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STEM IMPLEMENTATION IN RURAL SECONDARY SCHOOLS: A CASE OF KWEKWE ZHOMBE DISTRICT.

BY

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In partial fulfillment of the requirements of the Bachelor of Education Degree in History.

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DEDICATION

To my mother Farai and grandmother Tendai.

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ABSTRACT

The main objective of the study was to discuss and assess STEM implementation in rural secondary schools. The study mainly focused on two rural schools in Zhombe, Kwekwe District in the Midlands province. The schools are Siyaphambili Gwenzimkulu secondary school and S^{t} Faith Manzimnyama secondary school. The study sample comprised of ten teachers (five from each school) selected using purposive sampling and seventy students (thirty-five from each school) that were selected using the random sampling technique. In the collection of data the researcher used structured questionnaires, interviews and observations. The data collected was analysed using pie charts, graphs and tables. In the study the researcher found out that financial constraints burden both the staff and the SDC in planning on the activities to carry on the schools thus ending up developing infrastructure. Poverty was found to be dragging development of students as most of parents cannot even afford to the fees of their pupils thus also retarding development at school and community level. In the study poor technology and teacher training facilities were also found to be affecting STEM implementation in these rural areas. The study noted that the student's background, perception and socio-cultural values do affect the way pupils think and behave at school thus ending up having negative attitude towards STEM subjects. Demographic changes, lack of hands-on training for students, power shortages and lack of research collaboration across STEM fields were some of the challenges note to be affecting STEM progress. The researcher suggested solutions such as giving teachers in rural areas incentives acting as compensation for them as they live and are exposed to such harsh rural environments. There should also be training programmes and workshops for both teachers and pupils. The government should also engage in more payments of fees to STEM children.

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ABBREVIATIONS AND ACRONYMS

ECD	Early Childhood Education
ESSA	Every Child Succeeds Act
ICT	Information and Communication Technology
GDP	Gross Domestic Product
MSU	Midlands State University
NGOs	Non-Governmental Organisations
SCA	Science Circus Africa
SDC	School Development Committee
SFSS	S^{t} Faith Manzimnyama secondary school
SGSS	Siyaphambili Gwenzimhkulu secondary school
S & T	Science and Technology
STEM	Science, Technology, Engineering and Mathematics
USA	United States of America
UZ	University of Zimbabwe
ZETDC	Zimbabwe Electricity Transmission Distribution Coucil
ZIMSEC	Zimbabwe School Examination Council
ZOU	Zimbabwe Open University

CHAPTER ONE

1.1 Introduction

The research study seeks to explore challenges to STEM implementation in rural secondary schools. The main motive behind this study is that despite tireless efforts by the government to introduce Stem in all institutions of learning there seems to be challenges on the rate of adoption of STEM in rural secondary schools. Therefore this chapter includes an introduction, background of the study, statement of the problem, research questions as well as significance of the study. The key terms that are central to the study, limitations as well as delimitations are discussed in this chapter. A summary will therefore sum up all discussed in this chapter.

1.2 Background of the study

Education plays a fundamental role in the growth of any economy be it socially, economically, politically and mainly technologically. It is regarded by many countries as a key investment that leads to sustainable development of societies (Adedeji and Olaniyan, 2011). Many nations heavily rely in education so as to equip people in rural and urban communities with skills and knowledge which will enable them to contribute meaningfully to national development. In a move to try and improve the education system the United Nation's General Assembly advocated for innovative solutions towards sustainable development and lifelong education. It therefore emphasised on the relevance and need to implement the Science, Technology, Engineering and Mathematics (STEM) to forge sustainable development and sustainable lifestyles (IBE-UNESCO, 2017). Tsupros (2008) defined STEM Education as an interdisciplinary approach to learning where rigorous academic concepts are coupled with real world lessons as students apply STEM in contexts that make connections between school community, work and global enterprise. Mabhanda (2016) argue that STEM education is a phenomenon that has received extensive publicity so as to improve its rate of adoption in both levels of education especially in primary and secondary education. The STEM education phenomenon rotates around subjects namely Science, Technology, Engineering and Mathematics. For communities to develop the education system should be equipped with skills and knowledge that imparts participation in individuals and also that

reduces the rate of resource wastages at the same time moving with the changing global technology (Nyerere, 1968).

1.3 Implementation of Stem globally

Globally, the Malaysian government is widely taken as the fore-runner of the STEM education with a gender biased perspective (IBE-UNESCO, 2017). However in its motive to incorporate STEM education in all systems, Malaysia feels that more girls should be brought into STEM fields with a ratio equal to that of boys. This helps in the professional development of the teacher to pupil knowledge importation and also in the faster dissemination of the idea behind STEM since women constitute a greater population in most of the countries. Since the incarnation of STEM, governments across the globe have designed policies that do support STEM-related fields in their education systems' curricula.

The United States of America (USA) has emerged and developed as a global leader through the genius and hard work of its scientists, engineers and its innovators (IBE-UNESCO, 2013). The USA has wholeheartedly embraced and inculcated the philosophy as they attempt to prepare students for an uncertain and shifting work landscape. Ejiwale (2013) noted that the essence of STEM education is to prepare the 21st century workforce with STEM education so that students can apply what they learn in the classroom in their future jobs. Therefore the school is viewed as a critical part of the broader STEM education system targeting to boost economic development (Australian National STEM School education strategy 2015). The Blue Print underlines three steps to strengthen stem education by increasing student's interest through new learning approaches as well as improved new curriculum which are making subject content relevant to everyday life, improving teacher skills and competencies through continuous training and lastly the Ministry of education has also put efforts to increase both students and parent's awareness about the importance and opportunities in STEM fields.

In the Every Child Succeeds Act (ESSA) former President Obama alludes that the STEM component is crucial for it enables and provides access to science, arts, mental and physical education, social studies as well as fostering the learning of additional languages. Betrus (2015), allude that STEM increases students passion to inquire, fosters teamwork, and helps in the application of gained data to new situations. Today's complexities requires versatile human beings with the ability to copy and stay abrace with the changing technological environment so that they will be in a position to apply rightful skills and knowledge to solve

problems as well as making sense of information that is disseminated by various media (STEM 2026 Vision).

1.4 STEM adoption in Africa

Stem education in Africa has been delivered and implemented in Botswana, Malawi, South Africa, Zambia and Mauritius. In South Africa Red Hill has boldly in cooperated STEM as an integral part of its curriculum specifically Grade 7-8 but also as a guiding principle across the school. The administration of the school have dedicated on the school time table the space needed for STEM philosophy to take place through the means of a project Based learning . This therefore has led Red Hill proud to be one of the first schools in South Africa to take power towards a truly world class educational system in this manner. A programme called Science Circus Africa (SCA) funded by an Australian government has also serves as an entry point to STEM education by showing students, teachers, parents and the community the importance of STEM education. Science Circus in Africa is also working hand in hand with African governments in particular Ministries of Education, ICT in order to deliver immersive programmes which have long term benefits by increasing awareness of and interest in Sciences in selected African countries.

1.5 STEM Implementation in Zimbabwe

In Zimbabwe the Science and technology (S & T) did not seem to be paying dividends and doing justice to the growth of the economy against the growth of population and at the same time proved slow in alleviating the country's developmental problems (Shizha and Kariwo, 2011). This might be attributed to the path taken by many countries of following Rostow's model for development which takes a linear approach in adopting S & T (Rostow 1990). The model's weakness is that it views development as the same in all countries, which is wrong. In Zimbabwe the STEM curriculum commenced in 2016. The deputy Minister of Higher and Tertiary Education, Science and Technology Development, Dr Gandawa, alluded that necessary skills are needed to improve the living standards of the Zimbabwean inhabitants via modern technology (Sunday Mail 14/2/16).

Many policies have been designed which encompass the STEM tracts and motives such as the ZIMASSET Blue print. Incorporation of the STEM programme has been viewed as a solution to some if not all of the developmental problems hence it has been designed to start

from as early as primary schools. This builds a technological immune in all pupils thus they will always stay in-line with the changing global world (Parawira, 2016). Science and technology subjects have taken the lead in-terms of emphasise in all countries through the implementation of STEM curriculum. Gadzirayi et al (2016) argued that a country's power to being competitive and innovative in global markets lies in its ability and prowess of its education system to prepare all learners in STEM. STEM education has become a multicultural discipline addressing areas of disparity such as gender imbalances thus bring equality, equity and quality to the nation.

1.6 Statement of the problem

STEM education has become a major concern globally and in our country Zimbabwe. Many policies have been implemented to try and move the STEM programme but to no avail due to many factors around the economy. The central problem to the study is that though many efforts have been done there seems to be challenges dragging the STEM programme backwards and at the same time hindering progress in knowledge diffusion (Parawira, 2016). There has been a dilemma between stakeholders (teachers, pupils, institutes and the government) on how best they can mitigate challenges to STEM and in the process coming out with proper methods of disseminating it to all corners of Zimbabwe. The study therefore focuses on the challenges to STEM implementation in rural and secondary schools so as to try and come with proper mitigation strategies to these challenges.

1.7 Research objectives

The main objective of the study is assess and discuss the challenges to STEM implementation in rural secondary schools

Specific objectives:

- To explore the challenges to STEM implementation in rural secondary schools
- To discuss the solutions to the challenges of STEM.

1.8 Research questions

a) What is the nature of STEM implementation?

b) What are the challenges to STEM implementation in rural secondary schools?

c) What are the benefits of STEM implementation in rural secondary schools?

d) what are the strategies needed to ensure effective STEM implementation in rural secondary schools

1.9 Significance of the study

The findings of this study are expected to contribute to knowledge on barriers to STEM implementation in rural secondary schools. The study may also energise efforts towards school transformations aimed at promoting the adoption of STEM education in rural secondary schools. This may in turn lead to a step towards achieving universal STEM education policy in Zimbabwe. The study also equips policy makers with knowledge on factors hindering STEM implementation on full scale in rural secondary schools thereby making the designing of interventions possible. The researcher hopes that the study opens avenues for researchers in education who are concerned in this area of study with relevant facts and knowledge to conduct their research.

1.10 Delimitation of the study

The study is limited to two rural secondary schools (Gwenzimukhulu Siyaphambili secondary school and ST Faith Manzimunyama secondary school) that will be randomly selected from the Midlands Province, Kwekwe District, Zhombe area in Zimbabwe. Gwenzimukhulu Siyaphambili secondary school is about 13km from the Kwekwe-Gokwe highway while ST Faith Manzimnyama secondary school is also about 18km from the same highway. Pupils and teachers from these schools purposively selected are going participate in carrying out this research.

1.11 Limitations of the study

The study's research time was limited hindering the stretching to some schools thus ending up working with two rural secondary schools. Travelling expenses were also problem as well as some miscellaneous expenses found in the processing of a finished document. Some of the targeted population were shy and unwilling to corporate as they sited other commitments which led the researcher to take more time collecting data. However the researcher persuaded and convinced them that the research was not for personal gain but was valuable to them

individually and authorities in various ways. Due to economic hardships and financial constraints the study was also limited to just two rural secondary schools.

1.12 Assumptions of the study

The researcher based the study on the assumptions that:

- Teachers and students are aware of the STEM programme.
- Teachers and students are aware of the STEM related subjects.
- All students and teachers are in a position to understand the universal language (English) thus able to answer required questions on the questionnaire.
- Both male and female students are incorporated in STEM education.
- Participants would supply the researcher with the required information.

1.13 Definition of key terms

1.13 a) STEM

According to Brown, Brown, Reardon & Merrill (2011), STEM education is defined as "a standard-based, discipline that has its roots within the school boarders where all teachers deliver lessons to the pupils, especially science, technology, engineering, and mathematics (STEM). The word is an educational movement that deals with the adoption of main subjects like science, technology, engineering and mathematics. These subjects enhance the skills within individuals that are needed to drive economic development (Parawira 2016). The study defines the term STEM as an integrated approach to marry science subjects as science, technology, engineering and mathematics and other technology related subjects to develop human skills, impart knowledge so as to better up the manufacturing industry and the economy at large.

1.13 b) Science

The term science refers to the systematic method of continuity investigation, a problem solving philosophy that deduce answers to questions based on made observations, testing hypothesis, experimenting, measuring and the building of theory leading to more adequate explanations to the natural environment. It is also a tool used to analyse data so as to offer rational explanations (Wells, n.d). According to the Science and Technology paper 7, science

has got three main branches namely Earth science, Physical science and Life sciences (Biology). Science as phenomena requires a creative human mind that pays special attention to the natural world in terms of interaction and understanding.

1.13c) Mathematics

Chirume (2016) defines mathematics as a subject that involves varying degrees of inter-related content areas (arithmetic, algebra, geometry, etc.) and skills (evaluating, applying, problem solving, analysing, interpreting, recalling, constructing, etc.) which individual(s) pursue for the purposes of development. Mathematics is a discipline that deals with the studying of equations, numbers, geometric shapes, and functions and their interrelations to the natural phenomena. The major divisions of mathematics are calculus, algebra and arithmetic (Harel, 2001). Mathematics can either be pure mathematics (abstract concepts) or applied to disciplines such as engineering and physics.

1.13 d) Technology

It is the branch of knowledge dealing with creating and using technical means and their inter relation with life, societies, and the natural environment. Technology takes into consideration disciplines such as applied science, pure science, engineering only to mention a few. In many countries technology is the cornerstone to development.

1.13 e) Engineering

The term engineering is derived from the Latin word *Ingenium* meaning "cleverness" and *Ingeniare* meaning to contrive device. David (2012) defines engineering as the creativeness of the human mind to present scientific principles in a bid to design, manufacture and develop structures, machinery, and scientific apparatus so as to use them in singular form or in combinations. These may also be used in the construction or operation of other valuable gadgets or in the forecasting behaviour's under certain specific conditions of operation. The main branches of engineering are Mechanical engineering, Electrical engineering, Civil engineering and Chemical engineering.

1.14 Summary

The background to the study indicated why many countries are making a move and try by all means to implement Stem in their education system**s** .It also revealed its agenda that STEM education aims to produce well rounded students who are academically, practically gifted, proficient students who are logical thinkers, able to answer complex questions, develop solutions for problems. The chapter also presented problem statement which is challenges to STEM implementation in rural secondary schools as well as significance of the study which aims to achieve universal STEM education policy in Zimbabwe. Limitations of the study such as travelling expenses and miscellaneous expenses were noted. Key terms that are Science, technology, maths and engineering amongst others were defined in this chapter .The next chapter focuses on the review of related literature.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter reveals the existing knowledge in terms of STEM adoption globally, in Africa as well as in Zimbabwe. The chapter analyses the building blocks to STEM in Zimbabwe as well as the major challenges that have been faced to date in implementing the programme in primary, secondary and tertiary schools. STEM related concepts are also discussed in this chapter with a view to enlighten the research on a broader base. An analytical perspective on previous studies that are STEM related will also be looked upon to. The chapter will deduce past solutions that have been hinted by previous researches and will therefore end with a summary of the whole points discussed in the chapter.

2.2 Theoretical literature review

2.2.1 Zimbabwe's Education System

The country Zimbabwe is in Southern Africa and is a landlocked country that shares boarders with Zambia, Botswana, Mozambique and South Africa. Zimbabwe is a multi-cultural country with English as the main officiated language used though some many languages are being spoken inclusive of isiNdebele and chiShona.the education system of Zimbabwe incorporates a 4-5-4-2-3 formation (Musarurwa, 2010). According to the Education Sector Strategic Plan 2016 – 2020, this formation is best explained as, the first four years are of infant education comprising of two years of Early Childhood Development (ECD) and the other two years of formal primary education. The following five years are of junior formal primary education whereby pupils sit for grade seven examinations. There is also a four year lower O'level secondary education when students sit for other Zimbabwe School Examination Council (ZIMSEC) examinations and then further to a two year A'level course with reduced number of subjects. Some and not all of the students do proceeds to the A'level courses since they join different polytechnics and colleges. The three years or four years hinted are the taken in tertiary education (Mupinga, Burnett, & Redmann, 2005).

Zimbabwe's teachers are branded in the fifteen teacher training college that are distributed around the country's main cities and of these fifteen colleges twelve are owned by the state and the remainder are church related institutions (Mabhanda, 2016). Besides these teacher training colleges some universities have also incorporated the training of teachers in post-

graduate courses and also in higher tertiary teacher education courses, for example the University of Zimbabwe (UZ), the Midlands State University (MSU), the Zimbabwe Open University (ZOU)only to mention but a few. According to Musarurwa (2011), most if not all of these teachers' training colleges there is the use of Information and Communication Technologies (ICTs). The use of ICTs has been of great importance in the move towards STEM implementation. Trainees on the other hand have learnt to learn through these ICTs and also learnt to theoretically and practically deliver lessons through them. This has given a positive response in the Zimbabwean situation to pave way for STEM.

The incorporation of STEM education in the country's education system as it is advocated to be a tool fostering an improvement in the teaching and learning in the fields of science, technology, engineering, and mathematics inclusive of educational activities across all grade levels, from pre-school to post-doctorate, and in both formal and informal classroom settings has widely received a great response (Gonzalez, & Kuenzi, 2012). According to Bybee (2013) the literacy of any society, be it formally or informally is better improved by STEM education. A plethora of skills, knowledge and positive attitudes in blending individuals from as little as primary level up to tertiary education better improves the well-being and standards of living of a nation. Thus in the Zimbabwean context the government has through all its education Ministries has taken a lead in the promotion and incorporation of STEM in the system so that the nation stay tuned to the changing global technology. In the recently designed curricula, the media through musians and in awareness campaigns, the STEM education has gained grip.

2.2.2 The logic behind STEM education

According to Parawira (2016), STEM education is a phenomena emphasizing on the teaching of Science, Technology, Engineering and Mathematics. In contrary the above mentioned disciplines were taught separately and made optional in some instances. The philosophy integrates and marries the forenamed subjects. Students and teachers under STEM are taught to be explorative, exploitative, and problem solvers rather than being irrational beings that are not competent. STEM-proficient candidates think logically and have the ability to answer complex questions and develop solutions for problems. What lagged behind in the traditional science and mathematical teachings is the practical ability of human beings to apply theoretically learned concepts (Harisson, 2015). The STEM framework incorporates skills

and knowledge that best suits available problems. In the curriculum STEM has been added help students relate life at school with the environment surrounding them.

STEM education rests upon two major perspectives. The first is that, it enhances the teachers' integration to correlated subjects not forgetting their unique characteristics, depth, and rigor of their main discipline. The second perspective regards STEM education's curriculum ability to guide teachers in a flexible manner and enabling them to teach STEM related subjects in their natural contexts in contrast to disparate curricular disciplines (Parawira, 2016). Teachers are taught to be more creative and be in a position to utilise the natural environment using their gained knowledge and skills.

At primary and infant level pupils are acquitted with the general life environment so that they grow up with a strong STEM background. Pupils are therefore introduced to STEM based subjects and taught the logic behind. However at this level the main goal is of stimulating the young's interest to STEM. When they move to secondary and high school learning more complex STEM subjects are then injected to the learning environment in relation to real life events. In a bid to reinforce the applicability of STEM, more workshops and career guiding programmes are hence given to students. Different disciplines with different STEM opportunities are given to the STEM capacitated pupils. This also helps in the students' degree selection in tertiary institutes.

2.2.3 STEM education conceptual framework

STEM education is viewed as a key towards economic growth, empowerment and human capital development (Gadzirai, et al, 2016). The term STEM marries a many if not all of the subjects that pupils learn at schools. It is also imperative that with the adoption of such polices the socio-economic well-beings of societies is improved. The diagram below tries to deduce the whole concept of STEM to a diagrammatic representation. The diagram tries to simplify how the sectors of an economy work in conjunction with STEM knowledge and skills towards human capital development and economic growth. In the presentation institutions take the lead in fostering STEM education through funding, training of individuals and also through infrastructure development, scholarships are also availed to STEM students so that they are motivated to drive the economy for a better tomorrow. With well-equipped human capital more inventions and technologically advanced products and materials are development.

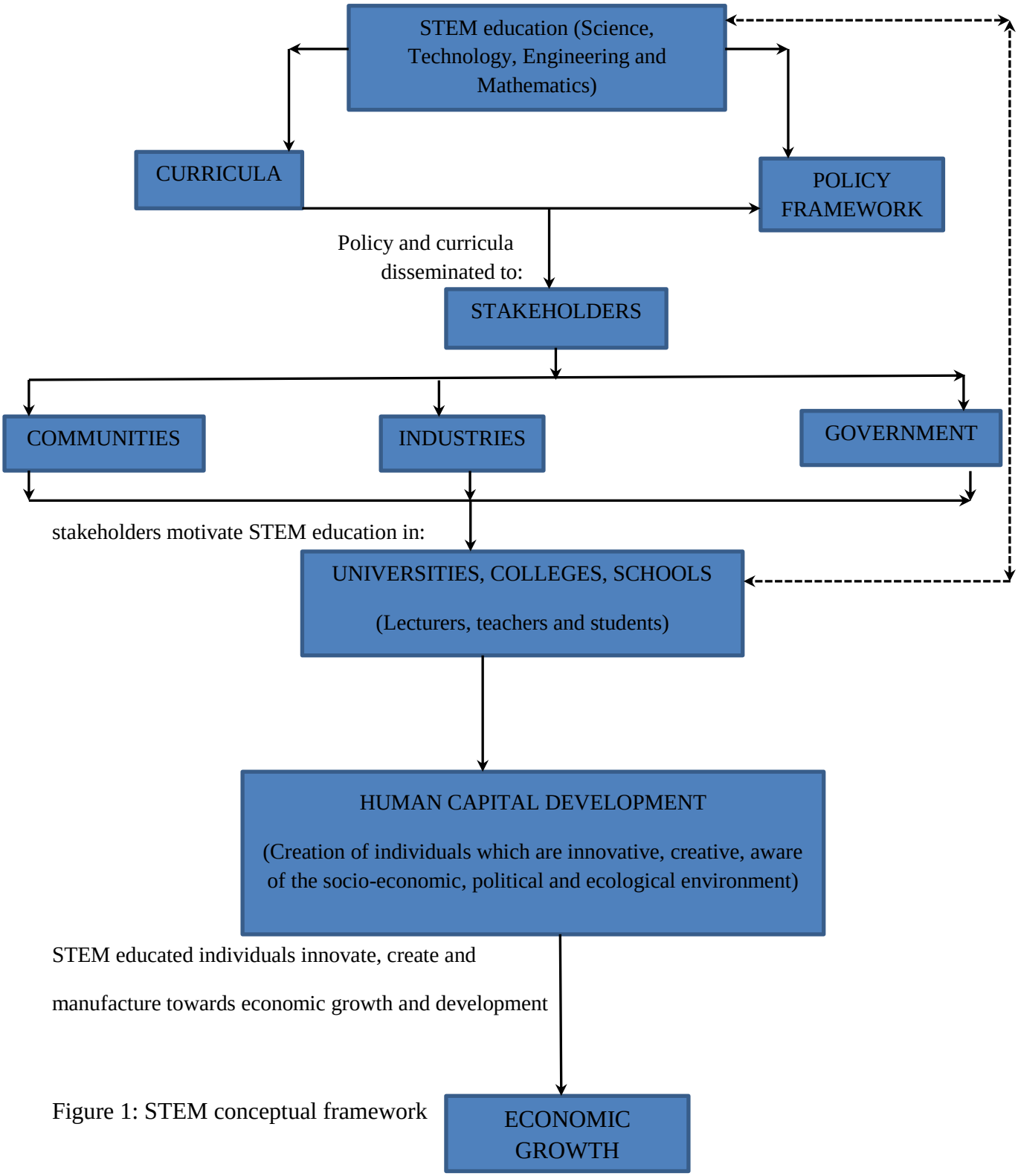

Figure 1: STEM conceptual framework

2.2.4 Opportunities of STEM education

According to Rothwell (2013), STEM education has in many countries proved to be a pillar to reckon in terms of job opportunities, social well-being and income levels of individuals.

Resource exploitation has also improved since the incorporation of STEM in many countries. The ability to deduce the concept and rationale behind STEM has improved the Gross Domestic Product (GDP) of many nations. STEM education is also a force to reckon in the engineering and manufacturing sector (Xie & Killewald, 2012). With STEM education higher wages and salaries are commanded in most institutions.

STEM trained people fit in many if not all of the world's modern jobs since they will be in a position to practically deal with modern technological changes. Many of the individuals are initiative and creative that they produce something out of nothing for a better tomorrow.

2.2.5 Gender issues and STEM education

Gender disparities had been and still a cause of concern in many disciplines of the nations in Africa. Women had been segregated in the working, learning and societies. Stereotypes have differently emerged in societies and have hindered the progress of women to higher educational levels thus been left out to take mainly household chores while men went to higher levels. In the educational system of Zimbabwe a few women pursued with science and commercial subjects while their path was mainly that of arts subjects. This lagged development since women constitute a greater percentage of the population. The commencement of STEM as a programme came as a turning point in the move to address equity and equality between men and women. Car (2013) postulates that most of the women have seen little or no employment growth in jobs related to STEM since year 2000. Since its inclusion in the curriculum, the number of women taking lead in STEM related subjects has improved.

The belief that the subjects related to STEM requires more physical strength hindered progress in the ICT environment. Martin (2008) argued that people need to do away with that mind-set so as to enhance development and move towards economic growth. In a bid to accommodate more women in the education environment, non-governmental organisations (NGOs), academic institutions and companies have sponsored more women to undertake STEM subjects and courses. These efforts had been made to encourage next generation women inventors and innovators. Most of the careers in STEM fields are rewarding and exciting and are more complex (Ganapathy, Olson, Imani, Edie, Kantor, Fimbres, Yinka, Babb and Gerstain, 2014). Men and women need to join hands and explore more in the ICT

industry. More STEM women need to be developed at a tender age such as in primary and secondary schools to stimulate invention and discovery of better methods.

Gudhlanga, Chirimuuta and Bhukuvani (2012) argue that a gender sensitive curriculum enhances the teaching and learning systems of a nation and at the same educating women reduces child mortality rates and also reduces the unnecessary growth of population. Moreso with STEM, the inclusion of women leads to higher production rates, reduced fertility rates and also improves hygiene and nutritional practices. SDA 2030 other target is to achieve, by 2030, "full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value'' (Sustainable Development Goals 8, target 8.5). The government and state of Zimbabwe has tirelessly made efforts to solve gender disparities in the system so as to economically and politically afford equal opportunities to both men and women. This, and STEM a better and brighter future with all in participation can be achieved.

2.2.6 Teacher- Student in STEM Curriculum

STEM subjects are hands on (practical) subjects, and learning of these subjects needs to be lees of theory for them to be effectively done (Parawira and Dzomba, n.d). The STEM subjects involve seeing, handling, understanding, and manipulating of real objects and materials. For STEM to be a success teachers must create a favourable environment for their students so as to motivate and stimulate them. The activities that they should create should be energetic, interesting, increase enthusiasm for STEM subjects. Teacher-student relations play a pivotal role in achieving a certain goal be it economically or socially since pupils spend most of their time at school than home. Teachers must use industrially linked materials in lesson delivery so that students have a clear picture of where they are heading towards.

The OECD (2012) postulates that teachers in institutions must be trained to deliver quality lessons whereby they use pedagogical techniques and components in the learning environment to try and create a student user friendly surrounding. Effective design of course content and curriculum with efficient feedback enhances proper assessment of progress. Quality teaching takes place at three main levels namely:

- Institutional level- at this level that's where policies are crafted and designed and usually greater support for the policies is issued at this level.

- Programme level-at this level a designed policy is then designed to use. In the realm of STEM this is where the subjects are taught theoretically and practically. There is content delivery, monitoring and evaluation of progress of students by teachers.
- Individual level-this level take the teacher or student as a person. Higher levels of creativeness, initiatives that helps a teacher to achieve a certain goal are needed and also greater motivational skills to students play a pivotal role at this stage.

Teacher-student relations have proved to be fundamental in both rural and urban schools and this helps move towards a gender balanced society. Students in primary and secondary schools need warmth and to be accommodated so that they understand the gist behind STEM knowledge. Most of the local universities and colleges have taken the lead to train teachers in STEM education so as to curb the short-comings that may arise due to lack proper training.

2.3 Challenges faced in rural schools' education

2.3.1 School Management Committees

The School Development Committees (SDC) of rural areas spends most of their time on infrastructural development issues rather than the inner classroom learning of their pupils. SDC monitoring in many if not all of these schools has been a failure. In some instances due to fear and lack of knowledge parents to teacher meetings are not even held in schools. The committees that are designed in these schools are usually not literate thus ending up being pace-detected by the teaching staff of these schools. They cannot go any further without the help of teachers and staff.

2.3.2 Communication problems

Primary and secondary school learning in rural areas is heavily influenced by language barriers. Sanjay (2008) purports that proper learning in these schools needs the conveying instructions beyond the use of the formal English language in classrooms for students to understand. It is of paramount importance that there is two way communication in the classroom whereby there is teacher-students discussion rather than a one way system whereby the teacher delivers to the students. Language barriers heavily influence drop-out rates of students and also high illiteracy rates. Teachers are deployed to societies with languages they are not familiar with thus creating difficulties in the efficiency of the rural schools.

2.3.3 Teaching and Training:

The teaching of pupils is heavily distracted by the unplanned teacher training programmes. Teachers usually leave classroom settings in a bid to achieve their personal educational goals thus leaving pupils unattended. Most rural schools are being taken as training grounds for teachers because they lack monitoring due to their remoteness and accessibility. Teachers are sometimes called upon to meet government needs such as census during working which disturbs the system. Some teachers are not even willing to train in new courses and also to further their education thus ending up delivering out-dated knowledge to pupils (Nath, 2014).

2.4 Characteristics of rural secondary schools

2.4.1 Technology resources

Stem (1994) argues that access to technology greatly affect the learning environment of pupils in rural secondary schools as to those in urban areas. This is being attributed by factors such as lack of infrastructure, background and societal beliefs, and also teacher beliefs and perceptions towards students. Students in rural areas due to lack of computers, end up living in the theoretical and lack the practical and hands on scenario. To try and catch up with the changing environment, rurals schools resort to distance learning and often use relatively inexpensive equipment (Greenberg, 1995).

2.4.2 School-community interaction

School-community interaction has been one of the major strengths of rural schools (Stoops & Hull, 1993). The school and the surrounding community usually have a close connection and this influences the day to day running of the school. In most cases whenever there are structures that need to be erected, the community stretches its hands to the building of the required facilities. The interrelations between the two also influences the way pupils learn and helps muld and develop better leaders. The interaction is however health in line with the STEM programme since it enhances easier diffusion to both ends.

2.4.3 School budgets.

School expenditures have a direct link with the outcomes from students in terms of fees structures (Hedges, Laine, & Greenwald, 1994). Due to small number of students, rural

schools' are very low and usually do not match or cover school running expenses. This also affects development at these institutions thus lag behind in terms of buildings and infrastructure. There is a trend between the earnings of parents and the school turnover since most of the stakeholders that commands a population are farmers. Schools are often faced with acute budgets thus they end up covering the basic needs of a school. Low revenues lead to poor ICT infrastructure and also poor education facilities.

2.4.4 School location.

In sparsely populated areas the major challenge is that children walk long distances to the school and this affects the student's performance at school (Chiromo, 2004).). Transport costs are usually high for one to embark in daily commuting. In some instances parents take the risk of liaising with nearby families so that their children can stay near the school. Many of the students in rural schools drop-out from school due to such factors as distance an hence move to towns in search of employment.

2.4.5 School size and buildings.

Rural schools have low teacher and students populations. This is attributed to the density of rural communities as to urban schools. Rural teachers reside at the school where there are houses mainly built by the community for them to stay. Most of these rural schools are not electrified.

2.5 Empirical literature review

Dekeza and Moses (2017) conducted a study focusing mainly on the sentiments and views of rural secondary schools' preparedness to adopt STEM subjects. In the study they wanted to expose challenges that are being faced in implementing STEM curriculum. The researchers adopted a qualitative approach in conjunction to a descriptive survey design. Open-ended questionnaires and focus group discussions were employed. 20 Maths and Science were sampled from Zaka's five rural secondary schools. They found that rural schools are iil-equiped to engage in STEM curriculum. The challenges that they found to be dragging STEM are lack of STEM teachers, laboratories and also financial constraints on the pupils' parents. The researchers concluded that most rural schools are incapacitated to engage in

STEM subjects and that the government need to take the steering wheel in training of STEM-teachers and also convey funds to the building of laboratories.

Gadzirayi, Bongo, Ruyimbe, Bhukuvhani and Mucheri (2016), conducted a study on the status of STEM education in Zimbabwe in a bid to determine how STEM education is applied and conceptualised. They based mainly on a desk review, informant interviews, focus group discussions, and high level STEM dialogue. The had four categories namely policy makers, industrial professionals, development partners and multi-lateral agencies, STEM-teachers in secondary schools and STEM lecturers in vocational and tertiary institutions and STEM students in secondary, vocational and tertiary institutions (starting from Form 4 Sciences). In the study they found that the major factors affecting the rate of adoption of STEM in rural schools are that students on their own have a negative perception towards STEM subjects. Some of the challenges are lack of resources, limited number of schools offering sciences, inadequate science teachers' development only to mention a few. However in the study they highlighted the opportunities that arise as a result of STEM education which are; enhancing the practical part of STEM subjects thus creating a more hands individuals, social and economic development amongst others.

Ejiwale (2013) in the study barriers to successful implementation of STEM education in the United States found out that lack of hands-on training for students in the schools , no or poor condition of laboratory facilities and instructional media. In most of these laboratories there are few or no apparatus to enhance proper and efficient learning. Poor content delivery is also another major setback since most of these teachers are not STEM trained and also the method of assessment is poor.

Mandina (2012) conducted a study on the challenges faced by rural schools and the remedies to the challenges so as to improve the standards of these schools. The study adopted a descriptive research methodology. The researcher used questionnaires and interviews to gather information. A sample of eighty teachers and school heads was used. Twenty of these were posted in Gokwe rural secondary schools using the cluster sampling. In the study the researcher found various challenges to be negatively affecting the delivery of quality education. These include lack of infrastructure, poor social and economic backgrounds, limited resources and poor funding, limited career guidance only to mention a few. To curb these challenges the researcher alluded that financial bonuses should be awarded to these teachers teaching in rural areas and also give incentives and better allowances to them.

Mandina's is relevant and essential to this research for gives a hint to some already found challenges in the rural secondary schools.

In his study on the effective science teaching and learning in Zimbabwean day secondary schools, Chiromo (n.d) used questionnaires, observations and interviews in collecting data. The researcher found out that learning and teaching facilities were inadequate and that students had a negative perception to science. The researcher also found that students' backgrounds heavily affected the learning of science as a subject. The researcher recommended that teachers should be more imitative and also improvise materials to help create a conducive science teaching environment for the pupils.

2.6 Summary

The chapter mainly focused on the theoretical and empirical review of literature in relation to STEM education. In the chapter the researcher looked on the government's logic behind STEM and also how it will help improve the nation. The challenges and characteristics found in rural schools have also been discussed. The chapter also presented the studies conducted by past researchers in the STEM field and how they have enlightened the research.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

Thomas (2009) argues that a methodology is factual framework where ideas and facts are structured, presented, nurtured and analysed so that they produce meanings to a certain area of concern. A description of the data collection procedures and methods used to gather information related to the study is discussed in this chapter. The chapter also discusses the population and size of the sample to be dealt with as well as the sampling procedures. The development of structured questionnaires and interviews is analysed and checked for relevance and validity to the targeted group. A summary concludes the chapter.

3.2 Research design

Saunders, Lewis and Thornhill (2012) define a research design as a plan structured to meet certain investigations and is used in extracting answers for the research questions. Creswell (2003) also defines a research design as an overall plan that links the research hypothesis or questions to the empirical research clearly highlighting the data that is required, the methods to be used as well as how the tools gathered are going to address the research objectives. In the study the researcher adopted a descriptive survey design in which conclusions are drawn basing on the sample derived from the whole population. Qualitative and quantitative data techniques were employed and mainly deriving answers from primarily collected data. The primary data was collected using structured questionnaires and interviews. The main reason why the study encompassed both the quantitative and qualitative design is because it dealt with human behaviour that is random and changing. The data was collected from two rural secondary schools in Kwekwe District, Zhombe area namely Siyaphambili Gwenzimukhulu and S^{t} Faith Manzimyama secondary.

3.3 Study area

The study was conducted in the Midlands province, Kwekwe District in Zhombe Central natural region 3. About 450ml to 650ml of rainfall are received in the area and high temperatures ranging between 25^{0}C to 30^{0}C are experienced. Siyaphambili Gwenzimukhulu secondary school is about 13km away from the Kwekwe-Gokwe highway and S^{t} Faith Manzimyama secondary school is also about 18km from the same highway. The study will

focus mainly on teachers and form 3 and 4 pupils. The most prominent activity in the area is conventional farming using the ox drawn mouldboard plough. The two schools were selected due to their accessibility as well as proximity to the main highway and also using the researchers' bias to the terrain.

3.4 Population

A population is described in simple terms as all cases of interest that a researcher is faced with (Frankel and Wallen, 2003). Popoola (2011:2) defines population as "the totality of the items or objects under the universe of study". The targeted population constituted of a pool of teachers at the two secondary schools (Siyaphambili Gwenzimukhulu and S^{t} Faith Manzimyama secondary) as well form 3 and form 4 students at these schools. The researcher then used random sampling to collect the required sample out of the whole population. Thirty five students and five teachers were selected from each of these schools. Purposive sampling was used in the selection of the two schools.

Table 1:Population and selected sample size

SCHOOL	**Total number of teachers**	**SAMPLE**	**Total number of pupils (Form 3 & 4)**	**SAMPLE**
S^{t} Faith secondary school	18	5	167	35
Siyaphambili secondary school	19	5	261	35
TOTAL	**37**	**10**	**428**	**70**

Sources: The headmaster and class teachers at the two schools

3.5 Sample

A sample is a section depicted from the whole population that is manageable and has all the true elements of the desired population under study. According to Baker (2002), a sample refers to any portion selected by the researcher to represent the true characteristics of the whole population under study. A sample is a true sub-representation of the whole population and resembles the characteristics of that population and is or can be randomly chosen so as to help study the behaviour of that whole population (Burgess, 2011). The sample comprised of two secondary schools (Siyaphambili Secondry School (SGSS) and S^{t} Faith Manzimnyama Secondary School (SFSS)) all from the Kwekwe District under the Midlands province. It also comprised of ten teachers, five from each school and seventy students from all the schools and thirty five from each school. All in all, the sample comprised of 88% (70 students) and 12% (10 teachers) of the whole population of teachers and students in the two schools. The sample percentage compositions are diagrammatically presented in the pie-chart below.

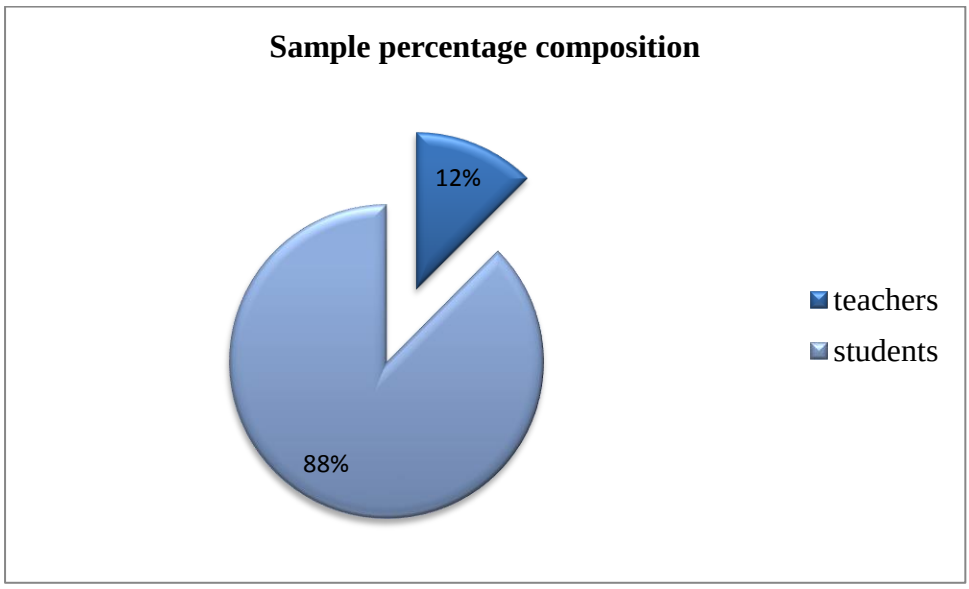

Figure 2: Sample percentage composition

3.5.1 Sampling

Sampling refers to the process of choosing the required number from each category, in this case schools, teachers and students. The researcher used purposive sampling in the choosing of schools and the simple random sampling in choosing teachers to conduct interviews and the pupils to give questionnaires. Purposive sampling is hen a certain category is selected

using the researchers ingenuity and is done based on his/her own perceptions. Barreiro and Albandoz (2001) argue that the purposive sampling procedure rests on the researcher and his bias towards the nature and subject of concern and also on the goal to be achieved.

In simple random sampling each object has an equal and independent chance of being selected as long as it represents the required population (Frankel and Wallen, 2003).

The researcher opted for the simple random sampling because:

- All students and teachers were to be given an equal and independent chance of being selected
- It is not biased and allows the researcher to draw clear results from the study
- It is representative of the total population

3.6 Research instruments

3.6.1 Questionnaires

The researcher used questionnaires and interviews in the collection of data. Interviews were conducted to teachers so as to enhance and improve the understanding of the STEM education system and also to allow face to face interaction between teachers and the researcher. Malhotra (2004) purports that a questionnaire is a well-structured bunch of easy to understand/straightforward questions that are oftenly used in the extraction of primary data from respondents. Phellas, Bloch and Seal, (2011) also defines questionnaires as a tool used in the collection and recording of useful information that is needed by individuals in a certain field or on the concerned subject matter and carry clear questions with spaces for the responses.

The study employed both closed and open ended standardised questionnaires. Open ended questionnaires are those that allow the researcher to give individual responses and also respondents are allowed to give explanations where necessary (Frankel, et al, 2003). Open ended questions usually promote and enhance freedom of expression in explanations by respondents. Closed ended questions are those that follow only two possible answers.

Siniscalco and Auriat (2005) describe a standardised questionnaire as one that allow respondents to be exposed to the same type of questions as well as the same coding system. This type of questionnaires ensures that differences in responses are interpreted in accordance to differences in the respondents. In the field of education, information collected using questionnaires is broadly classified into:

- Educational inputs (these include characteristics of the schools, pupils and or teachers, school resources)
- Teaching and learning process
- Educational outcomes (achievements by pupils, their attitudes towards learning, e.t.c)

The study employed questionnaires because of their main advantage of confidentiality. Phellas, et al (2011) argues that questionnaires maintain privacy of respondents since they answer them alone thus giving room of feelings expression. This in turn helps in the validity and reliability of data as anonymity plays a pivotal role to responses. The other reason why questionnaires were used is that they are less costly in administration.

The major drawback of structured questionnaires is that they can be inefficient that is if questions are not clear, short and well understood. If questions do not have these characteristics respondents may be prompted to discuss thus bias and false information given to the researcher. This therefore distorts and diverts the quality of the results to be obtained.

3.6.2 Interviews

Interviews are a method of directly acquiring information from respondents by means of asking questions either on face-to-face basis, over the telephone, mailing or using any other means of conversation. There are four types of interviews which are structured interviews, semi-structured interviews, in-depth interviews and focus group discussions. In interviews, in-depth content discussion is enhanced as well as freedom of expression on the interviewer and interviewee. The study adopted semi-structured interviews whereby the researcher is allowed to use a number of already planned questions and also allowed to modify the wording and the order of questioning.

The advantages of interviews are that they help the interviewer to observe non-verbal signs, behaviour and also help monitor the respondent's freedom of expression to answering questions. Interviews also allow in-depth discussions and follow up questions thus helping enlighten the filed under discussion. However interviews have shortcomings like there are not users friendly if the research wants to collect vast amount of data and also they are laborious.

3.6.3 Observations

To observe is to look and note systematically at the environment around you. In observations sensory systems of the body such inclusive of eyes and ears are used in the recording of information and also in making judgements of environmental elements. Simpson and Tuson (2003) postulates that observations give a clear picture of what is on the ground and also gives the researcher an opportunity to gather live data from the natural environment. Observation was used for it allowed the researcher to look directly at what was taking place at these two rural schools and also to look at the facilities that they do have which can be of importance in driving STEM education. The researcher was mainly concerned with key features such as laboratories, infrastructure, security, electricity, buildings and water and sanitation.

Wellington (2004) says observations are an easy way for the researcher to get free information without being hindered or distorted by third parties. An observation guide was created by the researcher so as to try and authenticate some of the responses from interviews and questionnaire. According to Russ-Eft and Preskll (2001) an observation is more reliable since it does not rely on people's behaviours and perceptions for example willingness or the ability to provide required information. Observations usually collect the data as the event is occurring. The main weakness of observations is that they are bias to the observer that is one observes what he/she only wants to. Observations can also be time consuming and expensive as to other methods of collecting data.

3.7 Pilot testing

Pilot testing of questionnaires is a process that is done prior to the administering of questionnaires to the targeted population. Tawodzera (2005) connotes that a pilot tests need to be done so as to ensures flexibility and clarity of questions and also to determine if the questions were user friendly. Pilot testing is also done to help judge the type and possible answers that the researcher can receive if questions are given to the sample. The researcher used students and teachers from other schools nearer to where she resides.

3.8 Data analysis

The study used the measures of central tendencies such as the median and means to describe the characteristics of the sampled population. Descriptive statistics in form of percentages were also employed to describe demographic characteristics and variables. Pie charts and tables are also used to explain certain findings of the study basing on the gathered primary data.

3.9 Data collection procedures

A letter seeking authority of research at the two rural schools was obtained from the chairperson of the Department of Education at Midlands State University to carry out the study. The researcher formulated and administered questionnaires to the form 3 and 4 students of both SGSS and SFSS. Teachers were also asked face to face questions via the interview method. In the process the researcher took observations of the components of STEM as well as the schools' facilities. Respondent's names were optional on the questionnaire to maintain confidentiality and anonymity. The researcher collected all administered questionnaires and also wrote main points as she conducted teacher interviews.

3.10 Validity and reliability

Thomas (2009*)* defines validity as the degree to which any research instrument measures what it is supposed to measure. Validity bases on the targetness of an instrument while reliability deals with consistence. The extent to which a research instrument such as a test measures and gives the same results under different conditions is known as reliability. Relating to questionnaires as in this study a set of administered questionnaires should yield more or less the same results in terms of challenges to STEM education in rural secondary schools. The determination and credibility of a study is also based on the reliability and validity of its key components such as the research instruments and data collection techniques. Before administering questions a pilot study was conducted and also pre-interviews to check if the questions were clear and well understood.

3.11 Summary

The chapter focused on the research methodology and particularly discussed research design, study area, population, sampling procedures as well as research instruments. The advantages and disadvantages of data collection instruments inclusive of questionnaires, observations and interviews were also stated in this chapter. The chapter also looked on how data is to be presented under subtopic data analysis as well focusing on data collection procedures. This was done in an effort to identify challenges to STEM implementation in rural secondary schools.

CHAPTER FOUR: DATA PRESENTATION AND RESULTS

4.1 Introduction

The chapter mainly focuses on the presentation and analysis of collected data from the two rural secondary schools. In its raw cause, data is meaningless hence the need to present and analyse it. Presentation and analysis is done so that useful conclusions are drawn that can help in the area of study. The chapter discusses the challenges to STEM education on a broader spectrum as to the respondents' ideas and facts.

4.2 Instrument's response rate

Table 2: Response rate of teachers and students

Instrument	Number issued per school	Number returned per school	% rate of return
Teacher's interviews	5	5	100
Pupils' questionnaires	35	35	100

The above table show that there was a 100% rate of return on the questionnaires administered to the pupils in both secondary schools. Thirty five questions were issued to each of these schools. The table also depict that there was 100% cooperation on the teachers that were interviewed from the two schools. The 100% was due to the researcher's distribution and self-presentation and also the willingness and students to respond to the asked questions.it can also be attributed to the way questionnaires were designed and also how the interviews were conducted.

4.3 Descriptive statistics

The mean age of the sampled students was fifteen years. The maximum and minimum ages of these students were eighteen and thirteen years respectively. For the sampled teachers the maximum and minimum ages were twenty-eight and thirty-eight respectively.

4.4 Respondents by gender

Table 3: Respondents by gender

N=80

CATEGORY	MALE	FEMALE
Teachers	4	6
Students/Pupils	29	41

The respondent's included teachers and students/pupils from the two selected schools. The study indicated that the researcher randomly selected more female teachers as to the male teachers. This is indicated by the ratios represented on the table of four males: six females. The reason why more female teachers were selected as to male teachers is that STEM education advocates for the inclusive of more women into the learning system thus a better focused economy. The table also indicates that twenty-nine students were given questionnaires as to the forty-one female students. More female/girls were given questionnaires which also may be contributed to the researcher's bias towards women inclusion in STEM education. STEM education advocates for the empowerment of the girl child in the science, technology, engineering and mathematics fields thus the researcher wanted to hear more from women.

4.5 Teachers' professional qualifications

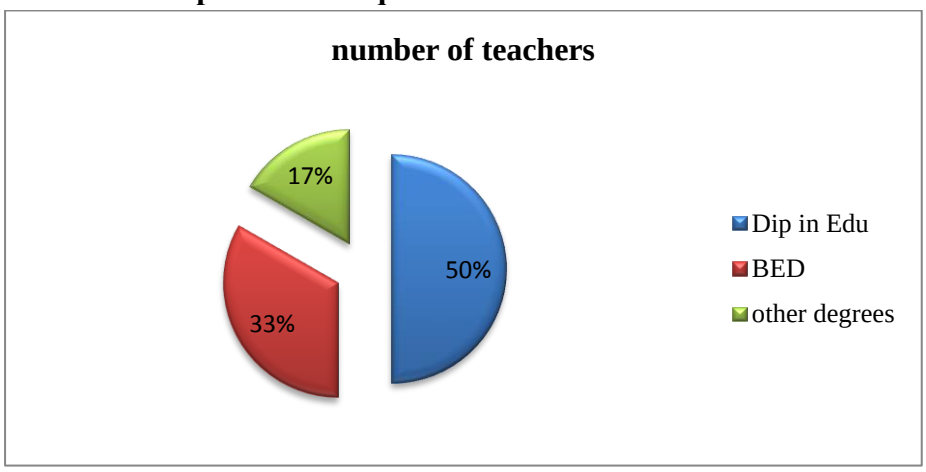

Figure 3: Teachers' professional qualifications

The diagram indicates that out of the interviewed ten teachers six (50%) had diplomas in education and from the different colleges that are spread out in the country. These include Belvedere, Hillside teachers colleges only to mention a few. Four (33%) of the teachers acquired at least a Bachelor's Degree in Education and two of them from Bindura University of Technology and the other from the Midlands State University. Two (17%) of the sampled teachers had non-teaching related degrees. Of the total sampled teachers the researcher found out that they were aware of the STEM programme and that they had done some STEM relate content at tertiary level.

4.6 Teachers teaching experience

N=10

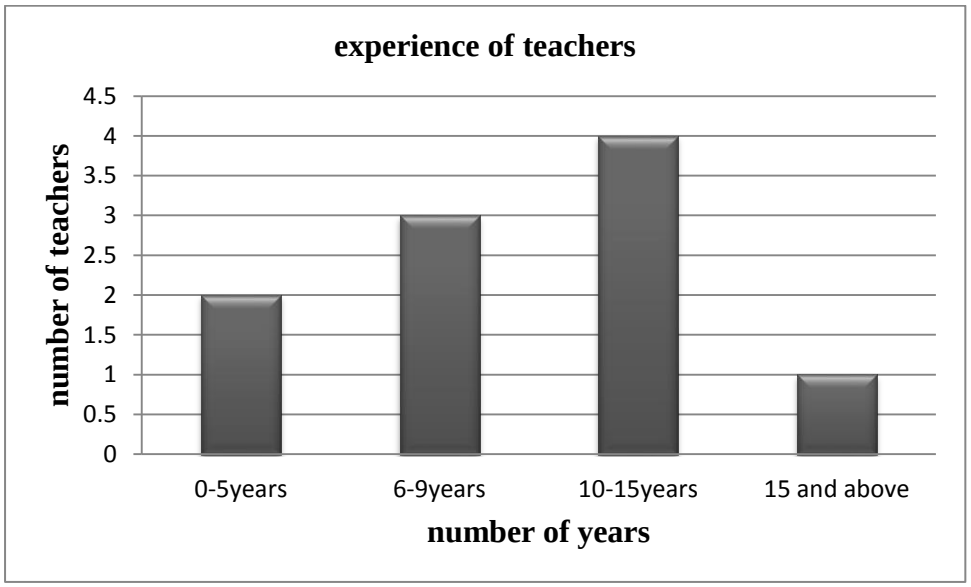

Figure 4: Experience of teachers

One out of the sampled ten teachers had been in the system for more than 15 years but gad taught in different schools. Four teachers from these two schools (Siyaphambili and S^{t} Faith Manzimnyama secondary) had a teaching experience between the categories of 10-15 years. In the category of 6-9 years only three teachers were found and only one teacher had less fell between 0-5 years.

4.7 Facilities present in the two schools

The researcher recorded the availability of the facilities using data gathered from both research instruments and coded the data using the YES/NO criterion. The number of each

facility is encoded in the brackets on the table. Some of the facilities availability is just recorded using the type that is available which is also indicated in the brackets under each school. Taking into considaeration of the data gathered from these two schools it showed that SFSS had better facilities as to SGSS. SFSS had ten computers and a computer laboratory while SGSS had none of these resources. This showed that pupils and teachers at SFSS were better in terms of the new STEM education curriculum. Modern day learning requires technologically advanced pupils and teachers so as to better move with the changing global economies (Nath 2014). The availability of computers and a laboratory fosters the implementation of STEM at SFSS rather than at SGSS. None of the schools had internet.

The researcher noted that both schools used locally available community boreholes as source of water although at SGSS there was an additional well. Availability of water is of paramount importance at any school for it enhances the carrying out of experiments and also fosters cleanliness of the school environment. SFSS had a generator used as an electric power source driving the computers. The other school had electrification in progress though no power is there at the present moment. Textbooks, infrastructure and laboratory apparatus were inadequate at these schools. There is great need of help in these areas so that pupils live and learn in reality rather than doing experiments the "*theoretical way*" (as situation when experiments are said rather than done).

Table 4: Facilities available per school

Facility	**Siyaphambili secondary school**	**S^{t} Faith Manzimnyama secondary**
Generator	No	Yes (1)
Computers	No	Yes (10)
Laboratory	Yes (There is a small room acting as a laboratory)	Yes
Internet	No	No
Solar panels	No	No
Adequate infrastructure	No (Does not match the pupils numbers)	No (Does not match the pupils numbers)
Adequate textbooks	Yes	Inadequate
Electricity	No (in progress)	No
Enough apparatus in the laboratory	No (inadequate)	No (inadequate)
Water supply	Yes (Borehole and well)	Borehole

4.8 Awareness of the stem education curriculum

From the study the researcher found out that almost all of the sampled respondents were aware of the STEM education system. From the ten sampled teachers, there was a 100% response in-terms of what the government expects them to do when it comes to the STEM programme. They hinted that efforts had been made to try and educate them on the new curriculum that is inclusive of STEM subjects at the forefront. Teachers argued that only the schools resources, students' perceptions and lack of institutional support hindered progress. Moreso they also highlighted that more awareness campaigns and workshops are needed to move the programme.

Out of the sampled seventy students from both SGSS and SFSS, only thirteen (18.6%) failed to define STEM and also to explain what the abbreviations meant. This may be attributed to their rural background and also their ability to grasp concepts at school. Students have different talents and educational capabilities, a factor that is also of great importance to the

adoption of STEM. Fifty-seven (81.4%) had the idea behind STEM conceptual framework and what they intended to be in the future. They said that they had gained the knowledge about STEM from teachers, media and awareness campaigns. One of the students vowed that he had about STEM when the popular musian (Jah Prayzah), advertised it with students on the television.

4.9 Number of students taking STEM related subjects

Table 5: Number of students taking STEM related subjects

SUBJECT	Siyaphambili secondary school	St Faith Manzimnyama secondary school
Mathematics	67	39
Biology	80	0
Physics	7	0
Integrated science	120	134

The table above show the number of students undertaking STEM related subjects at both SGSS and SFSS by subject. The statistics on the table indicate that more students took integrated science as to other subjects. This is so because many people and students view integrated science as cheap in terms of questioning. The table reveals that regardless of the nature and state of these rural schools, Biology and Physical Science are being done in these schools. At SGSS these subjects are still being done as indicated by the statistical figures of biology (80) and physical science (7). At SFSS these subjects were being done but due to shortage of teachers in these areas and also lack of resources there seized to existing.

Mathematics as a subject is done by few students in these rural secondary schools. Students feel that mathematics is a difficult subject that is only done by the intelligent. The perceptions and views of students are always negative to the subject mathematics. At SGSS only eighty students undertook mathematics out of the rest of the form three and four students. This constituted only 30.7% of the total population under study at SGSS. At SFSS only thirty-nine pupils did mathematics. This also constituted 23.4% of the total population under study. Students' responses towards these STEM related subjects indicated that the will and ability to do them is there but what lacked is the motivation and foresight of what they will be tomorrow if they take this rather perceived difficult channel.

4.10 Factors considered by pupils/students when choosing STEM subjects: a teacher's perspective

The researcher found out that there are some factors that students choose when they are to partake in scientific subjects that need attention and enthusiasm. Teachers argued that students consider a rapour of factors that they take as important before they associate themselves with mathematics, science, physics, biology other related subjects. These factors are that:

- They look at who is teaching the subject
- They take into consideration the prior knowledge they have on the subject and also at the challenges that the subject may impose to them
- They take their family background and put it into the school learning environment
- Peer pressure (just because my friend is not taking the subject I will also not do it)
- They also look at the subject's resource availability
- They take into consideration of what the society say about certain subjects at school
- Cultural beliefs and norms that they hear and live in within their communities
- Some of them are just lazy to work with numbers and experiments

4.11 Teaching strategies: A teacher's perspective

4.11 a) The lecture method and drilling method.

The drilling and lecture method takes the teacher as the main figure in the classroom whilst students are passive listeners. The teacher explains everything and usually the pupils take down notes given by the teachers thus they act as information recipients. Pupils usually lack the room and ability to plan for themselves and also construct meaningful responses. Richards and Rogers (2006) postulate that these two types of delivery in lessons hinder progress as they promote laziness and one way communication in the learning environment.

4.11 b) The discussion method

The discussion method is a method whereby the teacher presents a topic to the students and they are given room to discuss about the problem topic. This method involves the teacher-student interaction and has two way communications. Feedback is fostered under this teaching method. Most sampled teachers opted for this approach in teaching STEM subjects

though they said it is hindered by language barriers as most students don't understand the formal language (English).

4.11 c) The demonstration strategy.

The method received little attention from the sampled teachers as they cited many factors such as lack of apparatus, laboratories, student's interests, e.t.c, for it to yield fruits. 60% of the teachers showed that unless proper facilities are developed the method still remain dorsal in rural secondary schools which will in-turn ruin STEM achievement. The demonstration method reinforces skill and enhances the practicability of taught components. Mills and Cattel (2008) discuss the advantages of the use of the demonstration strategy and vows that it is the pillar to reckon in modern day learning environment as it promotes creativeness, innovativeness and fosters development in learning.

4.12 Challenges to STEM education: Teachers and pupils perspectives

The researcher came out with a lot of problems that are hindering the success of STEM in rural schools. Some of these challenges are institutional that is they are within the schools system and some of them are inherent to the behaviour of the taught students. Rural secondary schools face a rapour of challenges as to peri-urban or urban schools. These challenges are influenced by many factors such the geographical location of the school, population of these schools, and also the activities that the society/community around the school undertake.

4.12.a) Poverty

Poverty refers to the lack of income and usually one live below the poverty datum line. Poverty stricken people lack medical services, clothing, assets, good or proper education and basic socio-economic amenities. Haruna and Liman (2015) argue that poverty is one of the major factors that had dragged the education system of many developing nations and has also affected the development of human capital in these nations. Interviewed teachers argued that most of the peoples do not pay their school fees so that the school can develop and buy STEM related materials. Poverty also affects the understanding of these students: One of the teachers at Siyaphambili secondary said: *'rural children/pupils take a longer time trying to*

grasp and understand simple concepts as to urban schools because they will be thinking of the situation at home''.

The teachers and children argued that STEM related subjects requires a lot of anxiety and energy which means one has to be physically and mentally stable for the learning environment to be conducive (Salawu,2004). Students argued that some of their parents are not in a position to afford to provide stimulating environments for their beloved children. Parents in communities surrounding these schools are farmers whose produce are being bought at low prices and in some cases they illegal gold miners. Due to these conditions pupils and teachers argued that this brings frustration and depression to pupils who in-turn becomes emotional thus hindering their progress at school.

4.12.b) Student Background and Personal Characteristics

The teachers and pupils at these schools argued that rural backgrounds and personal student attributes affected their adoption of STEM related subjects. They argued that characteristics like living with single parents, minority group status, low parental education achievement and limited English proficiency affected them in taking these subjects. One of the asked pupils at SGSS said, *"STEM related subjects are difficult hence we resort to other subjects like Shona, Commerce and History only to mention a few''*. Khattri, Riley, and Kane (1997) also support the argument that was raised at these schools. They also found the same argument to be holding sufficient ground in most of the rural schools which then reduces the number of students taking up these subjects.

Students in rural areas are more likely to be living with single parents than those in urban areas (Sherman, 1992). Of the students given questionnaires some, 62.9% indicated that they lived with single parents while only 37.1% lived with both parents. The 62.9% included those with deceased parents as well as those who had their parents around the country looking/ searching for greener pastures. The fact that the other parent is not at there on daily basis affected the way students behave at schools as well as at home and this in-turn affected their educational activities. The other factor that also affected the implementation of STEM at these schools is that most if not all of the students have a low English proficiency. STEM subjects are taught using English as the formal language. Most of these rural schools students have difficulties in speaking English, a factor which also pose a problem to their teachers in delivering lessons. Khattri, et al (1997) postulate that students in rural forks are at risk of this

problem as they are not exposed to a lot of media content such as televisions (drammas, soaps, movies and cartoons) which will help them advance their English.

On the other note the low educational attainment of parents drastically affect the way pupils think and behave at schools. Especially mothers impart a negative attitude towards learning to their children since they are the ones who spend a lot of time at home with children (Thompkins & Deloney, 1994). Usually the local communities and environments do not support advancement of education to higher tertiary levels for they are influenced by societal norms and values. Parents believe that their daughters should be married as soon as they complete Ordinary Level (O' Level) and that boys should partake in farming and gold mining which are the main pillars of these societies. Some even think that travelling beyond boarders to South Africa and other neighbouring nations is better rather than tertiary learning.

4.12.c) Technology resources.

The researcher found out that the availability of technology resources affected the learning and hence the adoption of STEM curriculum at SGSS and SFSS. Technology resources that facilitate STEM education include computers, laboratory apparatus, internet, STEM trained teachers and the power (electricity/solar panels/generator) to help carry out experiments and enlighten the children. The development of these technology related resources is problematic at these schools as one of the pupils even cited that she cannot even power on a computer. SGSS and SFSS lagged behind in-terms of these resources which then is a powerful and inevitable factor hindering the fast adoption of STEM curriculum at these schools. Technological resources are on their own motivational to these rural schools (Spring, 2009). Lack of these facilities worsens the situation and even burdens teachers as they try and teach STEM related subjects. Out of the sampled students, 100% vowed for technological advancement at their schools and 0% was against this advancement. The responses from the students are represented by the chart below:

N=70

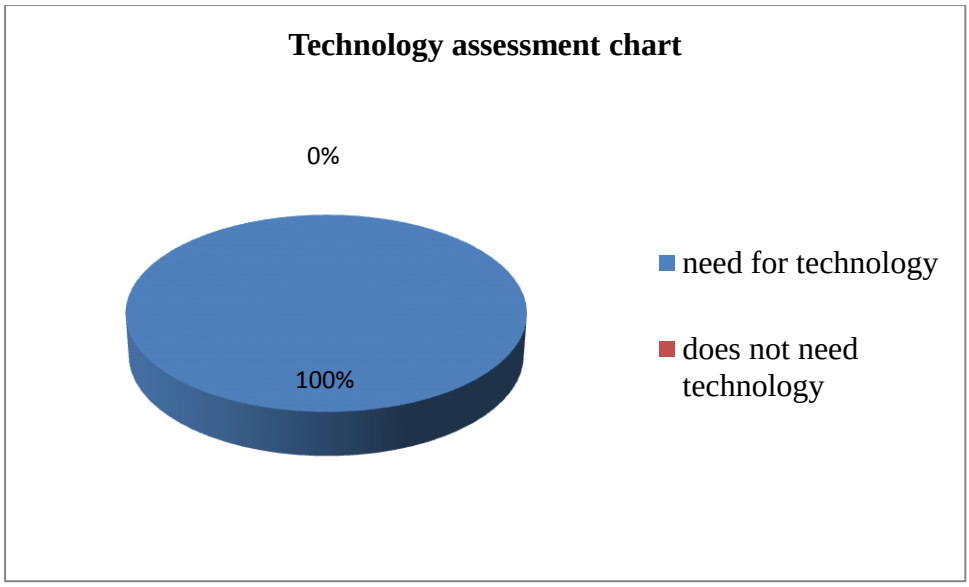

Figure 5: Technology assessment chart

The researcher found out that the availability of technology at home and both at school plays a cognitive role to the development of human capital, a notion that is also supported by Domenech (2006). For pupils in rural schools to reach their full potential, daily technological exposure is needed in their community and schools. Technological development and students' opportunities to technology must simultaneously move. One of the interviewed teachers said that technology is a fundamental and paramount tool to be used in schools to facilitate teaching of students and also to drive the Zimbabwean economy back to full potential.

4.12.d) Financial constraints and administration

Rural schools are those are characterised with low student and teachers population and usually they have a direct link with the communities they are cited in. I these rural schools the School Development Committee (SDC) usually face difficulties in budgeting for modern day equipment and infrastructure that suits the changing world. One of the major challenges that these schools face is of planning from a narrow financial base. The school fees that are usually paid in these areas are very low since the parents and guardians around the school are poverty stricken farmers that also need help from the government. Taking the logic behind STEM, more technologically advanced equipment is needed thus difficulties in buying and

developing the school. In most cases whenever a building is to be constructed at the school the community comes to handy (Tsupros, et al 2009). Tsupros, et al (2009) argues that the community and the school in rural forks work hand and glove and is difficult for one to separate them as to in urban areas. The SDC in some cases spend more time in property development rather than buying the necessary equipment to drive STEM education (Olivia, 2009). This is sorely because they lack the knowledge of the school new curriculum and objectives. Awareness campaigns and workshops involving SDC members need to be conducted so that when they meet with other school staff members they know what is expected of them in terms of the STEM curriculum.

4.12.e) Availability of STEM-trained teachers

Pasametier and Maeroff (2011) argue that the availability of STEM trained plays a key and fundamental role in the move towards a STEM based nation. In the study the researcher found out that teachers had the idea of the STEM implementation programme but were not equipped to teach and embark on the new curriculum. The researcher had the chance to come across science and maths teachers in her sample. When they were interviewed one of them said, *''Yes we are aware of the STEM programme and most of us are qualified to teach the subjects we teach but not the STEM way''*. He added that teachers need to be retrained in line with the new curriculum that is training in STEM education and this will improve the system's efficiency. The other teacher said, *''workshops have been attended and also the print and electronic media has covered ground but still more training is needed so that teachers feel comfortable to implement the new curriculum'',*

The researcher concluded that most of the rural secondary schools lack STEM trained teachers basing on the sentiments of the interviewees. In his document, Ejiwale (2013) is of the notion that more human capital development in form of teachers is needed so that STEM related skills and knowledge are imparted to these teachers. However the government through the Ministry of education is trying to carry out training of science and maths teachers so that the STEM objectives are met.

4.12.f) Demographical changes

The schools in the rural areas face rapid changes in demography thus increasing the diversity of both schools and community. There has been a high increase in numbers of people moving

out of the Zhombe area to better farming lands that were issued by the government. The transition has hampered development of many rural schools because students are always on the migration zone. Changes in the demographic composition of schools reduce and affect the planning of schools (Rural School and Community Trust, 2007). The researcher found out that changes in student's population affect both the school and communities. Changes in demography create tension on both short and long-term goals of these schools (Chavez, 2005). Movement of students out of the school community pose financial instability and accountability in schools. This lead to poor planning thus less infrastructural development hence low STEM education uptake in these schools.

4.12.g) Power shortages

The study revealed that at both SGSS and SFSS power challenges were a bone of contention. Only at SFSS existed a petrol powered generator that was used to run computers. Though it was available still challenges were met as expenses were found on the buying of the fuel petrol. This reduced the efficiency in use of the generator. A student at SFSS hinted that the generator although available was not used on daily basis which made it non-existent in the learning environment. At SGSS no power was available although electrification is in progress. This led to the existence of a gap between the STEM abjectives and resources available at these two schools. Teachers argued that for experiments to be undertaken and also for computer student hands-on to be necessary electricity is needed at the school be it solar powered or from the Zimbabwe Electricity Transmission Distribution Coucil (ZETDC).

In Zimbabwe, electricity is a national problem but it is more serious in the rural areas where it is not found at all. STEM related subjects need more experiments and stable minds with adequate resources (Haruna and Liman, 2015). The lack of electricity in these schools reduces the morale and vogour of teachers teaching STEM subjects thus also imparting a negative attitude to students learning in these environments.

4.12.h) Poor infrastructure

The term infrastructure refers to desks, play fields, laboratories, chairs, teacher's houses (typical of rural areas), classrooms, libraries, workshops, school farms and gardens as well as provision of water and sanitation. From the study a lot of infrastructure development is needed at both SGSS and SFSS which means most of the rural schools since the chosen two

were a representation of rural schools. The infrastructure at these schools did not match the number of pupils and teachers using them thus creating challenges to these schools. The houses that are being used by teachers are dilapidated and need renovation. Poor infrastructure creates conflicts amongst pupils themselves thus the situation doesn't create a learner conducive environment. Usually juniors end up sharing desks and chairs because all furniture is taken by the senior students.

For STEM education to be a success the government and community need to embark on methods to develop infrastructure first so that pupils comfortably learn and also their teachers live in a stress free environment. Subjects that are embodied in the STEM curriculum need neat and presentable work which is however affected by infrastructure. Infrastructure has to be of appropriate quantity, size and quality to meet the minimum standards of any meaningful teaching and learning condition.

4.12.i) Socio-cultural challenges

Rural schools are affected by the societal values and norms and also the culture the school is situated (Mahuta and Inuwa, 2008). Communities usually teach their children the tradition, values and norms they should follow and in most cases these contradicts the learning environment. The study found socio-cultural issues to be playing a pivotal role in reducing the rate of STEM technology adoption. Rural societies have their scientific beliefs that are not similar to the modern scientific world. Local herbs and other useful items are designed in the society. The way pupils think even at school is greatly influenced by the way they behave and live in the society. Girls are channelled to being mothers and boys to being responsible fathers. The society views education as a way to just enlighten the children and not as a way to success especially taking the economic and political situation of our country. Students in-turn take the school as a growing area hence they do not pay attention to the changing world and modern technological changes. Beliefs of societies do not favour the logic behind STEM education thus more awareness campaigns are needed in these societies surrounding rural schools so that STEM teachings begin at home. Rural children act and think in their societies as compared to their urban counterparts.

4.12. j) Lack of research collaboration across STEM fields

There has been discourse between STEM movers and STEM educators that do teach in these STEM disciplines and also with those that are to receive the education. A linkage transfer of information from the top to the bottom is without the practical facility to suit urban, peri-urban and rural schools. The policy and strategies designed are embracing and taking all schools to be having equal opportunities and facilities, which is not true. Rural schools lag behind in most of all of the STEM key resources. Gadzirayi, et al (2016) also argued that without collaboration of all STEM related fields from the government down to the schools the ideology still will remain in vein. Lack of collaboration leads to poor development of skills, inadequate and less effective learning leading to poor choice of career amongst students.

4.12.k) Lack of hands-on training for students

Students hands-on is one feasible and result yielding approach that can be implemented in STEM education so as to develop trained and well equipped young engineers and scientists. Most of the students better learn and grasp concepts when they are living within the contextual environment. If the practical part is done a brighter future is enhanced as pupils grow with the jobs they are to undertake in mind and also with the status quo of what they are to be in future. Cooperative learning is an alternative to lecture but is also an important tool to responsibility and brainstorming in students. Students are taught to cooperate, associate with peers and also to share responsibilities. Teachers argued that for this to be achieved more equipment is needed on the ground so that the pupils learn what they live in. In the conducted interviews most of the teachers advocated for support from other institutions be it donors or other well-wishers so that the learning conditions of students improve.

Research collaboration across STEM fields enhances connectivity and sharing of information among all concerned stakeholders. There is need for great participation and togetherness between teaching personnel and educators so that classroom teachings becomes effective and meaningful. If there is collaboration a pool of talented STEM taught candidates will be branded thus a positive move towards economic development and growth of the nation. Individuals that are resourcefulness, creative and innovative are created only and only if all forces push and pull in the same direction and with one unit of purpose.

The students and teachers in these two rural schools cited many challenges that negatively affect progress of the STEM curriculum. Amongst the cited challenges some of them have been full explained above but also exist other challenges such as poor content delivery on the side of teachers since they lack the knowhow and objectives of STEM education. They also face challenges of poor laboratories and shortage of instructional media in classrooms. Laboratory apparatus are also not fully available in these schools. The STEM curriculum also lacked support from the school system as many of the resources needed are expensive and are in excess of the school budgets.

4.13 Suggested solutions to STEM progress

The researcher found out many solutions to curb the problems hindering STEM education. One of the solutions is to embark in thorough preservice induction and awareness campaigns in most rural schools. One of the students said, *'the government and teachers need to conduct student STEM related workshops teaching us on the meaning and objectives of the programme so that we know what we will be intended to do and also to help our colleagues at school''.* Preservice induction motivates both teachers and students and also creates a base for STEM education so that it doesn't seem to be favouring urban schools only. Moreso Hannon, Henderson and Royster (2003), postulates that although many alternative and conventional programmes place candidates in rural schools in field experiences there is evidence that teaching in these schools especially in areas with high poverty rates becomes problematic. This is also increased by lack of training in the implementation of new programmes.

There is also need for professional development for the programme to be a success. The teachers highlighted that they are trained and qualified to teach the subjects they teach but extra training related to STEM is needed so that they impart proper knowledge to learners. Colleges and universities need to be more practical than theoretical when teaching and developing teachers. Sherwood (2000) argues that professional development is one of the positive moves towards proper and meaningful education in elementary schools and is a tool that positively drives the economy. Research has shown that the quality of teachers and teaching in rural areas play a pivotal role in boosting the pupils academic achievement (Lewin, 2004). Besides professional development it also of paramount importance to try and device methods that help in the retention of experienced personnel in rural areas. The

government and board need to at least give rural teachers allowances that are vivid and sounding so that they enjoy living and teaching in these areas.

Most of the Sub-Sahara African countries argue that they value teachers but the reality is that they treat them as second class workers thus giving them low wages and salaries and in many cases and thus continuously risking the status of these teachers (Adedeji and Olanayan, 2011). Adequate provision of infrastructure and resources is needed for the improvement of rural education. Teachers and their students argued that financial support is needed and direct government intervention to try and upgrade their living and learning environments. Political commitment to rural education is needed and also the government should not delay salary payments so that teachers are motivated with the little they have. Moreso there should be workforce to repair dilapidated buildings and teacher houses as well as desks and chairs to facilitate proper learning.

In a bid to curb the shortcomings of STEM the rural community need to be educated on the importance of children to go to school and embarking on science learning. Parents need to be taught of ways that can alleviate them from poverty that is if their children are taught to higher educational levels. This will help induce the sense in children behind science learning thus pupils are taught and motivated at both the schools and society. This also will reduce the high rates of STEM related subjects drop-outs at schools. Community funded projects can also be of paramount importance to reduce the levels of poverty in rural areas (Marlaine and Adriaan, 1991). The Non-Governmental Organisations (NGOs) operating in these rural areas can also help the parents and society to produce goods and products and in turn help them to secure markets for these products. This is useful in the sense that they will be in a position to send their children to school. The school will be in a better position to source the required materials and equipment thus driving the national goal of quality education.

Many solutions can be discussed to help STEM education implementation and amongst these, students should also be taught about STEM from as little as ECD level so that it lives and dwells in them. There should also be improvement in water and sanitation. School boreholes should be drilled so as to improve hygiene rather the school using community boreholes. The pupil-toilet ratios need assessment. The responsible education authorities need to embark on strict supervision programmes so that they continuously check teacher’s effectiveness and efficiency. This acts as a benchmark for standards to be achieved.

4.14 Summary

The chapter focused on the presentation and analysis of data obtained fron the questionnaires, observations and interviews. In the chapter the researcher found out that there was a 100% return of the questionnaires from the students and also a 100% response from the interviewed teachers. From the sampled teachers, 17% had other degrees, 50% had Diplomas in education and 33% had Bachelors in Education Degrees. Most teachers had between 10-15 years in the service of teaching. Only at SFSS existed a generator and a computer laboratory and no internet was available in both schools. Both schools relied on boreholes as a source of water but they shared water with the community. The researcher found out that most of the sampled population had knowledge on STEM education and objectives. The main factor that determined most students in taking science subjects is the negative perceptions that students have towards STEM related subjects. Cultural beliefs, financial constraints, poor infratsucture, poverty, lack of hands-on training for students, lack of research collaboration in STEM fields were some of the major challenges that the researcher found to be hindering STEM education success. Teachers and students suggested solutions such as government incentives to teachers, NGO intervention in projects helping the community and also embarking in more awareness campaigns.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The purpose of the study was to delineate the challenges to STEM implementation in rural secondary schools. The study was centralised to two rural schools in Zhombe namely Siyaphambili Gwenzimkulu secondary school (SGSS) and S^{t} Faith Manzimnyama secondary school (SFSS). This chapter presents the research summary to the whole project as well as the conclusions drawn from the research findings and recommendations to different stakeholders in Zimbabwe.

5.2 Summary

Chapter one looked at the study's background and how STEM education started globally, in Africa and in Zimbabwe. The chapter presented the main motive behind carrying the study/ research which is the problem statement. It also looked at the main objective of the study which was to asses and discusses the challenges to STEM education in rural secondary schools. In the chapter the researcher defined the key terms of the study and also the limitations and delimitations of the study as well as the significance to the study. In chapter two there was review of both theoretical and empirical literature with the STEM conceptual framework designed.

The study was conducted in the Midlands province, Kwekwe District in Zhombe Central natural region 3. About 450ml to 650ml of rainfall are received in the area and high temperatures ranging between 25^{0}C to 30^{0}C are experienced. Siyaphambili Gwenzimukhulu secondary school is about 13km away from the Kwekwe-Gokwe highway and S^{t} Faith Manzimyama secondary school is also about 18km from the same highway. The study targeted form three and four students at both SGSS and SFSS. Thirty five students were sampled from each school using random sampling techniques and five teachers from each school using purposive sampling technique. The researcher used questionnaires, observations and interviews as the data collection tools. All the ethical considerations necessary for collection of data from all the respondents were observed.

The study used tables, pie charts and graphs in presenting and analysing data. The challenges and solutions to STEM implementation were discussed in the research.

5.3 Conclusion

The researcher came out with a number of factors that do affect the implementation of STEM education in rural secondary schools. In the study the researcher found out that financial constraints burden both the staff and the SDC in planning on the activities to carry on the schools thus ending up developing infrastructure. Poverty was found to be dragging development of students as most of parents cannot even afford to the fees of their pupils thus also retarding development at school and community level. In the study poor technology and teacher training facilities were also found to be affecting STEM implementation in these rural areas. The study noted that the student's background, perception and socio-cultural values do affect the way pupils think and behave at school thus ending up having negative attitude towards STEM subjects. Demographic changes, lack of hands-on training for students, power shortages and lack of research collaboration across STEM fields were some of the challenges note to be affecting STEM progress.

The researcher suggested solutions such as giving teachers in rural areas incentives acting as compensation for them as they live and are exposed to such harsh rural environments. There should also be training programmes and workshops for both teachers and pupils. The government should also engage in more payments of fees to STEM children.

5.4 Areas of further study

The study was only grounded to two secondary schools in Zhombe, Kwekwe District thus the researcher will be delighted if other researchers explore the challenges to STEM on a broader context in both rural primary and secondary schools, urban schools as well as in universities, colleges, poly-techniques and the nation at large.

5.5 Recommendations

5.5.1 To the government

- Engage in more STEM awareness campaigns
- Facilitate improvement in infrastructure in rural areas (road networks, furniture at schools, water and sanitation)
- It should facilitate the rural electrification programme

- It should also channel more funds to the payment of school fees to STEM students so as to motivate more pupils to join the programme
- It should engage in more STEM trained teachers so as to improve in the type of skill and knowledge imparted to students
- Lastly the government should facilitate the development of rural areas that are still lagging behind in their socio-economic status through the distribution of various NGOs and other government funded projects

5.5.2 To the teachers

- Teachers should attend more STEM workshops so that they familiarise themselves with the STEM objectives and content
- They should also be initiative and creative so that they better up their teaching strategies
- They should also try and upgrade themselves so that they move with the changing global technology

5.5.3 To the students/pupils

- Students are recommended to remove the negative attitude and perception towards science and mathematics subjects for they are now the key driving tools of many economies. This will them broaden their job opportunities since most of the present day work require STEM trained personnel. Students should also change their thinking and move with the changing global technology.

REFERENCE LIST

Adedeji.S.O and Olaniyan. O(2011), **Improving the conditions of teachers and teaching in rural schools across African countries,** Addis Ababa,UNESCO: International Institute for Capacity Building in Africa.

Baker, G. (2002). "**What about boys? A literature review on the health and development of adolescent boys".** WHO, Africa review on school based violence. Technical Paper, 2009,

Barreiro, P. L and Albandoz, J. P. (2001). **Population and sample: Sampling techniques**. Management Mathematics for European Schools.University of Seville.

Burgess, T. F. (2001). **Guide to the Design of Questionnaires: A general introduction to the design of questionnaires for survey research**.

Chavez, S. (2005), **Community, ethnicity, and class in a changing rural California town**. rural Sociology, 70, 314–335.

Chiromo. A.S (n.d), Challenges of Science Teaching and Learning in Rural Day Secondary Schools in Zimbabwe : The Way Forward, Faculty of Education, Midlands State University, Zimbabwe

Chiromo, A, S (2006), **Research methods and statistics in education: A students" guide**: Gwerrhceaseu. Midlands State University.

Chirume. S (2016), **The Zimbabwe 'O' Level Mathematics Curriculum And Students' Career Aspirations In Shurugwi And Gweru Districts**, Midlands Province: A Causal Comparative Analysis, Thesis Submitted In Fulfilment Of The Requirements For Doctor Of Philosophy In Mathematics Education, Zimbabwe Open University

Creswell. J.W. (2003). **Research Design :Qualitative, Quantitative. and Mixed Methods Approaches,** SAGE Publications, University of Nebraska, New Delhi, London..

Dekeza. C and Kufakunesu. M, Robert Mugabe School of Education, Great Zimbabwe University Masvingo- Zimbabwe.

Dokora, L.D. (2015**), Minister of Primary and Secondary Education Report to the 15th ZANU PF Conference,** Harare : ZANU Pf.

Dokora, L. (2015), **ZANU PF National People's Conference, Victoria Falls, Zimbabwe, Implementation of STEM Curriculum in Rural Secondary Schools in Zimbabwe: Limits and Possibilities**.

Domenech, D.A. (2006). **City-Country**, American School Board Journal, 28-29.

Ejiwale, J.A. (2013), **Barriers to Successful Implementation of STEM Education,** Journal of Education and Learning: 7(2), 63-74.

Frankel, R And Wallen, N,E. (2003). **How to Design and Evaluate Research in Education.** 5th Edition, Mc Graw Hill Companies Inc.

Gadzirayi, C.T., Bongo, P.P., Ruyimbe, B.,Bhukuvhani,C., and Mucheri,T. (2016), **Diagnostic Study on status of STEM in Zimbabwe,** Bindura University of Science Education and Higher life Foundation.

Gudhlanga. E, Chirimuuta. C and Bhukuvani (2012), **Towards a Gender Inclusive Curriculum in Zimbabwe's Education System: Opportunities and Challenges** ,Faculty of Arts and Education Department of Languages and Media Studies, Zimbabwe Open University, P.O. Box MP 1119 Mount Pleasant, Harare.

Hannon.H.L, Henderson.S.A and Royster.W.C (2003), **A Research Agenda for Improving Science and Mathematics Education in Rural Schools,** Timberville. VA, JournaI of Research in R.,m f Education. Vol. 18. No. 1. 52-58

Harrison. E. P (2015), **The Governance of Natural Resource Management in Zimbabwe:** Unravelling the Relationships between Conservation and Development Submitted in accordance with the requirements for the degree of Doctor of Philosophy, The University of Leeds: School of Earth and Environment.

Haruna M. J and Liman B. M (2015), **Challenges Facing Educating Nigerian Child In Rural Areas: Implications For National Development,** Department of Educational Foundations School of Education, Shehu Shagari College of Education Sokoto, Sokoto state, Nigeria

IBE-UNESCO (2017), **Training Tools For Curriculum Development: A Resource Pack For Gender-Responsive Stem Education,** C.P. 199 1211 Geneva 20 Switzerland.

Khattri. N, Riley.K.W and Kane. M.B (1994), **Students At Risk in Poor, Rural Areas:** A Review of the Research, Pelavin Research Institute, Journal of Research in Rural Education, Fall, 1997, Vol. 13, No.2, 79-100.

Lewin, K.M. (2004). **The Pre-Service Training of Teachers: Does it meet its Objectives and how can it be improved?** Background paper for EFA Global Monitoring Report 2005.

Mabhanda. W (2016), **Opportunities and Factors Affecting adoption of STEM Education: The Case of Gweru Polytechnic First Year Commerce Students**, Department of Management Studies Gweru Polytechnic, Gweru, Zimbabwe.

Mahuta, M. G. and Inuwa, A. M. (2008). **Teaching and learning in rural societies: problems and strategies for improvement**, Sokoto educational review, 10(1), 96-107.

Malhotra, N. K. (2004). **Questionnaire Design and Scale Development**, Georgia Institute of Technology.

Mandina. S (2012), **Quality Rural Secondary School Education in Zimbabwe: Challenges and Remedies,** Department of Educational Foundations, Management and Curriculum Studies Midlands State University P Bag 9055 Gweru, Zimbabwe.

Marlaine. L and Adriaan. V (1991**). Improving Primary Education in Developing Countries.** Oxford University Press, World Bank.

Musarurwa. C (2011), **Teaching With and Learning Through ICTs in Zimbabwe's Teacher Education Colleges**, University of Botswana, Gaborone, Botswana.

National Stem School Education Strategy A Comprehensive Plan For Science, Technology, Engineering And Mathematics Education In Australia, DECEMBER 2015

Nath. S (2014), **Problems of School Education in Rural Areas of West Bengal** ,India

OECD (2012), **Equity and Quality in Education**, Supporting Disadvantaged Students And Schools.

Olivia, P. F. (2009). **Developing the curriculum.** New York, NY: Pearson Education, Inc.

Parawira, W. (2016). **Science is our natural world.** (Sunday Mail 14/2/16)

Parawira. W and Dzomba. P (n.d), **The Role Of Practical Work In Teaching And Learning Of Stem Subjects,** Bindura University of Science Education.

Pasametier, A.S. and Maeoff, G.I.(2011). **Lets conquer Maths anxiety.** Newsday. Com. Retrieved 24/1/17 from http://www.newsday.com.

Phellas, C. N., Bloch A., and Seale, C. (2011). **Structured Methods:** Interviews, Questionnaires and Observation.

Rural School and Community Trust. (2007, October). **Why rural matters 2007: the realities of rural education growth.** Retrieved July 31, 2008, from http://www.ruraledu.org/site/apps/s/link. asp?c=beJMIZOCIrH&b=3508815

Russ-Eft, D. & Preskill, H. (2001). **Evaluation in Organizations.** New York: Basic Books.

Salawu, A. A. (2004). **The society and the child: A challenges for parents.** In Muhammad, U.T, Salawu, .A.AS, Ardo, G.V and Dukku, M.G (ed) educational themes in Nigeria, Kaduna: Nasara press ltd.

Sanjay. S.K (2008): **Trends and Issues In Indian Education**.

Saunders M, Lewis P, Thornhill A (2012). **Research Methods for Business.** Students Sixth Edition, Pearson Education Limited.

Sherman, A. (1992**). Falling by the wayside: Children in rural America**. Washington, DC: Children's Defense Fund..

Sherwood, T. (2000). **Where has all the "rural" gone? Ru- rateducation research and current federal reform.** Jour- nal of Research in Rural Education. 16131. 159

Shizha. E and Kariwo. M.K (2011),**Education and Development in Zimbabwe,** A Social, Political and Economic Analysis.

Siniscalco. M.T and Auriat. N (2015), **Quantitative research methods in educational planning,** International Institute for Educational Planning/UNESCO 7-9 rue Eugène-Delacroix, 75116 Paris, France.

Spring.J.L (2009), **The Advantages and Disadvantages of Attending Rural and Urban Middle Schools,** A Master's Research Project Presented to The Faculty of the College of Education Ohio University, In Partial Fulfillment of the Requirements for the Degree Master of Education.

STEM 2026: **A Vision for Innovation in STEM Education**

Tawodzera, G. (2005). **The Socio-Economic Impact of HIV/AIDS on Communal Agriculture in Kandeya and Chundu wards of Mt Darwin and Hurungwe Districts.** Department of Geography and Environmental Science. University of Zimbabwe. Zimbabwe. (Unpublished).

Thomas, G (2009). **How to do your project.** Publications Ltd. **Approaches.** Patson Press Ltd.

Thompkins, R., & Deloney, P. (1994). **Rural students at risk in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.** Austin, TX: Southwest Educational Development Laboratory.

Tsupros, N., Kohler, R., and Hallinen, J. (2009**). STEM education: A project to identify the missing components**, Intermediate Unit 1 and Carnegie Mellon, Pennsylvania.

Wellington, J.(2004). **Educational Research- Contemporary Issues and Practical**

Wells. J (n.d), **Definitions of Science in State Standards Research.**

Zvavahera, P. (2015) **Human capital problems in Zimbabwean rural schools: a case study of Mazowe District,** Journal of Case Studies in Education

LIST OF APPENDICES

APPENDIX A: QUESTIONNAIRE

My name is Zhou Mascilline Makaita and I am a student at Midlands State University, studying a Bachelor of Education in History. I am carrying out a research on STEM implementation in rural secondary schools.The research is in partial fulfillment of the requirements of the programme. I therefore seek your assistance in carrying out my research by completing the attached questionnaire. The information you provide will be used for academic purposes only and will be treated with utmost confidentiality.

Date…….

Name of school…….

Nationality……..

Name of respondent (optional)…….

SECTION A: DEMOGRAPHIC CHARACTERISTICS

Tick of fill where appropriate

1. Age:……..

2. Gender:

Male	
Female	

3. Which form are you in?

Form	3	4

SECTION B: STEM IMPLEMENTATION

Tick or fill where appropriate

1. Do you undertake science subjects?

Yes	
No	

2. Which subjects do you take?

Mathematics	
Biology	
Chemistry	
Physical science	
Integrated science	

Others (specify)…….....

……..

3. How many science subjects did you register/ are you willing to register?.....
4. a) Have you ever heard about STEM education?

Yes	
No	

b) if yes, what does the abbreviations STEM stand for?

S…….,

T…….,

E…….,

M……

5. Tick the facilities that you do have at your school below

Computers	
Enough STEM textbooks	
Electricity	
Solar panels	
Generator	
Laboratory	
Enough teachers	
Water (well/borehole)	
Adequate learning buildings	
Adequate infrastructure (desks, chairs,e.t.c)	

6. Do you conduct experiments during STEM lessons?

Yes	
No	

i. If yes, are there enough apparatus at your school?.....

ii. If no, what do you think are the reasons behind?.....

……

……

……

……

……

7. a) Have you ever attended workshops/training regarding STEM education?

Yes	
No	

8. Are rural schools being neglected when it comes to STEM education? Yes……/No…….
   i. If you say yes, why do you say so?.....
   ……
   ……..
   ……..
   ……..
9. What do you think should be done to improve the education of pupils in rural areas?.....
   .....
   .....
   .....
   .....

SECTION C: CHALLENGES AND SOLUTIONS TO STEM EDUCATION

10. Do you face any challenges in the rural learning environment? Yes……./No……..
11. a) If Yes, list all the challenges you face as pupils learning in rural areas?.....
    .....
    .....
    .....
    .....
    .....
    .....
    b) Of the problems state the ones you think hinders STEM education?
    .....
    .....
    .....
    .....

12. What solutions can be implemented to solve these problems?

.....

.....

.....

.....

.....

.....

.....

THANK YOU FOR YOUR COOPERATION. MAY THE GOOD LORD

APPENDIX B: INTERVIEW GUIDE

1. How many science and mathematics teachers are there at the school?
2. Do you understand the rationale behind STEM education?
3. Is it being implemented at your school? If No, why?
4. If Yes, are there any problems to its implementation at your school level?
5. What are the problems?
6. Did you ever attend/train in STEM education?
7. What should be done to improve STEM education in the Zimbabwean rural schools?
8. Is there gender balance by pupils taking STEM subjects?
9. If No, what is causing the imbalance?

APPENDIX C: OBSERVATION GUIDE

The researcher had to take observations on the availability of the following facilities as she administered questionnaires and conducted interviews:

- Laboratories
- Water sources
- Number of classrooms
- Power source (electricity/generator/solar panels)
- Infrastructure