this mentality that men are supposed to go to work and they are the ones who are supposed to look after the family (laughing). Yes some.

RF20. For example, they have still this belief yekuti they think that males are the ones who are supposed to educate, go to work and then girls are just of household chores, looking after the family but it depends on the person, some they just want to be as equals as boys.

Question 3. Would you like to be taught natural sciences by a teacher of the same sex as yourself and why?

RF1. (Laughing) I prefer a teacher of the same sex, exactly because I'm not that free with male teachers, my father and my brothers yes, not my teachers, well I really don't know, I haven't thought about it, I'm just much free with female teachers than male teachers.

RM2. I would like to be taught by a teacher opposite my sex, why because I think there is a favor if the opposite sex, male teachers favor girls (laughing), female teachers favor boys more than girls, (laughing), let's say after writing a test, you have queries and there are so many people you are just chased away (laughing), and boys come later, and their marks are adjusted.

RM3. I think both sides would prefer teachers of the same sex like you said due to being comfortable talking to a male teacher, well I would be more comfortable talking to a male teacher than a female teacher, I don't know it's just natural, let's say I will specify, in Biology we have got some topics that I just can't discuss with female teachers if you know what I mean and if it's for the girls they can't spend that much time discussing with a male teacher like some of our junior teachers, they just can't do that because it won't feel comfortable and for us guys as well I can't discuss some of the topics we learn in Biology with a female teacher.

RM4. Personally, I would prefer a teacher of the opposite sex, a female teacher because in a situation, these whatever male teachers teach sciences they based on their terrible experiences, during their A levels and University so they would like to teach us using the same methods under harsh conditions, whereas female teachers take us bit by bit, (laughing), they are patient, male teachers are not.

RF5. I think I would prefer a male teacher, the way they like ehh, most of them are very like strict and tough so it is like for conditions. I know if someone is not tough I just relax, I need a person who will strangle me if I don't do the correct thing which will make me work an extra mile.

RF6. I think when someone is in a lesson I think it's comfortable to have a male teacher teaching in front of you because actually from my own opinion males and females in comparison females are slightly short tempered, not that much but slightly, if they explain to you something and you don't understand they are like "what don't you understand" (laughing) and then you just go even if you don't understand, for a male teacher if he tries to be harsh he controls himself, males can control themselves and explain again but females just burst, but when you going for like extra, if you want to ask something you didn't understand in a lesson think it would be better to go to a same sex teacher because actually when I'm like a girl and I go to a male teacher it won't really be a comfortable environment to ask things I didn't understand in a lesson because he is a guy and I'm a girl (laughing), if I come alone there is no way I will be able to ask but maybe we come 3 or 4 that's quite comfortable.

RM7. It's just the same as guidance and counseling or going to see a doctor. You can be treated by a male or a female doctor because they are both qualified. So, if the teacher is qualified does it matter who teaches you? Myself, I will choose a teacher who knows the subject most. If the students fail every year ooh (laughing) I will not go into that class and if the headmaster forces me I will change the school. The sex of the teacher is not a problem.

D- Summary of Interview Transcripts

D- 01 Repeated Ideas from FGDs (Female)

Focus Discussion Group(FDGs)	**FDG1**	**FDG2**	**FDG3**	**FDG4**
Q1. Which natural science subjects are you studying and why are you doing the subjects?	**RF1** – Interest in natural sciences, career in medicine. **RF2** – career as Pharmacist. **RF5** – Ability below school standards, no interest in natural sciences, fear of sciences. **RF7** – career related to natural sciences, success prospects. **RF8** – ability below school standards. **RF11** –influenced by sister to drop sciences. **RF15** – Role model influence,	**RF4** – Financial problems prohibited me from pursuing natural sciences. **RF12** – Interest in natural sciences, got support from teachers. **RF13** – Career in medicine, decision to study sciences supported by brother.	**RF2** – Interest in natural sciences, career as a food technologist. **RF4** – Career in medicine influenced by grandfather.	**RF1** – Easy to study on my own, role model influence, and science related career. **RF2** – A career in the medical field, would like to be a Pharmacist.

	success prospects. **RF16** – Job Opportunities.			
Q2. Research has shown that fewer girls than boys choose natural sciences at O and A level in Zimbabwe. What do you think are the reasons?	**RF3** – Father of house cannot wash dishes; time management is important. **RF6** – Parents discriminate against girls' study time; some subjects' concepts require group discussions. **RF4** – Poor performance not necessarily due to home duties **RF8** – Equal ability between boys and girls, girls are lazy, not all girls see science subjects as difficult. **RF9** – Sciences require a lot of hard work, adolescence peer pressure affects	**RF2** – Parental discrimination, some concepts require group discussions, too many household chores. **RF4** – Self-efficiency, too many household chores. **RF6** – Girls should be independent, science subjects not difficult. **RF8** – Independence. **RF9** – Girls lack concentration, social pressures. **RF10** – Social pressure and time management. **RF11** – Lack of motivation, same ability. **RF12** – Lack of confidence.	**RF1** – Fear of failing **RF2** – Perceived as difficult, inferiority complex. **RF4** – Mind-set, cultural gender beliefs. **RF5** – Cultural gender beliefs. **RF8** – Inferiority complex. **RF13** – Girls have more household chores. **RF15** – Lack of confidence in girls. RF18 – Ambition and Attitude. **RF20** – Cultural gender roles.	**RF2** – Science subject difficult belief. **RF8** – Equal treatment at home, girls smarter than boys. **RF9** – Girls have more chores at home, same treatment at school. **RF10** – Boys look down upon girls, girls lack confidence, treatment not equal at school.

	girls easily, and girls are affected by relationships. **RF11** – Some guys have natural intelligence. **RF12** – Natural sciences not difficult, fear of the subject. **RF15** – Science subjects are difficult, they require a lot of concentration and reading.	**RF15** – Girls mature faster than boys, affected by social pressures. **RF16** – Girls as good as boys, girls get less time to study, house hold chores. **RF17** – Social pressures, girls need empowerment, lack of trust from parents, parental discrimination. **RF20** – Sciences not difficult, require interest.		
Q3. Would you like to be taught natural sciences by a teacher of the same sex as yourself and why?	**RF2** – Ability to teach is unisex. **RF3** – Underestimates same sex teacher, attitude towards female teachers. **RF5** – Ability to teach unisex. **RF8** – negative attitude towards female teachers prejudiced.	**RF1** – Same sex, freedom of expression. **RF3** – No gender preference. **RF5** – Selection by ability.	**RF1** – Same sex and freedom of expression. **RF5** – Female teachers have a temper, discomfort alone with male teachers.	**RF1** – Prefer same sex teacher, same sex teacher easy to approach. **RF7** – Unisex, ability is what matters. **RF9** – Unisex ability is what matters.

D- 02 Repeated Ideas from FGDs (Males)

Focus Discussion Group(FDGs)	FDG1	FDG2	FDG3	FDG4
Q1. Which natural science subjects are you studying and why are you doing the subjects?	**RM3** – Government funding, career as doctor. **RM4** – Previous school didn't off natural sciences, would have wanted to be a doctor. **RM6** – Many science related jobs, career as a scientist. **RM9** – Career as an Agritex Officer, ability below school standards. **RM10** – Interest in natural sciences, career as Pharmacist. **RM12** – Not intelligent enough to do natural sciences. **RM13** – Many job	**RM7** – Interest in natural sciences. **RM9** – Government funding. **RM13** – Self influence and interest.	**RM1** – Interest, career as doctor. **RM3** – Interest in natural sciences.	**RM4** – Personal interest, career in civil engineering. **RM5** – Influenced by parents.

	opportunities, government funding, and physical science is difficult, influenced by brothers. **RM14** – Physical science is difficult, influence by brothers. **RM17** – Natural sciences require hard work. **RM18** – Ability below school standards.			
Q2. Research has shown that fewer girls than boys choose natural sciences at O and A level in Zimbabwe. What do you think are the reasons?	**RM1** – Girls have less time to read. **RM2** - Family background critical in house hold chores, Day scholars have less study time than borders. **RM5** – Choice of "O" level Physical Science based on school policy. **RM7** – Girls affected by peer pressure, environment has a bearing on performance. **RM10** – Subject	**RM3** – Cultural gender beliefs. **RM13** – Girls spend more time on social media. **RM14** – Peer pressure. **RM18** – Parental discrimination **RM19** – Girls perceive sciences as difficult.	**RM3** – Girls tend to lose focus. **RM6** – Smartness. **RM7** – Smartness. **RM9** – Cultural gender beliefs. **RM10** – Preferential treatment. **RM11** – Cultural gender beliefs. **RM12** – Distribution of house hold chores. **RM14** – Career misconception. **RM16** – Girls are	**RM7** – Science subjects are difficult belief, marriage belief influence girls, and few role models in the society. **RM8** – Marriage belief influence, regardless of status women dream of their marriage day.

	not difficult, pubertal challenges disturb girls, subject requires a lot of concentration. **RM13** – Girls concentrate less than boys. **RM14** – Subject not difficult, girls take love relationships seriously. **RM16** – Subject not difficult, teacher methodology linked to subject choice by students. **RM17** – Subject requires concentration. **RM18** – Some teachers lack the ability to teach.		less confident, negative attitude. **RM17** – Girls have a negative attitude. **RM19** – Cultural gender roles, girls lack seriousness.	
Q3. Would you like to be taught natural sciences by a teacher of the same sex as yourself and why?	**RM1** – Female teachers not as good in physical sciences, males preferred to teach the subject. **RM4** – Male teachers are strict and female	**RM2** – Different sex, made teachers easily provoked. **RM4** – Selection by ability. **RM6** – Teacher personality.	**RM2** – Different sex and favouritism. **RM3** – Same sex and freedom. **RM4** – Different sex, female teachers are patient.	**RM5** – Female teachers easy to communicate with. Female teachers for Biology and male teacher for Physics and Chemistry.

	teachers are not strict. **RM6** – Male teachers' comfortable doing experiments than female teachers. **RM7** – Female teachers only concentrate on able students		**RM7** – Same sex, freedom of speech.	**RM8** – Historically most discoveries in physics and chemistry made by males.

D- 03 male teacher responses

Teacher	Male Teacher 1	Male Teacher 2	Male Teacher 3
Question 1 In your view what do you consider to be the factors that affect the choice of natural sciences by students? Justify your opinions. (RQ1)	○ O and A level science uptake by ability-school policy. ○ High flyer's decision considered.	○ Success, ability and experience. ○ Ability – school policy. ○ Able student decision respected.	○ Cultural beliefs ○ Boys preferred more than girls. ○ traditional (girls can't handle sciences) ○ subject ability ○ home duties for girls ○ Subject ability equal.
Question 2 What do you perceive to be the factors that influence performance by students in natural sciences? (RQ 2)		○ Choice influenced by ability. ○ Sciences are a status symbol. ○ Cognitive abilities. ○ Mind construct. ○	○ Girls believe less in themselves. ○ School ability-based screening. ○ Girls influenced by previous observations. ○ School administrators influence. ○ traditional beliefs, ○ stereotyping influences girls easily

Question 3 Research has shown that fewer girls than boys choose and pass natural sciences at O and A level in Zimbabwe. What do you think are the reasons? (RQ1 & 2)	○ Fewer girls in multi-sex schools. ○ Boys influence girls in multi-sex schools. ○ Few role model female science teachers. ○ Cultural Roles. ○ Gender sensitive curriculum. ○ Girls fear embarrassment. ○ Girls have more home duties than boys. ○ Girls conditionally allowed to join study groups. ○ Fear of sexual harassment for the girl child. ○ Historically physics is a male domain. ○ Boys and girls treated equally at school.	○ Girls intellectually overtaken by boys. ○ Boys perceive special relationship concepts better than girls. ○ Male brain more concrete and logical. ○ Female brain more expressive and intuitive. ○ Males good with physics. ○ Females good with biology. ○ Girls have more chores than boys. ○ Equal treatment at school.	○ Employment opportunities, lack of role models, ○ Treatment of girls & boys equal at school. ○ Traditional beliefs. ○ Subject ability equal. ○ Girls doing sciences are assertive and strong characters.
Question 4 Given a choice, which gender of teacher would you like to teach your child natural science? Justify your choice. (RQ 3& 4)	○ Male teacher preferred. ○ Male teachers strict and disciplinarians. ○ Female teachers equally able to teach as male counter parts.	○ Unisex ability. ○ Society biased against female science teachers. ○	○ Unisex ability preference
Question 5 In February 2016 the government launched the STEM project to encourage more students to do sciences at "A" level.	○ Government funding a good idea. ○ Discord between two ministries derails the program. ○ Laboratories for rural schools.	○ Government funding. ○ Strategy of funding. ○ No affirmative action. ○	○ Not a new idea. ○ Resuscitating the system. ○ Level of funding not best. ○ Affirmative action not good.

Are you aware of this project and if so what are your views?	○ Affirmative action for girls.		○ Inadequate labs and resources. ○ Application of portable kits limited. ○ Lack of employment opportunities.

D- 04 female teacher responses

Teacher	Female Teacher 1	Female Teacher 2	Female Teacher 3	Female Teacher 4	Female Teacher 5
Question 1 In your view what do you consider to be the factors that affect the choice of natural sciences by students? Justify your opinions. (RQ1)	○ Peer pressure. ○ Life career. ○ Parental influence. ○ School based ability. ○ Perceived subject difficulty. ○ Subject combinations. ○ Student's choice respected. ○ Girls lack confidence. ○ Motivate girls through rewards.	○ Cultural influences . ○ Parental influence. ○ Selection by school policy. ○ No freedom of choice to learners. ○	○ Ability based on school policy. ○ School administrators select the students. ○	○ Perceived difficulty. ○ Career choice. ○ Family influence. ○ Fear of mathematical aspects in physical science.	○ Career choice. ○ Imposed by school policy-based ability.
Question 2 What do you perceive to be the factors that influence performance by students in natural	○ Stereotyping beliefs ○ personal choice (high performance) ○ forced choice (low performance)	○ Subject associated with males. ○ Few female roles models.	○ Science is hard mind set. ○ Influence of role model.	○ School policy-based ability. ○ Girls think sciences more challenging than humanities. ○ Positive attitudes by some parents towards girls.	○ Negative attitude towards mathematics linked subjects. ○ Influence from relatives. ○ Positive perceptions improve performance, role models,

sciences? (RQ2)				○ parents should help and show interest in the girl's education. ○ low enrolment of girls in upper forms send wrong signals to lower forms. ○ boys and girls exposed to the same experiences at school.	career choice. ○ Negative attitudes lower performance. ○ Most girls have negative attitudes. ○ boys work very hard to achieve goals.
Question 3 Research has shown that fewer girls than boys choose and pass natural sciences at O and A level in Zimbabwe. What do you think are the reasons?	○ Girls equally good as boys ○ intelligence not sex linked ○ Environmental pressures affect girls. ○ Mind-set beliefs ○ Negative comments on girls doing sciences. ○ Equal treatment in homes makes a difference in subject	○ Girls equally good as boys. ○ Science is difficult label reduces the number of girls. ○ Girls have more home duties than boys. ○ home duties affect performance,	○ Perception that science is for boys. ○ Some girls are more intelligent than boys. ○ Same tasks give confidence to the girls. ○ Home duties affect performance, girls have more home duties than boys. ○ Boys have more study time at home. ○ No	○ Think subject is difficult. ○ Girls lack confidence. ○ Few role-models. ○	○ Lack of exposure and information for girls. ○ Socialisation approaches discriminatory. ○ Lack of role models. ○ Exposed to same learning experiences at school. ○ Boys and girls treated differently at home. ○ Treatment is gender biased.

(RQ1, 3 & 4)	choice ○ Stereotyped comments. ○ Girls have more home duties than boys. ○ Teachers sceptical with girls choosing physics. ○ Subjects are unisex. ○ Stereotyped jobs. ○ No disparities at school, disparities are at home, free study time discriminatory	○ Girls easily affected by adolescence. ○ Something difficult needs more time. ○ Culture labels females as inferior. ○ Boys and girls treated equally. ○ School learning experiences the same. ○ Social experiences different. ○ Girl child headed families many. ○ poor girls need assistance with basic things of	gender biased subjects. ○ Sciences require more time to study.		○ Girls overloaded with home chores. ○ Mental ability of boys and girls at par. ○ Girls lack confidence. ○ Boys are adventurous and experimental. ○ Allocation of chores is discriminatory.

		life.			
Question 4 Given a choice, which gender of teacher would you like to teach your child natural science? Justify your choice. (RQ4)	○ Ability is unisex	○ Female teacher preferred. ○ Female teachers are more patient.	○ Unisex ability.	○ Unisex teacher preferred. ○ Passion for teaching.	○ Female teacher preferred. ○ Female teachers more patient and motherly.
Question 5 In February 2016 the government launched the STEM project to encourage more students to do sciences at "A" level. Are you aware of this	○ No STEM funding yet. ○ STEM has increased the uptake of sciences ○ Affirmative action for the girl chid ○ O and A level upwards should be funded. ○	○ Unaware of STEM.	○ Government funding. ○ STEM did not consider school infrastructures. ○ STEM increased enrolment in sciences.	○ Project good. ○ Many students given opportunities. ○ Previous selection standards too high. ○ Government funding. ○ Sciences are practical subjects. ○ Infrastructures and resources inadequate	○ More inventors in the making, government funding, ○ STEM increased uptake of sciences. ○ Equipment and resources inadequate. ○ Project should start at primary. ○ Affirmative action for the girl child

project and if so what are your views?					

E- Sources of Quotes

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Focus Discussion Group (FGD) 1

Key: RF= Response Female, RM= Response Male

Question 1. Which natural science subjects are you studying and why are you doing the subjects?

RF1. Yes, because I'm in A level and I would like to study pure sciences, Yes Pure Sciences, I'm just interested in them. I would like to use them later in my life, I would like to be a doctor.

RF2. I am doing physical science because in the future I want to be a Pharmacist.

RM3. I am doing physical science at O level because I want to do it at A level so that I can have help from the government and be a Doctor. It's like the shortage of students who are taking sciences in Zimbabwe so the government decided to help those people who go for sciences.

RM4. Ndichingotaurawo neShona, ini zvangu ndoita Integrated Science, Ndirikuita Integrated Science nekuti pachikoro pandaidzidza panga pasingaitwe Inter Science saka ndakangotangawo kuita Inter Science kusvika nanhasi ndodzandiri kungoita. Yes, ndaidziita because ndoziva kuti ndakaitawo Physical Science kana ndichinge ndapedza ndanyora O level yangu ndikaenda kuA level ndokwanisa kuzoitawo Doctor.(I will speak in Shona, I do integrated science because at the school I was learning there was no inter science and Iam still doing integrated science to date. Yes I would have studied it ,because I know if I had done Physical Science at O Level and proceed to A Level I could have been able to be a doctor.)

RF5. Inini haa handiite Physical, ndoita Integrated Science, inini ndakadhitemainwa ne pass rate yangu kuti ndiite Integrated Science because class yandanga ndiri yanga isingaite asi dai kuri kuti ndakapinda mu class yaiitwa Physical Science ndanga ndisiri interested nayo, ndakangovhundukawo pandakaona zvima sign sign, hameno zvimasign zvema periodic table, ndakatobva ndango loser interest. (I don't study physical , I do integrated science, I was determined by my pass rate to study integrated science because the class I was in does not have physical science as I was not interested in it, I had fear instilled in me when I saw signs, of the periodic table, and I lost interest.)

RM6. My name is Adams, I'm studying Physical Science at O level, because I know it will be my future life, because in Zimbabwe jobs are there but there are many people who are Accountants and they have many degrees but they do not have jobs, which are scientific and because if you read the newspapers vacancies are there but qualifications in sciences are the most challenging qualifications so I decided to take sciences because I need to be a great scientist here in Zimbabwe.

RF7. I'm studying Physical sciences because it doesn't promote laziness, it keeps you occupied just working those sums and my ambitions in the future requires Physical Sciences so that I can earn a living, I will be having that kind of living you know, having my own house, my own car, living peacefully, in low density suburbs.

RM17. Inini ndinofungawo kuti Physical Science is not very difficult because ndinonyanyoona kuti chimwe chachona chinoita kuti vanhu vakundikane inenge iri laziness yekuverenga nekushanda because inodawo munhu anogara achi practiser Physical Science dzachona, nekuti pachadzo kana uchiita Physical Science ne Integrated Science unogona kuuraya shiri mbiri nedombo rimwe chete. Zvimwe zvaunoita ku Integrated Science zvinouya ku Physical Science, saka zvakuuya ku Integrated zvinenge zva easier, mamwe ma questions anova easier to tackle kana uchiita Physical Science. (I think physical science is not a difficult subject but what makes people fail is that they are lazy to read because physical science requires hard working because you can study both physical science and integrated science at the same time, so integrated science will be easier, questions will be easier to tackle.)

RF3. Ahhh inini ndopikisana nepoint yake yekuti munhu anogona kuneta nemabasa ekusuka ma plates kana kutsvaira tsvaira because we are responsible kumabasa iwawo, masmall tasks iwayo because baba vako hapana pavachasuka totaura kuside revasikana, mai hapana pavachasuka ma plates iwe uripo, chakakosha I time management yako yataurwa yekuti iwewe unosuka maplates, hapana pauchasuka maplates for 2 hours, unosuka for about 30mins then wobika, wapedza kubika pamwe kunenge kwakuma 8, hapana pauchatanga kuverenga vanhu vachiri kuona t.v wozotanga kuverenga hako manheru. (I don't agree with the point that one can get tired from washing dishes or sweeping the house because we are responsible to those chores, those small tasks because there is no way the father of the house would wash the dishes. What is important is time management, there is no way you will wash the dishes for 2 hours, you can wash the dishes in 30 minutes then start cooking, by 8 you would be done, there is no way you will read whilst people are watching TV and then you start reading after that.)

RF6. Ndikuda kutaura issue yekuti zvinonoenderana nema parents edu. Vakomana vazhinji vanogona kunzi endai munoverenga ku library kuzvikoro, kuverenga varimuma groups kana kuti anogona kumbopedza week asipo pamba achinyatsoverenga asingaite misikwanzwa but inini musikana kuti nditi ndiriikuda kunoita ranguwo group manheru, ma parents anoramba saka ndopedzisira ndakungoverenga ndegani, uchiverenga wega hazvipinde, zvinenge zvichidawo magroups but ma parents anenge achikurambidza achiti uri musikana, mukomana achibvumidzwa kuenda. (I want to talk about the issue concerning our parents.Most boys can be allowed to study at the library at school, studying in groups and can even spend a week away from home while studying without getting involved in any mischief but with us girls if I were to ask for permission to go for group studies my parents would refuse so I just end up studying by myself.Some concepts are difficult to grasp and some require group discussions .)

RF8. Okay on my opinion, inhema kuti maSciences ndeevakomana nekuti vakomana vanogona kudarika vasikana, kana vasikana vanogonawo asi inyaya yekuti, pakuverenga apa, girls we are too lazy, but hatizi tese vasikana vachona, plus vanoona kunge zvakavaomera, it’s too hard for them. (Ok in my own opinion its not

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true that sciences are for boys because they are better than girls, even girls are as good but its all to do with reading, girls we are too lazy, but not all of us and they see the subjects as difficult.)

RF9. Okay, I would like to emphasize on the issue of the fact that girls are not much better than boys in terms of Physical Science, I think since Physical Science needs more concentration most of the girls usually during this adolescence stage, most of the girls lose concentration for school work so Physical Science it seems as if Physical Science is much more difficult, much more challenging to girls but according to me Physical Science is just a subject that needs a lot concentration so girls due to peer pressure that we experience during the adolescence stage we find that the subject at the end will appear as hard or difficult, it’s not(laughing), for example at our own stage now teenagers, mmmmh we are falling in love, takunyengwawo vasikana(we are now being asked out)(laughing), aaaa its that’s the truth guys, takunyengwawo vasikana hanti(we are now being asked out) and guys vakunyengawo saka iwewe manje (boys are now proposing love to girls)instead of concentrating on your books sometimes when the teacher is explaining on the board you are thinking of someone, yesterday he told me he loves me so much, concentration hauchaisi yawaimboisa pamabooks ako(one will be concentrating less on their books).

RF12. Inini sekuona kwangu ndekwekuti Physical Science hadzina kumbooma asi vanhu nekuda kwe fear vanonzi Physical Science dzakaoma saka vasikana vanobva vati

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ahhh dzakaoma ini handingazvikwanisi asi boys ndavanogona kudzigona Physical Science nekuti zvinenge zvakaoma, ndomaonero angu. (The way I see it physical science is not difficult but just because of fear people are told that it's difficult and they say they can't do it but boys they can manage physical science, that's what I think.)

RM13. Ndinoona chinoita vakomana vazokunda vasikana inyaya yekuti concentration inenge yasiyana vasikana hameno ka concentration kavanoisa kamwe kari weaker than inoiswa nevakomana, vakomana vari powerful really kudarika vasikana. (I observed that boys tend to be better than girls because girls tend to concentrate lesser than boys. Boys are more powerful than girls.)

RM14. Nyaya ye Physical Science hadzina kuomera munhu wese nyango vasikana or vakomana but problem inoitika manje ndeyekuti kana dzanyaya dzerudo idzi manje isusu vakomana masikati tinenge tichisendera ma messages but manje vasikana, isusu kana takuda kuita zvema books vakomana tinozozvitora serious manje vasikana vanenge vakuzvitora serious ma message aya aamboverenga omboavhura futi omboti ahhh mukomana uyo atori serious nezvaari kundinyorera apa ininiwo kumba ndinenge ndichitorova book rangu zvakasimba saka dzimwe nguva ndozvinoita kuti performance yevasikana izodzikira. (Physical science is not difficult for everyone whether girls or girls but the problem Is the issue of relationships, in the afternoon we boys would be sending messages to girls but when it's time to read, we really take it seriously but with girls they tend to put more seriousness on those messages sent by their boyfriends and end up losing focus, so at times that is what reduces the girl's performance.)

RF5. Ini ndine point yekuti ma teacher echikadzi haangambotye mwana wechikoro yango achinzi mukomana because isusu titori nemamwe ma subjects akaita sana Maths, totichwa nateacher wechikadzi but muclass hapana munhu anoita noise, akangopinda munhu wese anonyarara saka zvinenge zvakungoenderana kuti totichwa nani science dzachona, kana ari teacher wechikadzi angora lazy, science unogona kudzisiya but kana ane punch hapana anombodzisiya. (I have the point that female teachers are not afraid of male students because we have subjects such as maths which is taught by lady teachers but in class nobody makes noise, as soon as she gets into class everyone becomes quiet, it's just depends who is teaching the sciences, if a lady teacher is lazy you might quit but if she has ability you wont quit.)

RM6. Ini ndoona sekuti especially, Physical science dzinotoda male teacher cause vakadzi vari weak, ini I remember ndiri Form 1 ndakatanga kuzoziva kuti kune ma experiments, kuti kune ma beaker,machii nda Form 3, Form 1 & 2 hatina kumboita experiment, taitira mabook, takatozoita Form 3 takuita nemurume, takutoona kune ma experiment, so vakadzi vari weak kuma sciences, havaite cause vari weak. (Laughing). (The way I see it, science requires a male teacher beause women are weak in doing experiments. I never did experiments in F1 and 2 when taught by a female teacher but started doing experiments in F3 when taught by a male techer.) and laziness. One would just read in a book as they teach without any explaining and we end up not understanding the concepts.)

FGD 2

Question 1. Which natural sciences are you studying and why are you doing the subjects?

RM1- Ndiri kusitadha masubjects aya, ndanga ndichida kuzoita Doctor kana ndakura, saka ndo only way yekuti ndigokwanisa kuita izvozvo plus ndiwo andinonyanya kufarira. (I am studying these subjects because I would want to become a doctor when I grow up. So that's the only way I will be able to do that and those are my favourate subjects.)

RM2- Inini hangu ka, ndoda kuzoita engineering, kana ndakura ndoda kuzogadzira mota dzevanhu, zvakangowanda wanda. (I would like to do engineering, when I grow up I would like to fix people's cars, and many other things.)

RF3- Inini hangu ndoita masciences aya cause ndofarira kuzoita Doctor, saka paDoctor panodiwa munhu anenge aita masciences, plus futi masciences aya vanhu vakawanda vanongomafarira, saka chinhu chinongofarirwa nevanhu ndosaka ndichizomafarira.(I study these sciences because I would like to be a doctor, so to be a doctor they require one to have science subjects, plus many people like science subjects, so I like them because it's something that people like as well.)

RF4- As for me I am not studying subjects but I wished to, I passed physical science but because of finances my father couldn't send me away to another school. I had to choose this school that's why I couldn't do it. Here there is no physical science there is only biology and chemistry at A level.

RM7- Inini ndikuita physical science , chandakaitira subject iyi , chandakadzidza pamusoro pazvo ndakaona kuti tinodzidza kuti zvinhu zvinotangira papi ende zvombofamba sei , chii chinoitika pachinhu , zvinhu zvandinoda kuziva kuti inini ndigoziva ,muti uyu kana ndichiuwona chii chinenge chichiitika pauri neniwo ndozokwanisa kudii , kutsananguririrawo vamwe ndozodzidzisawo vamwe .Interest yandinayo pamusoro pesubject iyi, inhau yekuti ndigokwanisawo kucreator zvangu zvinhu sezvinoitika pasciences , vanoita masciences zvekuti vanogona kugadzira or something chinobatika. Zvinoita kuti ndizove famous nokuita mari. (I am studying science because of interest and it gives me knowledge about many things including creating my own inventions. I will become famous and make money.)

RF12- Inini hapana akandinfluencer, ndakango chooser ndega, ndakabvira hangu ndiri Form 1, ndikati ah inini ndofarira kuita Bio nePhysics, mateacher angu akandisimudzira, vakati aah its better for you kuti to go mu3Red, ndobva vandisimudzira. (Nobody influenced me I just chose the subjects since I was in form 1 because of interest and the teachers supported me.)

RM13 - Inini ndingangoti ndakazvitanga hangu ndichiri mudiki , ndaifarira kucreator , kungocreator something nekugona kugadzira mota dzamawaya , ndichingogadzira zvimwe zvinhu soo, saka zvichingoenda nekuenda , ndichidzidza , ndabva ndatanga Form1 ndikaona kuti kuscience kunoitwa zvema experiment ndichingo experimenter zvinhu ndozvinhu zvakanyanyo ndi influencer , ndanga ndine pfungwa yecreativity. (Since I was young I liked experimenting and creating things like toy cars and this influenced me to like sciences at form 1 level.)

RF2 - Ndofunga kutii, like vasikana handiti pane zvimwe zvinhu zvekuti, sekuti kumba, sezvambotaurwa nauyu zvekuti vabereki havatruster vasikana, vanenge vachiti pane zvimwe zvinhu zvekuti unokwanisa kuverenga uri wegani zvopinda, kozoita zvimwe zvekuti zvinodawo madiscussion, zvekuti unobva wati ukuda kumboenda kumba kwefriend yangu tonodiscusser, mubereki otanga kuti hee hapana chaunonoita ukunoita mskanzwa asingambokutruster. Pane zvimwe zvekuti mobva kuchikoro opihwa mahomework anenge akatowanda osvika kumba kunenge kune basa, otanga kuita mazibasa, vamwe vakomana vanenge vakangogarawo vasingamboshanda. Kusvika kumaplates, tomboti kusuka maplates nekutsvaira mumba, otanga kubikirawo vanhu nekungochera mvura chii chii chii. (Parents don’t trust girls to go and have group dicussions away from home citing mischief. School home works are many, some easier to do alone but others require group discussions with friends. Girls are denied this chance. There are other situations where you are given lots of homework and when you get home there will be a lot of work like washing the dishes, sweeping the house , cooking and also fetching water.)

RM3 - Ndikuda kutsigira yemukomana kuti muchaona kuti even pakucreatwa kwatakaitwa isusu, isusu varume vane mamuscles, vakadzi, isusu takagadzirirwa mabasa ari hard, vakadzi vakagadzirirwa tumabasa turi simple; kusuka maplate hakunganzi chinhu chinorema nekutsvaira tsvaira mumba nekuwacha wacha, ndozvavakasikirwa kuti mabasa avo avanoita, avanofanirwa kuita, isusu varume takasikirwa mabasa ari hard of which tofanirwa kubalancisa tobatsirana, haticharamba tichiti nemhaka yekuti iwewe wakanzi unoita chakati, tokusiya uchingokuvara; tobatsirana but tirikuti hazvingafanire kukuaffecter pakuti iwewe nekuti ndinofanirwa but ndosuka ndiro, unotofanha kuti uzvijaire otoziva kuti inini ndofanha kubata nguva yakati. (I want support the point of the other guy, even when we were created men had muscles, we were made for tough jobs and women simple jobs, washing dishes, sweeping and washing clothes can't be hard, that's what they were created for us men were created for harder jobs so we should balance and assist each other. We should assist each other.)

RF5 - Inini chekutanga chandinoda kutaura ndechekuti like maparents, kuvasikana handiti havafanhe kudzvinyiririrwa isusu vasikana, nekuti pane zvimwe zvekuti vasikana tinokurumidza kureasoner kana tichibatsirana batsirana takawanda, but kana uchinzi verenga pamba ipapo, unokurumidza kunzwisisa kana kuti onzi huya kumba kwedu kana kuti onzi dedza shamwari yako auye kunoku, zvimwe zvacho shamwari yacho iinopedzisira yakunzi ko iwewe shamwari yako isingauye kunoku panapa yakaita sei; zvezvichida kuti muchifambirana muchienda kumba kwavo muchibatsirana, kozoti like pano pachikoro pakaitawo kana kuti Physics dzacho dzirikunzi hadziko, zvinotibatsira kuti tirambe tichiendererawo nemaSciences. (First I would like to say that parents should not be too strict with us girls, there are things we are quick to reason about if we help each other but if we are told to read at home, understanding is quick or if you are told to go to your friend's place or you are told to invite your friend, at times you end up being asked why your friend doesn't come to your place , visiting each other's homes and helping each other, like at this school they don't offer physics, it would help to continue with sciences.)

RF11 - Inini zvangu sekuona kwangu vasikana potential tinayo but sometimes its lack of empowerment. Isusu as girls ka we might look kuti ukatarira boys at times vanogona kuzvishingisa than isusu girls kuti haa physical science, chemistry zvinenge zvakati omei kwatiri tobva taona kunge zvakaoma, saka tozoshaya anoti empower kuti ita umboona zvakamira sei, than boys vanenge vachida kuexperiencer vega kuti zvakaoma here. Isusu tikawana kurudziro, empowerment yakasimba iri chaiyo, aiwa potential tinayo. (Girls have the potential to do well in physical sciences but lack empowerment in the form of motivation. Boys want to prove for themselves whether sciences are difficult or not but we girls we easily believe what we are told.)

RM13 - Ini ndinotiwo vasikanawo vacho vakanyanya kuconcentrator nezvemabooks, vakasiyana nezvambotaurwa vane potential yekukwanisa kungogonawo zvakafanana nevakomana. (If girls concentrate on their books more and less on socializing, they have the potential to perform well just like the boys.)

RM14 - Ini ndofunga kuti inyaya yepeer pressure uye akaona uyu achitengerwa zvinhu nemukomana wake uyu anotanga kuda kuchiva zvimwe zvinhu, anobva anobvunza uri kuzvifambisa sei, iye oti ndikuita zvakadai zvakadai, ndopamunozoona vasikana vanonodanana nevanhu vakuru kwavari, kana vanenge vatori ana baba vevamwe vanhu handiti. Saka isusu tobva kumafamilies akasiyana handiti, towana zvakasiyana, nyangwe chinozovakonzeresa kuti vadaroka, vanenge vaona kuti uyu arikuwana zvinenge zviri nani kudarika inini, ende vasikana chinhu chavasingade ka kudzikisirwa vanotoda kutoiswa pamusoro saka ndizvo zvinhu zvikuvakanganisa. (I think it has to do with peer pressure. Most of the girls like good life like celebrities and end up dating sugar daddies so that they are bought nice things. They admire their friends who receive lots of gifts from the boy friends and this affect their performance.)

RF15- Inini ndofunga kuti like vasikana handiti kana uchiri mwana mudiki unenge uchinyatsoti brain dzinenge dzichiri sharp because zvimwe zvacho unenge usati wambozvinzwa kunge kunzi nemkomana ndokuda, especially isusu vasikana tinoti kana tanzi nemukomana kunzi mskana ndokuda, kana kunzi wakanaka, otoudzwa tumwe tumashoko, unobva watoshaya, pfungwa dzinenge dzakuto-tenderera, otoshaya kuti zvinhu zvacho zvinofamba sei (laughing). Zvekuti kuzonzi kuchikoro tanzi tizoita zvakadaiso zvekumasciences, like masciences anoda kuverenga zvakanyanya, saka iwewe kuti uchiverenga unenge wakutadza kuverenga, wakungoti mkomana wangu azonditi ndakanaka, ende ndakabatana; hauchambo-concentrater nemasciences nezvekuchikoro, wakungofunga izvozvo chete, saka zvimwe zvacho zvinotidzikisira vasikana. (I think girls when they are young their brains are quite sharp because they would not have started being proposed by boys. Especially us girls the moment we are proposed by a boy and being told that you are beautiful and all the sweet nothings, you will be head over heels. It will now be difficult to handle science subjects as they require a lot of concentration and hard work. When you are in a relationship all you will be thinking about is your boyfriend that is what disturbs us as girls.)

RF16- Vasikana vanogona zvakafanana nevakomana asi kungoti vasikana havasi kuwana time yakakwana yekuverenga zvakafanana nevakomana. Vasikana tikasvika kumba unosvika uchiita basa, mkomana anongosvika achibvisa hembe, pamwe anotowachirwa kana kuti inotopihwa sisi, kunzi “sisi, wachayi uniform iyi.” Vasikana pauchasuka ndiro nekuti wapedza ovapakurira futi, unenge watoneta zvekuti unenge usisakwanise kunyatsoverenga zvekuti mkomana anenge ava pane chimwe chinhano. (Girls are as good as boys but just that girls are not getting enough time to study like boys do. Us girls when we get home we first do housework, boys just get home and change their clothes, at times their laundry is done by the maid. Girls by the time they wash the dishes and when you are done you dry the dishes as well you would be so tired and cannot study anymore.)

RF17- Ini ndofunga kuti vasikana vane potential yekugona zvakafanana nevakomana, vamwe vanogona kuti tinokanganiswa nevakomana but the other issue nyaye yemaparents chaiwo. Vasikana vanoda empowerment yanga ichambotaurwa vasikana tinoda kukurudzirwa panyaya yekukosha kwakaita masciences. Then pane a lack of trust kumaparents edu isusu sevasikana, hawanyanyo titruster vanofunga kungoti kana musikana asvika stage yekuva mature akuita mkomana havacha nditruster. Motonzwa mukomana achitoti ndikuenda kunovata kumba kweshamwari yangu tenge tichiverenga, tenge tichiita madiscussions. But kune vasikana the moment yaunotaura izvozvo, vanotanga kutotaura kuti hee ukuita mskanzwa, havatobvumidzwe vasikana kuenda kumadiscussion. It’s like kuchikoro kuti ndiwane nguva yemadiscussions chaiyo inotonetsa.maybe all the time unenge uri occupied the moment yaunenge wakuti maybe ndi…, tinobva kuma different families pamwe ndiri ndega kumba. (I think girls have as much potential as boys, but some are disturbed by relationships but the other issue is of parents. Girls need empowerment that was mentioned earlier we girls need encouragement on the importance of sciences but then there is lack of trust from our parents. They don’t really trust us, they think when girls mature they start engaging in relationships, they don’t trust us, they wont allow us, you would hear a boy child saying they having a sleepover at a friend’s place reading and also having discussions but if a girl child says the same the parents would start talking of mischief. We are not allowed sleepovers and also at school I will not find the time for discussions as we might be occupied most of the time. We come from different families maybe I am the only child. I have to first do housework, so we need empowerment.)

RM2 - Inini zvangu ndofarira kudzidziswa nateacher wechikadzi, mukaona kuti kazhinji kacho mateacher echirume anokurumidza kutsamwa kudarika vakadzi, isusu sevana tinoti tinotora nguva yakareba handiti kuti uzobata chinhu handiti munhu wechirume anokurumidza kuva harsh sterek zvekuti anopedzisira akutoti uri zidofo haunzwisise but munhu wechikadzi anotora nguva achinyatsokutsangurira kuti unyatsobata, unyatso nyatso zvinzwisisa nemasides ese, ndoona kunge kudzidziswa nemunhu ari same sex newe hazvinyatsoite (laughing). (Myself I would like to be taught by a female teacher, usually most of the times male teachers tend to get angry faster than females, us as students we take time to understand some concepts and male teachers are easily provoked and ends up calling you names but female teachers take their time explaining so that you understand the concept. I think being taught by a teacher of the same sex as your-self is not proper.)

Qualitative Interview Transcripts- FGD-3

Question 1. Which natural sciences are you studying and why are you doing the subjects?

RM1. Well I'm doing A level Biology, Chemistry and Mathematics, mostly I chose the Biology part of it because well I had a passion for Biology, I love Biology, I enjoy everything in it, mostly the content, the vocabulary, the diversity of things you find in Biology. Oh, it was my choice because of interest. Well the subject is not that hard but it seems mostly because of the interest it makes it easy, so due to interest it makes it easy. Well I would love to do medicine and become a doctor.

RF2. Well I'm currently studying Biology, Mathematics and Food Science, why because I have interest in all my subjects, Biology I love, Math's I love, Food science, I love to deal with food, I love everything that concerns food , that is why I'm studying these subjects. I don't think there is a subject which is difficult, I think it all depends on your interest and what you like to do and what you don't, what you prefer so I prefer to do these subjects and I find them quite enjoyable. Well I'm planning to be a food technologist if everything goes well.

RM3. I'm studying O level Chemistry, Biology and Mathematics, I particularly like Chemistry, I need to pursue Chemistry, the reason being I have interest in Chemistry and I really want to make some new inventions. It is out of interest that I do it.

Question 2. Research has shown that fewer girls than boys choose natural sciences at O and A level in Zimbabwe. What do you think are the reasons?

RF1. I think it's because of fear of failing them for example my personal example I did not take Chemistry because I thought I would not be able tackle it so therefore I did not take it, instead I took Food science, I thought that would be easier than Chemistry.

RF2. It's because ummh many girls have just this feeling that science subjects they are difficult and that girls usually they tell themselves that they are inferior to boys as a result you find there are fewer girls doing these subjects, Maths, Physics, Biology and Chemistry because they have fear.

RM3. I think girls just lose focus, they (laughing) don't understand better than boys, I mean boys they understand Engineering better than girls.

RM10. Maybe that depends with the parents, it might differ sometimes but I think its quite the same how they take your education but only that they give preference to the one who seems more serious, like interest in the jobs that are more paying.

RM11. The female, the girl, well we said due to the cultural beliefs and stuff that the girl is supposed to be doing the household chores and stuff like that so at home I wouldn't expect my dad to call me to come wash the plates, I would expect him to say go do the garden, go wash the car so we classify ourselves according to the chores we are expected to be doing.

RM12. If you check the chores that are done by the males right, mostly the garden stuff, its hard work, it requires energy and stuff so if you are a guy doing those jobs let's say today you might be doing it for 2 hours, after those 2 hours you will be tired, you will go to sleep of which the female she might work for 5 hours, washing plates, sweeping the house and it would require that much of energy, the same as the guy if you get where I'm coming from, (laughing).

RM17. Well bringing back the issue of household chores (laughing), okay basically the girls gives them excuses so because of that they get this negative attitude, no I can't do this, I can't do this if you get what I mean, they just makeup excuses, they get negative.

RF1. (laughing) I prefer a teacher of the same sex, exactly because I'm not that free with male teachers, my father and my brothers yes, not my teachers, well I really don't know, I haven't thought about it, I'm just much free with female teachers than male teachers.

RM4. Personally I would prefer a teacher of the opposite sex, a female because in a situation, these whatever male teachers vanoticha ma sciences they had terrible experiences, during their A levels and University so they would like to teach us

using the same methods under harsh conditions, whereas female teachers, she takes us bit by bit, (laughing), they are patient, male teachers are not.

RF6. I think when someone is in a lesson I think it's comfortable to have a male teacher teaching in front of you because actually from my own opinion males and females in comparison females are slightly short tempered, not that much but slightly, if they explain to you something and you don't understand they are like "what don't you understand" (laughing) and then you just go even if you don't understand, for a male teacher if he tries to be harsh he controls himself, males can control themselves and explain again but females just burst, but when you going for like extra, if you want to ask something you didn't understand in a lesson think it would be better to go to a same sex teacher because actually when I'm like a girl and I go to a male teacher it won't really be a comfortable environment to ask things I didn't understand in a lesson because he is a guy and I'm a girl (laughing), if I come alone there is no way I will be able to ask but maybe we come 3 or 4 that's quite comfortable.

RM7. It's just the same as guidance and counseling, the females can't come to the guys for guidance. She can't come to you for guidance right? It's kind of like the same thing, she is more comfortable talking to a female teacher. There is no problem with the teacher.

FGD 4

RF2. Sciences are too hard, I'm doing Commercials because I had 2 Cs in Biology and Physics so they are, too hard.

RF3. I don't think that science subjects are that hard, it depends on your attitude towards them, if you believe you can make them easier for you they will be.

RF4. I also believe that it is the belief because ever since I don't know people just have that belief that ahhh science subjects are hard, you think that this thing is hard before you even attempt it, even when you try to make something easier for you, you just have that mentality that this thing I can't handle it, that is why most girls tend to do these science subjects when they are in Form 3 and 4, they won't want to go on and explore the world of sciences.

RF5. I think most girls lack perseverance and only a few of them are taking science subjects, when it comes to boys they encourage each other among them, they give each other strength, when they want to do something they do it with passion like sciences. I know from some of my classmates, the guys, they work together in achieving something and once they commit to something they make sure they work hard to achieve it, that is quite different with us girls, some girls they are even proud, they are like they want to work on their own and some they even discourage each other, they are like ahhh I can't do this and so they just give up just like that, we lack the perseverance in us.

RF9. Girls I don't think we are treated the same as boys because you at home, we are the ones who do the cooking, washing and the boys at most they are sleeping so the time we are supposed to be reading, I will be doing the house chores so I don't think we are treated the same. At school we can be treated the same but as I can see most science subjects are being taught by male teachers so as girls we don't feel free to ask those teachers.

RF10. To me even the guys look down upon us and from that discouragement from them I think that's what makes us inferior, (laughing), well they actually that ego that they are the best, once they see you on top they are trying to pull you down, they don't believe that girls can do better than them so most of them will start discouraging you, mocking you, looking down upon you, that's the reason why most girls perform different from the guys in terms of how we are treated even in school.

RM7. Chipping in on the issue of belief like what's been said by my fellow colleague here the issue is girls grew up with the belief that they have to have the little education or basic education of having Maths, English and taking that Integrated science, after that if you have that basic education they get married so by the virtue of having getting married at a very tender age, that's the first limitation giving rise to the number of girls not doing like A level science and even O level science which is because they don't have the dream of them being big, majority of them think of getting married at an early age, Point 2 is they have few role models, if you take a closer look, a random sample in our communities you find a very few number of girls or women who have achieved in life because they are the few who have endured to the top and by having a few role models in society, you see that the proportion is very different in favor to boys, they don't have role models.

RM13. I think that most girls think that they are being trained into getting into marriage when they are doing their chores at home because when comparing the 2, the boys also do work like gardening, mowing the lawn, cutting the grass and the hedge, washing the cars and doing all the things outside and then the ladies cook and do the chores, that's what they are expected to do by the parents and since they are going to be in a life of marriage later onwards they will have their occupation they are supposed to be doing these things even when they are married, when the girl has become a doctor, a female engineer she is still expected to do all those kind of things in her own house, (laughing), that's not where I'm heading, I'm just saying that 70% of this issue that's where the story might end (laughing) almost every woman dreams of her big day. They do dream of becoming a Pharmacist but also dream about walking down aisle. No! Of cause we dream of marrying but some of us have to wash our own clothes, iron, all sorts of we do as bachelors, obviously we will need the help, someone to comfort you, make you a cup of coffee for you (laughing), when you are making plans about the bridge you are going to construct. (Laughing)

RF7. Yes, in my own opinion I prefer both teachers, male and female, teachers it's all about experience about the subject and what he has in store for me and also he teaches me to be free to all the teachers and treat them the same and have that same respect and to love them equally whether male or female so to male and female are okay.

RM8. I just want to oppose what he said, the female would take students at heart when teaching Natural sciences and saying the female teacher would have that motherly advice when I'm focusing on Physics and Chemistry most of the things we are learning there were discovered by the male sex like Isaac Newton and other laws we learn in Chemistry and Physics so I think it should be left to the men since they made most of the discoveries.

Female Interview 1

Then the other thing when a student wants to take up physics for example if it's a girl, usually teachers tend to talk more to her trying to really establish if she really wants to do physics. For boys its easy if they get an A in physical science, they want to do physics but if it's a girl usually people are, a lot of attention is drawn when a girl picks. Even for example at this school its usually one girl, two girls, maybe three doing physics. So when a girl makes such a choice teachers might want to check, Are you sure you are making this choice, physics is quite tough it's for the boys if it's your choice , its ok you know. So those are some of the comments.

Female Interview 2

Well I'm saying it is more of a social thing and it's not much influenced by the school they are certain things being experienced. These days we are experiencing something like they are child led families where they are just children and sometimes these children might not have enough basic things and that can maybe end up forcing these girl children being involved in other things like prostitution to get basic things. But for the boys they won't be involved in things like that. So if some measures are taken by the government to see that some assistance maybe given to these disadvantaged children like these girl child led families. Give some sort of assistance in form of basic items, so that they won't end up being engaged in these other activities which are not good.

Female Interview 3

At O level, they are using end of year exam in integrated science and mathematics. Umm I'm not quite sure how they do it because we do not do the selection , they get selected at the senior office . Yes if they do select a person we do not really have a choice because they would have already accepted the student to do the sciences. We really do not have a choice in choosing if you want the person with a C or not. No the HOD is not involved. We really don't have a say we really don't have a say.

Ahh, I think it does, because umm, sorry come again with your question.

Ok if I got your question correctly. I think it does affect because you realise that if incorporating this gender thing the girls when they go home they start doing the cooking they start doing the housework whilst the boys are probably left to do whatever they want to do. So it will mean that the boy will actually get more time to study than the girl who has to cook for the whole family. After cooking the girl has to do the dishes and there won't be enough time for the girl to actually to do more work more study.

Yes. I think its ok but the way it was started actually they were not considering the infrastructure in the schools because they were just saying take more students take more what we will pay for their school fees and stuff. But then now like in this school we don't have enough classrooms for them but then now they are almost 30 something in one classroom. We don't have enough apparatus to help them with but if they had started probably by first equipping the schools with the right apparatus the required apparatus the infrastructure and all that then we could start enrolling more students. Though the program is good but how it was implemented it's a bit difficult. Yes it has like umm last year we had 15 students now they are 28. Yes that is the school fees and levies only. I think it's the school fees only.

Female Interview 4

I think it does, umm I have had experience with students who sort of been made to do natural sciences when they had doubts because at this school we don't really give them a choice , it's like we select those whom we think have the capability and place them in the sciences. And you find that out of those children that you pick some will actually say ahh I don't think I will be able to handle these subjects and some pupils as we move along you find that they may drop out or they continue doing those subjects they will not be performing that well, they will not be at par with their counterparts. Usually those who don't do well are those who had reservations about their ability when they started. Umm usually say after form 2 when they write their final exams in form 2 , we just look at their performance in the final exam and sometimes it may be necessary to look at the performance over the two years , we could actually tell that this child actually does better than this , especially in the sciences and mathematics , those are the subjects we look at and if the child did well in those subjects throughout and he or she performs well in the second year then that child is a good candidate for natural sciences .

Mmm, I have no preference, male or female as long as the teacher is committed. There are some teachers, we look at each other and there is a kind of teacher who is just doing his work, he just does what he has to do and that's it, but with these sciences, I have discovered a teacher really needs to go an extra mile with sciences in order to help the children. Even those who like I said before will be facing challenges if we really take out time to help them they can make it they can excel. So you really need someone who has passion for teaching someone who really wants to see his or her pupils pass. Someone who really wants to teach his or her subject not just there to work and earn money.

Female Interview 5

Normally they consider the career, maybe their future career that's when they look back and say which subjects can I take and then they can take the natural sciences. And then the other thing I can say is that normally it is something that is imposed to them before they understand what they want to do.

Yah, I think so because they are certain subjects whereby, take for instance biology, students they just enjoy studying life then when you look at a science subject like physics, they are a lot of calculations, and normally our pupils they have a negative tendency towards maths and calculations so the moment that they come across calculations you will find that they close off. When they are closed you find they give, in fact they don't take very seriously so it's an attitude I can't say that science is a difficult subject , then they have an attitude towards a certain science and that affects a lot on their performance because when you go through questions and problems , solving them you find that someone gets it , I thought it was difficult I thought it was like maths , I thought you know there were some difficult calculations , so at times their attitude towards a certain subjects affects how they tackle it , it affects the time they give to the subject , so that's normally what happens.

Yah it's a difficult one, but which is true anyway. Generally in Zimbabwe, maybe lack of exposure, lack of information and at times with the boy even our socialisation , boys we just groom them to be inventors , to be mechanics and things like that you know . I think they are focused from a tender age unlike girls maybe the problem starts off from our socialisation so in the end as they go higher and higher they don't see where they can apply the sciences except a few maybe who are exposed and those who are well informed but when they lack information now they don't go for the sciences , they opt for other things something else different because there is lack of exposure and in our socialisation the sciences are not introduced from a very tender age.

Ok, so you find out that its rare maybe for those one or two, if you go around this school, we are closer to the hospital, but if you ask them, have you ever seen a female doctor? You will be surprised, a female engineer you will be surprised, because to them they don't know that they are ladies who are involved in this field. We used to have a field day or a career guidance day where you call one of the artisans out there come and address our girls. You will be surprised with the questions they ask, where you trained in Zimbabwe?. Because to them in Zimbabwe there is no institution whereby a scientist is trained as a female and maybe fortunate enough we have a university close by. If we can have open days where by there can also inter-mingle with what is happening there, they can enlighten them because we assume a lot that they are exposed. We are close to the hospital and we are close to town but they don't know that there are females who are involved in these other careers. I think that's why I'm saying exposure itself, then they are exposed they know they are other girls doing it. I think that can encourage them.

Hey , haa that's a difficult one (laughing) that's a difficult one haa because both are ok but I would prefer the ladies because the ladies are more patient . As teachers of natural sciences we have discovered that they have that motherly nurturing spirit. Umm males are good but most of the times they don't have time for zvima nonsense but motherly nature in the females , can help even those who do not have confidence so I would prefer ladies yah.

Yah, I'm aware of the project and I think it's a good one. It encouraged a lot of students to participate so that in the end we have more in the field of science, more discoveries, lots of research and things like that. It's a good thing, it's a good initiative to encourage the natural sciences because previously the other thing why most students were not opting for sciences at advanced level was because some parents they had the upper hand, the moment that they heard about the STEM and also the government initiative and support, most of them came as parents and say, we brought our children and we want them to pursue the sciences. So to me it's a good initiative and it can take our country far. At least we have more inventors coming into being. The government pays their fees and I think it's enough for them because most of them what is a hindrance is their school fees , so the government pays the fees for every student who is taking sciences , so that's a good initiative.

Yah , we have seen a great change , because if you look at our previous intakes , we had a few students , for instance upper 6 we only have 7 students but the lower 6 those who started the STEM program we have 29 students taking sciences It's great, we have never enrolled such a great number, so to me that's a great increase four – five times, and that's a great number.

Yah now the greatest challenge is on our equipment and resources. We are looking at our apparatus they are not enough for a large group. We are also looking at our groups they are now congested so you find out that it's a bit difficult to handle. You really enjoy a large number and at the same time we look at the resources, they are no longer balancing off with the number that we have.

Mmm I don't think it's a good strategy I thought it was good if it was implemented even at primary so that students the appreciate the natural sciences at a tender age and then they are groomed when they come to secondary. They should have a platform whereby we can award the best science student from form 1 going upwards so that we can groom them from the base, so that at A level we are just moving on rather than just taking from the surface without building the base. I think we have to build the base and then award the upper classes later.

Uh for the girl child I think it's a matter of just encouraging, so that they continue in there and maybe awarding them better than the boys in order to attract them into the system because if we have the same rewards with the boys, at times there isn't much to encourage the girls into the STEM system. So maybe there should be other rewards that encourage the girl child to be part of the STEM.

Male Teacher Interview 1

Fourthly, science is a practical subject and students enjoy doing those practicals, the titrations in chemistry, electricity in Physics and the like. When they make new substances from other substances like making salt and you have got hydrochloric acid and maybe sodium hydroxide, so they…they enjoy doing that. I think, those I think are the main factors in my view.

No I…I don't think so, umm beginning with at home umm it depends now on the type of home, for girls from those umm orphaned families, I think they don't normally do the household chores and the like. But in other families, like my family, my daughter she has to work, I am the old type of father. In the morning she has to do something (laughing), so…but in the school with the training, the professional training of teachers, I think for teachers who are trained this is a topic in colleges I think where we are trying to move away from treating the girls differently from the boys. For example, I think now they are trying to come up with textbooks which are gender sensitive, they are also trying to do that; and the professional teacher knows the sensitivities uhh regarding the female, the female students, know their weaknesses psychologically you know their strengths that the girl child is engaged with their hands, so we try to encourage them in the things they can do best.

Household duties like for day scholars or for boarders, oh the household duties they really affect the performance negatively I think, because obviously when she comes from school she goes home, she begins cooking and doing the other household chores, she will be very…very tired.

After that she needs to rest and then obviously she will go to sleep without studying because she will be very tired. It's the opposite the boarders just go of the classes and fro classes they go to the dormitory to feed and then they go for prep and they tend to study. So it's only that finances are quite limiting so it will be very good if after school they have their time to rest and then they can look at their books. I think that improves their performance.

Physics is a male subject it has been dominated by male, I don't know whether things are going to change but as it is right now, Physics is dominated by male.

No, I don't think so but I don't know what actually happened like I said before, you see, right now the girls at Bonda, the girls at…they are performing equally compared to their boy counterparts, sometimes even beating them. Yah there is nothing, maybe I don't know what went wrong long back, yeah.

Uhm it's not there, here in this school, it's not there; we don't have any disparities, we don't have, we afford them the same, the same opportunities.

(Laughing) Haaa male obviously, males I mean their masculinity and discipline, I think the students tend to…eeh tend to, you know, I don't know what you can say. They normally obey the male teachers more compared to their female teachers. Several times you have to chip in when certain lady teachers at school are referred to. Uhm I think it's both, uhh maybe the feminists will kill me but I think naturally uuh ladies are not, women are not aah, that very what can we say. They are not that rough they are softer than their male counterparts; they would even be more lenient.

I have seen, I have seen some female teachers doing far better than their male counterparts here at school we have then but they are a few. No here they were almost half- half they were almost 50%, if not more female teachers. It's only in the sciences that we have got fewer female teachers in other departments scoring high 100%, several A's and the like.

So female teachers, if they want they can do wonders. Ahh they have the ability, no doubt about it, yah discipline wise, vano…vano…vanoramwa you know. You see what I'm trying to say I don't know what words we can use in English. Vanokurumidza kuti uyu ndaakumusiya, because the male counterparts will never say, ahh hakuna mwana anofanira kuderera.

MALE TEACHER INTERVIEW 2

Umm, I think actually the ability, success and the experience, if they experience success in the Sciences they will continue with it because I believe that naturally every student would want to do the sciences, so those who do not do it is not because they do not want but it's because they experience failure and tend to move away from it. Initially I'm sure everyone wants to do the sciences.

They are just based on ability. In form 3 we just pick the two classes, regardless of…Ok like when they enroll for form 1 we take even those with the least points but the highest performers constitute the two best classes and then as they progress from form 1 to form 2 there is a bit of screening. Those who don't do well will go into a lower class and then those who do well go into a higher class. So when they get from form 2 to form 3, the first two classes are the ones which automatically do physical science.

When you talk ehh, I'm not sure are you referring to the funding part of it or maybe the concept behind. Looking at the…No, the concept is noble like you say science and technology is the backbone of the economy and almost every aspect of life, quality of life is determined by science.

But maybe where they are starting, they are focusing on A-Level students when at the moment we have A Level graduates with good sciences passes at A Level who do not have the opportunity to go to university because they do not have funds. So we are developing them at that level and throw them in the middle of the street. I'm sure they should be focused on those graduate science students from schools, maybe by finding them universities and giving them grants and so forth so that we can take that.

Right now we are producing things that are just going to be thrown into the street most of the students don't have funding for the education in the sciences. Or maybe even sponsoring the A-Levels, this is just half the job being done. I think it should be broad, affirmative action by what I understand you going to allow someone with an inferior qualification to do a certain course, I think it should be equal opportunity for everybody.

If you want to help the girl child, let's make her competitive not lower standards for her to proceed. Maybe affirmative action on instruction or whatever so that they perform equally well they become competitive. Yah because they are just treated the same when they are not the same, they are not the same so maybe some way should be found to, like your research exactly why where are they failing.

Male Teacher Interview 3

Yes, let me give you an example where we had a form 3 class and we had what we believed where quite above average students and we had a girl who pointed out she was not going to waste a lot time in physical science , because after all we do screening. We take lets say a group of 60 leaners for physical science and then three to four months down the line we examine them then re-screen and we get the last 30, so in variably everybody knew at that time that preference was given to the boys, vanhu vaingoti ahh the boy child understands, they are likely to perform well, they are likely to go through their studies they are not going to get married after form 4 and so on. So naturally the interest of girls went down in that particular area. So more they were then interested in commercial subjects.

It was a test, a written test at that time written tests were given, currently we have now done away with that. Once we do the same at form one and two, screen for physical sciences, biology and the rest will pursue integrated science, so that screening is still going on. But we used to have another screening at form 3 that would re-screen the same group and remain with one group for instance. That is what we obtained at that time that is correct.

Preceding discussions we have mentioned some of the reasons are cultural, some of them are broadly market for employment, employment opportunities. If we were to look at Zimbabwe for instance where we are we see no employment opportunities. The tradition has been you are likely to go for instance kumabanks and be a bank teller. The majority are likely not to go beyond O level maybe work in some supermarket that's where you are going to be or some service delivery somewhere which don't require say physics or chemistry.

Not only are those, also the fact that even those that have excelled professionally jobless. Lecturers have left the country, so when you look at youngsters and the job market, they don't find women there. They don't find these women who are pharmacists are engineers, who are miners, geologist they don't see them so it's a dark world to them.

I found that they are at par, in some cases girls are even more commanding especially when you have them in sciences, they are quite assertive, quite strong characters and they can present their argument but then you still have the anomaly that you have fewer girls in that group. That's the disadvantage in terms of what content, expression of them, those two are equal but the question becomes how many are there?

Question 4 given a choice, which gender of teacher would you like to teach your child natural science? Justify your choice. (RQ3 &4)

I would say the better teacher irrespective of gender, if I had two teachers, I would say In terms of their professional work, who is better male or female? Whoever it is in other words I'm saying whether male or female.

F- Matters of Ethics

Wits School of Education

27 St Andrews Road, Parktown, Johannesburg, 2193 Private Bag 3, Wits 2050, South Africa. Tel: +27 11 717-3064 Fax: +27 11 717-3100 E-mail: enquiries@educ.wits.ac.za Website: www.wits.ac.za

19 June 2015

Student Number: 590332

Protocol Number: 2015ECE009D

Dear Welensky Mashavave

Application for ethics clearance: Doctor of Philosophy

Thank you very much for your ethics application. The Ethics Committee in Education of the Faculty of Humanities, acting on behalf of the Senate, has considered your application for ethics clearance for your proposal entitled:

Gender and High School Science Education in Zvimba District: Zimbabwe

The committee recently met and I am pleased to inform you that **clearance was granted**.

Please use the above protocol number in all correspondence to the relevant research parties (schools, parents, learners etc.) and include it in your research report or project on the title page.

The Protocol Number above should be submitted to the Graduate Studies in Education Committee upon submission of your final research report.

All the best with your research project.

Yours sincerely,

MMabety

Wits School of Education

011 717-3416

cc Supervisor – Dr Emmanuel Mushayikwa

University of the Witwatersrand, Private Bag 3, WITS 2050, Johannesburg
Tel: +27 11 7173249 Fax +2711 7173259

PhD (Science Education) Coordinator: Dr Emmanuel Mushayikwa
Tel: (011) 717-3249; Fax: (086) 516-7237 ; e-mail: Emmanuel.Mushayikwa@wits.ac.za

The Director of Research
Ministry of Education, Sport and Culture
Ambassador House
Harare
Zimbabwe

30 January, 2016

To whom it may concern,

Re: Research Access for Mr. Welensky Mashavave

I would like to support Mr Mashavave's application to be allowed to carry out his research on **Gender and Science Education in Makonde District from 2015 to 2018.**

Welensky is a bona fide PhD student at the University of the Witwatersrand, Johannesburg. He is reading for this degree under my supervision. He needs to collect national information on O-level and A-level perfomance of students from the years 2010 to 2015. He needs this data to study trends and look for patterns in O- and A-level enrolment and performance.

I would like to ask if you could assist him in any way to gain access to this data, which is crucial to his research.

Your assistance is much appreciated

Best Regards

EMushayikwa

Emmanuel Mushayikwa PhD (*York, UK*); M.Phil (*Cantab*); B.Ed. (*UZ*).

Ref :C/246/1/MW

All communications should be addressed to
"The Provincial Education Director"
Telephone: 067-23083/4/5
Fax: 067-23320
Email edumashwest@gmail.com

ZIMBABWE

Ministry of Primary & Secondary Education
P.O Box 328
CHINHOYI

MIN. OF PRY & SEC. EDUCATION
HUMAN RESOURCES (DISCIPLINE)
MASH. WEST PROVINCE
11 FEB 2016
P.O. BOX 328, CHINHOYI
ZIMBABWE

Mr/Mrs/Ms/ WELENSKY MASHAVAYE
STUDENT Nº 590332
....
....

Dear Sir/Madam

APPLICATION FOR PERMISSION TO CARRY OUT AN EDUCATIONAL RESEARCH: SCHOOLS IN MASHONALAND WEST PROVINCE

Your application letter dated 11.02.16 seeking authority to carry out a research/survey in schools in Mashonaland West Province refers:

Permission has been granted by the Provincial Education Director on the following conditions:-

-that the learning and teaching programmes at the targeted schools are not interrupted in any way.
-that you strictly adhere to the activities and topics specified in your letter of request.
-that the permission or authority may be withdrawn at any time by this office or a higher office if need be.

Please apprise this office on your research findings for the benefit of the Province.

By this letter, all District Education Officers and Heads of schools you wish to visit are kindly requested to give you assistance in your work.

We wish you success in your research and studies.

For : **PROVINCIAL EDUCATION DIRECTOR**
MASHONALAND WEST PROVINCE

Ref :C/246/1/MW

All communications should be addressed to
"The Provincial Education Director"
Telephone: 067-23083/4/5
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ZIMBABWE

Ministry of Primary & Secondary Education
P.O Box 328
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MIN. OF PRY. & SEC. EDUCATION
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MASH. WEST PROVINCE
11 FEB 2016
P.O. BOX 328, CHINHOYI
ZIMBABWE

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STUDENT Nº 590332

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By this letter, all District Education Officers and Heads of schools you wish to visit are kindly requested to give you assistance in your work.

We wish you success in your research and studies.

D.E.O.
MIN. OF PRY. AND SEC. EDUCATION
MAKONDE DISTRICT
15 FEB 2016
P.O. BOX 376, CHINHOYI
ZIMBABWE TEL: 067-25596

For : **PROVINCIAL EDUCATION DIRECTOR**
MASHONALAND WEST PROVINCE

LETTER TO THE PRINCIPAL, SGB Chair, etc.

09 April 2015

Dear Sir/Madam

My name is WELENSKY MASHAVAVE.I am a PhD student in the School of Education at the University of the Witwatersrand.

I am doing research on **Gender and high school science education in Makonde District; Zimbabwe.** This research seeks to unravel gender disparities in the teaching and learning of science at Ordinary and advanced level.

My research involves collecting data from both the students and teachers. Students will answer a questionnaire, participate in interviews and focus group discussions and will be observed whilst being taught. Teachers will be interviewed and observed whilst teaching. Observations and interviews will be audio taped .Interviews on average should take 30 minutes and observations 40 minutes .Completion of questionnaire should last 35 minutes. Times are subject to change as per situation.

I am inviting your school to participate in this research.

The reason why I have chosen your school is because of its enrolment profile and geographical position within Makonde district.

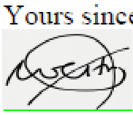
The research participants will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study.

The names of the research participants and identity of the school will be kept confidential at all times and in all academic writing about the study. Your individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed between 3-5 years after completion of the project.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,



Welensky Mashavave
3679 Mzari ext.Chinhoyi. Zimbabwe
mashwelly@gmail.com
Cell: +263775630301/ +27734127090

INFORMATION SHEET LEARNERS

09 April 2015

Dear Learner

My name is WELENSKY MASHAVAVE.I am a PhD student in the School of Education at the University of the Witwatersrand.

I am doing research on **Gender and high school science education in Makonde District; Zimbabwe.**The research seeks to bring out the different ways in which boys and girls learn science, and seeks to address the issues of inequalities in science education.

My investigation involves collecting data from you and your teachers. You will answer a questionnaire. I will also sit in and observe you during lessons. I will ask you to fill in the questionnaire that should last 35 minutes. Some of you will be selected to participate in interviews and focus group discussions.

I was wondering whether you would mind if you use some of your free time to participate in the study. I need your help with the filling in of the questionnaires and attending the class lesson which I will observe and record.
Remember, this is not a test, it is not for marks and it is voluntary, which means that you don't have to do it. Also, if you decide halfway through that you prefer to stop, this is completely your choice and will not affect you negatively in any way.

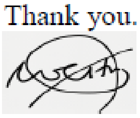
I will not be using your own name but I will make one up so no one can identify you. All information about you will be kept confidential in all my writing about the study. Also, all collected information will be stored safely and destroyed between 3-5 years after I have completed my project.

Your parents have also been given an information sheet and consent form, but at the end of the day it is your decision to join us in the study.

I look forward to working with you!

Please feel free to contact me if you have any questions.

Thank you.



Welensky Mashavave
3679 Mzari ext.Chinhoyi. Zimbabwe
mashwelly@gmail.com
Cell: +263775630301/ +27734127090

Learner Consent Form

Please fill in the reply slip below if you agree to participate in my study called:

Gender and High School Science Education in Makonde District; Zimbabwe.

My name is: ________________________

Circle one

Permission to observe you in class

I agree to be observed in class. YES/NO

Permission to be audiotaped

I agree to be audiotaped during the interview or observation lesson YES/NO

I know that the audiotapes will be used for this project only YES/NO

Permission to be interviewed

I would like to be interviewed for this study. YES/NO

I know that I can stop the interview at any time and don't have to answer all the questions asked. YES/NO

Permission for questionnaire

I agree to fill in a question and answer sheet or write a test for this study. YES/NO

Informed Consent

I understand that:

- my name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- I do not have to answer every question and can withdraw from the study at any time.
- I can ask not to be audiotaped, photographed and/or videotape
- all the data collected during this study will be destroyed within 3-5 years after completion of my project.

Sign______________________________ Date___________________________

INFORMATION SHEET PARENTS

09 April 2015

Dear Parent

My name is Welensky Mashavave and I am a student in the School of Education at the University of the Witwatersrand.

I am doing research on **Gender and High School Science Education in Makonde District; Zimbabwe.** This research seeks to find out if any differences exist in the way boys and girls attending the same class are taught or learn science at Ordinary level.

My research involves collecting data from both the students and teachers. Students will answer a questionnaire, participate in interviews and focus group discussions and will be observed whilst being taught. Teachers will be interviewed and observed whilst teaching. Observations and interviews will be audio taped .Interviews on average should take 30 minutes and observations 40 minutes .Completion of questionnaire should last 35 minutes. Times are subject to change as per situation.

The reason why I have chosen your child's class is because my study is focused on students doing form 3 and 4. I was wondering whether you would mind if your child participates in completing the questionnaire, participate in interviews and attend a class lesson which will be observed and audiotaped.

Your child will not be advantaged or disadvantaged in any way. S/he will be reassured that s/he can withdraw her/his permission at any time during this project without any penalty. There are no foreseeable risks in participating and your child will not be paid for this study.

Your child's name and identity will be kept confidential at all times and in all academic writing about the study. His/her individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed between 3-5 years after completion of the project.

Please let me know if you require any further information.

Thank you very much for your help.

Yours sincerely,

Welensky Mashavave
3679 Mzari ext.Chinhoyi. Zimbabwe
mashwelly@gmail.com
Cell: +263775630301/ +27734127090

INFORMATION SHEET TEACHERS

09 April 2015

Dear Sir/Madam

My name is Welensky Mashavave and I am a PhD student in the School of Education at the University of the Witwatersrand.

I am doing research on **Gender and High School Science Education in Makonde District; Zimbabwe.**This research seeks to unravel gender disparities in the teaching and learning of science at Ordinary level.

My research involves collecting data from both the students and teachers Students will answer a questionnaire, participate in interviews and focus group discussions and will be observed whilst being taught. Teachers will be interviewed and observed whilst teaching. Observations and

Teacher's Consent Form

Please fill in and return the reply slip below indicating your willingness to be a participant in my voluntary research project called:

Gender and High School Science Education in Makonde District; Zimbabwe.

I, ________________________ give my consent for the following:

Circle one

Permission to observe you in class
I agree to be observed in class. YES/NO

Permission to be audiotaped
I agree to be audiotaped during the interview or observation lesson YES/NO
I know that the audiotapes will be used for this project only YES/NO

Permission to be interviewed
I would like to be interviewed for this study. YES/NO
I know that I can stop the interview at any time and don't have to answer all the questions asked. YES/NO

Permission for questionnaire
I agree to fill in a question and answer sheet or write a test for this study. YES/NO

Informed Consent
I understand that:

- my name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- I do not have to answer every question and can withdraw from the study at any time.
- I can ask not to be audiotaped, photographed and/or videotape
- all the data collected during this study will be destroyed within 3-5 years after completion of my project.

Sign______________________________ Date___________________________