

**EXPLORING THE DEVELOPMENT OF BIOLOGICAL LITERACY IN
TANZANIAN JUNIOR SECONDARY SCHOOL STUDENTS**

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ABSTRACT

Internationally, scientific literacy is a major goal of science education in the twenty first century. In Tanzania, where there is a widespread lack of public understanding about major health issues, biological literacy is needed so that people can make decisions about the socio-scientific issues that confront them. To that end, the Tanzanian school curriculum aims to connect students' understandings of Biology to their everyday lives but few studies have been conducted that show whether these aims have been achieved, especially in junior secondary school. This ethnographic case study investigates the ways in which the junior secondary school Biology curriculum in Tanzania supports or constrains the development of biological literacy and how institutional context, particularly as it relates to urban and rural schools, influences the delivery of the Biology curriculum. Teachers' and Year Four students' of secondary schools views about school Biology were sought in the course of this study and the issues that emerged were analysed using social constructivist and social constructionist theoretical frameworks. Data were collected through student questionnaires, student focus group interviews, teacher interviews, and classroom observations. The research sites included rural and urban schools, and government and private schools. The findings suggest that the Biology curriculum and the ways it is delivered do not adequately address the students' needs and therefore is unlikely to enable them to become biologically literate. Rural schools are less well equipped than urban schools to deliver the curriculum and teachers and students face bigger challenges. A key finding was that Tanzanian young people have a strong desire to learn more about reproductive Biology and health issues but these are not prioritised in the current curriculum. In light of these findings, curriculum changes are recommended to provide learning opportunities for students to gain biological knowledge and skills that are relevant to their daily lives.

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ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
AMREF	African Medical and Research Foundation
ARV	Anti Retro-Virus
CIGI	The Centre for International Governance Innovation
ESDP	Education Sector Development Programme
ESR	Education for Self Reliance
FEMA	School program offered by Femina HIP-Health Information Project
FGM	Female genital mutilation
HIV	Human Immunodeficiency Virus
ICSU	International Council for Science
IFAD	International Funds for Agricultural Development
IIEP	International Institute of Educational Planning
MoEVT	Ministry of Education and Vocational Training
NGOs	Non-Governmental Organisations
OECD	Organisation for Economic Co-operation and Development
PASHA	Prevention and Awareness in Schools of HIV/AIDS
SEDEP	Secondary Education Development Plan
SPSS	Statistical Package for the Social Sciences
STDs	Sexually transmitted diseases
STIs	Sexually transmitted infections
TAYOA	Tanzania Youth Alliance
UNESCO	The United Nations Educational, Scientific and Cultural Organisation
URT	United Republic of Tanzania
WHO	World Health Organisation

CHAPTER ONE

INTRODUCTION

How can science help young people in developing nations understand the world they live in? And how might an understanding of Biology assist them to make informed, courageous decisions about their health, their cultural and social practices, and their future lives? Hodson (2014) argues that young people need to make connections between what they learn at school and how this can be applied in their daily lives. Many of the decisions they make will relate to physical and environmental health matters that require a working knowledge of Biology (Holden, 2010; Miller, 2011). In Tanzania, young people face very serious challenges to their health and wellbeing. It is a developing country and the number of people living in poverty is increasing; the HIV/AIDS epidemic continues unabated; communicable diseases, such as tuberculosis and diarrhoeal diseases, claim the lives of many young Tanzanians every year; and malaria is the leading cause of death for Tanzanian children under the age of five years (Global Health Initiative, 2011). To equip young people with the knowledge and skills they need to make informed choices about the specific issues that confront them, schools need responsive and relevant curricula (Hodson, 2014; Osborne & Dillon, 2008). This study explores teachers' and young people's ideas about the junior secondary school Biology curriculum in Tanzania and investigates the role of schooling in developing biological knowledge and literacy.

In this chapter, I discuss the background to this research. I also outline the research questions that guided this study and the relevance of this project to science education generally and to Tanzanian science education specifically. The chapter concludes with an explanation about the organisation of the thesis.

1.0 Background to the study

In this section I discuss the personal motivation and commitment that led me to write a doctoral dissertation about Biology education in Tanzania. I also discuss the social, cultural, economic, and political contexts that gave rise to this project.

1.0.1 Personal motivation

In my professional capacity as a Tanzanian science educator and teacher educator I have seen many students dropping out of science as soon as they can, and I have always wanted to understand why this happens. I wondered if students do not, in fact, perceive the benefits of studying Biology and whether they are aware of the link between school Biology and their everyday lives. I have also wondered why those young people who decide to continue with science often do not perform well even when they are interested in the subject (Ottevanger, van den Akker, & De Feiter, 2007). With this in mind, I asked myself, "Why do so many students not perform well in science? Is it because the content is not interesting, or is it because the methods of teaching are not relevant or appropriate?" I was unable to find satisfactory answers to these questions and this prompted me to study the problem more closely in this PhD.

Another motivation for this study is the concern I have about the many socio-biological challenges that face Tanzanian communities. For example, in the highlands of East Africa the spread of malaria, which is a leading cause of death in Tanzania, is linked to changes in temperature and rainfall (Haines, Kovats, Campbell-Lendrum, & Corvalan, 2006). Malaria kills about one million people in Tanzania each year and over 400 million cases are reported per annum (Mboera, Makundi, & Kitua, 2007). The impact of this disease is profound; the social and economic costs of malaria, particularly in rural and agricultural areas, have been linked to intergenerational poverty, and economic underdevelopment (Mboera et al., 2007). Climate and temperature change exacerbates the problem so the issue of climate change is an important one in Tanzania. Yet the link between human

activity, climate change, rainfall and the spread of diseases such as malaria, is not widely understood in many communities where widespread deforestation continues unchecked. In the highland areas, increases in local temperature accelerate the growth of malaria parasites which leads to the transmission of the disease (Afrane, Githeko, & Yan, 2011). This problem affects rural people most severely and it is in these areas where deforestation, often as a result of domestic practices such as felling trees for firewood for cooking purposes, is common (Pattanayak et al., 2006). Biological literacy is poor in many of these areas and I have long wondered if people were more aware of the Biology that is at work in the relationship between human activity, the environment, and human health, they would make different choices. This has motivated me to include rural participants in this study.

1.0.2 Rationale for the study

Movahedzadeh (2011) argues that biological knowledge plays a significant role in every human life. Yet, as Wilhelm-Rechmann, Cowling, and Difford (2014) report, many African countries have low levels of biological literacy, particularly in areas that are of economic importance, such as conservation Biology and human health. In the Southeast African context of Malawi, Smith-Greenaway (2014) explored general literacy levels to find out whether literacy influences the choices that young people make about their health. The findings show that further efforts are needed to accurately estimate the relationship between literacy and health benefits (Smith-Greenaway, 2014).

Miller (2011) and the International Council for Science (ICSU) (2011) further contend that biological knowledge can lead to improvements in many spheres of society including social, economic, political, and cultural life. Indeed, many of the cultural, economic, political, and social dilemmas that face contemporary societies can be linked to a lack of knowledge about Biology, biological and environmental issues (Miller, 2011). For example, people need to understand how problems such

as climate change and global warming come about and their impact on human health, they need to have a level of awareness about the potential and the ethics of genetic modification, and the safety and sustainable sources of energy, amongst many other issues (Hofstein, Eilks, & Bybee, 2011; Osborne & Dillon, 2008). In this section of the chapter I outline some of the considerations that I took into account when developing my research topic and research questions.

1.0.2.1 Political considerations

Miller (2011) argues that people need to understand how socio-biological issues affect their society so that they can make informed judgments about, for example, policies relating to biological research. Bull, Gilbert, Barwick, Hipkins, and Baker (2010) argue that the ability to address biological issues, to critically evaluate information, and to be equipped to participate in public debates and thus influence policy and government decision-making that directly affects them, is critically important. However, Yuenyong and Narjaikaew (2009) comment that many people are unable to fully participate in public debates about biological research or make informed judgements because they lack this basic knowledge. Schools can therefore play an important role in equipping people with the knowledge they need to participate effectively as citizens in those debates (Hodson, 2014). Hofstein et al. (2011) argue, however, that members of the public often only have access to information about the socio-biological matters that directly affect them when it has been heavily “filtered by journalists, politicians and pressure groups” (p. 1466). This places them in a situation where they are dependent on the knowledge and integrity of others. But it is important that people are wellinformed enough to make their own judgements about an issue.

According to Hofstein et al. (2011), the public needs to be equipped to actively debate and participate in the formulation of public policy that relates to biological matters. For instance, debates about the effective and responsible use of natural resources requires a reasonable level of socio-biological knowledge (Hofstein et al.

2011; but see also Movahedzadeh, 2011). The Biology school curriculum can, therefore, potentially play an important role in preparing students to be citizens who can make informed decisions about these matters in this regard (Hofstein et al. 2011). The question I asked myself as I began this study is: In practice, do schools in Tanzania do a good job of creating informed, knowledgeable citizens with an understanding of basic Biology?

1.0.2.2 Economic considerations

In this thesis, I argue that public awareness about Biology has the potential to contribute to poverty reduction. While poverty is a complex problem that has multiple causes, I argue that at least some of the effects of poverty can be mitigated when people increase their knowledge and awareness about Biology. For example, the connection between a biologically literate citizenry and strong economic productivity can be seen most clearly in wealthy nations where biological and biotechnical advancements have led directly to increased economic development (Njoku, 2011). In line with this, many countries have begun to explore the possibilities of biotechnology to improve their own agricultural systems, increase crop production, and promote economic growth (Sharma, Crouch, Sharma, Seetharama, & Hash, 2002). In some nations, for instance, seed and agricultural biotechnologies have led to a dramatic increase in agricultural harvests (Sharma et al., 2002; Herrera-Estrella & Alvarez-Morales, 2001). Also, stem cell research and genetic engineering have led to a range of biomedical advances and discoveries but it is vital that the wider public grasps the implications of these developments and is aware of the ethical, political, and legal challenges involved in order to be able to make accurate, informed decisions about whether to use biotechnology or not.

Miller (2011) argues that if this is to happen, the public's level of biological literacy needs to be raised. This is important because scientific advances bring with them their own moral and ethical problems that affect people in their everyday lives. For example, biotechnology has informed many agricultural activities such as crop

production, but there are ongoing debates about the environmental risks of biotechnologically produced food that affect people in their everyday lives (Herrera-Estrella & Alvarez-Morales, 2001). Many consumers and farmers, especially those in less developed countries where large corporations are often less regulated than in wealthy nations, are frequently unaware of these debates (Herrera-Estrella & Alvarez-Morales, 2001). A wider public engagement with these issues is therefore very important in developing nations where the effects of these practices have a profound impact on the wellbeing of communities, especially rural communities like those in Tanzania where rural economies are tied very closely to agricultural activities. For this reason, the school curriculum, in places like my own country of Tanzania, needs to prepare students to engage with these matters as informed and knowledgeable people, in the activities that directly affect them, their families and their communities.

Many developing countries in Africa have developed poverty reduction policies and strategies and in Tanzania, poverty reduction initiatives are embedded in the *Tanzania Development Vision 2025* (URT, 1997). This policy outlines a long-term nation-wide vision of economic and social priorities that the government hopes to realise by the year 2025. *Vision 2025* aims at the total elimination of poverty by 2025 through developing the national education sector as a means of bringing about social and economic transformation. According to *Vision 2025*, Tanzania proposes to create a knowledge society with a well-educated citizenry. In line with this policy, the Ministry of Education and Vocational Training (MoEVT) of Tanzania developed the Education Sector Development Programme (ESDP). The ESDP was initiated in 1997, considerably amended in 2001, and now provides a framework that regulates and monitors early childhood, primary, secondary, and adult education, teacher training and school-based programmes. A related educational reform, known as the Secondary Education Development Plan (SEDEP), aims to improve the quality of secondary schooling in Tanzania. Since its inception in 2004, most major policy developments in Tanzania have been closely linked to the *Vision 2025* document and SEDEP officials have responsibility for the oversight of the

implementation of policy development plans including teacher education, Community-based Adult Education and Vocational education. These initiatives are expected to improve people's lives through raising the quality of education (United Republic of Tanzania, URT, 2009b).

In this regard, the Tanzanian government has acknowledged the importance of education in national development. Tanzania's science and technology policy emphasises the effective utilisation of the country's resources based on a scientific understanding of the nature and the dynamics of these resources, as well as consideration of the socio-economic needs of the local people (URT, 1996). None of these plans can be achieved, however, without public education on scientific matters. This is because it is not only people who enter the science professions who require this kind of education but in a real sense, all people need good quality science education so they can address socio-scientific issues that affect them (Hodson, 2014; Holbrook & Rannikmae, 2009). In this respect, poverty alleviation programmes in Tanzania are closely connected to what is taught in schools and they aim to influence the kinds of choices available to people who have received some form of education. Given that so many of the challenges that Tanzanian communities face relate to the health and wellbeing of individuals and communities, many of whom live in rural poverty, the importance of a grounding in Biology during the years of school, cannot be underestimated.

Despite these initiatives, many of which are aimed at education, Tanzania still faces many challenges related to national development. The majority of Tanzanians live in rural areas where agricultural activities are the primary source of income and poverty is widespread (International Funds for Agricultural Development, IFAD, 2011). In these areas, the poor resourcing of schools, serious shortages of qualified teachers, and the remoteness of many rural communities means that the majority of rural Tanzanians are educationally and economically disadvantaged compared with those in urban areas (International Institute for Educational Planning, IIEP, 2006). With this in mind, this study takes a comparative approach and explores the

differences between urban and rural areas in relation to the development of biological literacy amongst secondary school students.

1.0.2.3 Cultural and social practices relating to health

The importance of biological literacy, however, goes beyond debates about economic and political matters. In many communities, a lack of awareness and understanding about hygiene and human Biology lead to the health risks associated with various cultural practices, such as female genital mutilation (FGM). FGM refers to the partial or total removal of external female genitalia for non-medical reasons (World Health Organization, WHO, 2008) and the practice continues in some parts of Tanzania today. In Tanzania, the primary aim of FGM is to reduce or eliminate women's desire for sex, particularly extra-marital sex. Current government action relating to FGM is focused on public education campaigns that provide information about health risks (WHO, 2008). While these public education campaigns are important, there is a disconnection between the ideals of government policy-makers who hope to deter the practice and the reality that some tribal peoples have a conflict between maintaining aspects of their cultural heritage and accepting that there are often serious health issues associated with FGM (Miller, 2011).

In addition, the HIV/AIDS epidemic is a major concern in Tanzania and public education campaigns have been initiated that aim to change people's sexual and social behaviour. One of the challenges here is the stigma and discrimination that people with HIV/AIDS face in Tanzanian society (Kisinza et al., 2002). Shame, fear and prejudice mean that many people are unwilling to be tested for HIV or disclose their results to family members, friends, and sexual partners (Kisinza et al., 2002). This culture of silence about HIV/AIDS and a lack of knowledge about disease transmission facilitate the spread of the disease.

While the Tanzanian school Biology curriculum includes a limited amount of material about health issues, there is little connection made either at national policy level or

by individual teachers about issues such as FGM or HIV/AIDS and the cultural and social contexts that frame people's behaviour, beliefs and daily practices. J. Kidman, Abrams, and McRae (2011) argue that the science curriculum needs to be culturally responsive if it is to meet the needs of people in culturally diverse societies. But in Tanzania, it is not clear whether young people are given the information they need to make the links between cultural practices in their communities and what they learn in their science and Biology classes at school. Nor is it clear whether they are able to make meaningful and informed decisions about these matters from what they learn at school. These matters are explored further in this study.

1.0.3 Biology education and Tanzanian social needs

There is growing international literature that focuses on the importance of equipping citizens with scientific knowledge and skills that can be applied in everyday situations outside the classroom (Ghartey-Ampiah, 2006; Hodson, 2014; Osborne & Dillon, 2008). In line with this, Holbrook and Rannikmae (2009) argue that science education aimed at developing biological literacy needs to be grounded in the communities where schooling takes place. This is because students' direct experiences of socio-biological challenges within a particular society or community can help them to make immediate and authentic links with the Biology curriculum if it reflects their needs, priorities and everyday realities (Holbrook & Rannikmae, 2009). In the New Zealand context, Bull et al. (2010) contend that science education is increasingly linked to ideas about citizenship education. They argue that science in schools should build students' biological literacy so that they can become informed participants in the science-related debates and issues that take place in their society if social, economic and political development is to take place. Likewise, Yuenyong and Narjaikaew (2009) argue that, internationally, the acquisition of biological literacy needs to be a high priority. With this in mind, this study explores whether science education in Tanzanian secondary schools helps students to acquire the knowledge and skills that will allow them to make informed decisions about Biology-related issues that affect the social, economic and political development of the nation.

As a former colony of Britain and Germany, Tanzania has adopted western science education in schools and much work still lies ahead in integrating indigenous Tanzanian science worldviews into curricula (Semali, 2014). In this regard, I concur with Shumba (1999) who argues that western science needs to be carefully interrogated before it is introduced into schools in developing nations. Curriculum content, teaching methods and assessment techniques need to facilitate students' acquisition of skills that can be applied in their daily lives. It may well be that more integrated paradigms are adopted that draw on both western and indigenous Tanzanian cultures. The participants' responses in my research suggest that accepting cultural practices just because they have always been there is no longer an acceptable option in modern Tanzanian society and for this reason; a more blended approach to the nature of science would probably assist young people to make informed decisions about their health and wellbeing.

Much of the literature in this domain takes the view that scientific literacy is important, although as Shwartz, Ben-Zvi, and Hofstein (2006) point out, the field of science comprises several disciplines such as Biology, Chemistry, and Physics. For that reason, they argue, young people need to be exposed to as many science disciplines as possible (Shwartz et al., 2006). The impact of the various science disciplines may, however, manifest in different ways in different societies. Consequently, rather than attempt to explore all of the science disciplines within the secondary school curriculum, I have limited myself to focussing on Biology education in Tanzania and its role in developing scientific literacy.

Although a thorough grounding in Biology education is seen as providing a basis for a scientifically informed citizenry by many commentators, much still needs to be done to improve the quality of Biology teaching in many nations. Recent research in the field of Biology education has identified a range of challenges and barriers that hinder the development of biological literacy, particularly in African nations such as Tanzania. These include students' lack of interest in studying science subjects, a lack of classroom resources, and poor teaching methods (Organization for Economic Co-

operation and Development, OECD, 2006; Osborne & Dillon, 2008). A OECD report (2006) argues that positive engagement with Biology at an early age can lead to a long-lasting impact, while negative experiences at school, such as irrelevant and poorly taught content, can be detrimental to fostering students' interest in the subject. Osborne and Dillon (2008) found that many students lack enthusiasm for science because they find it irrelevant. For that reason, they contend, pedagogical approaches in Biology need to be more relevant to young people's interests and priorities. Little is known about how this situation plays out in Tanzanian secondary classrooms however, and this study therefore explores this issue in the Tanzanian context.

Many African countries are taking steps to improve their economy through investing in education and schooling. In line with this, the Tanzanian government is in the process of developing a national Biology curriculum for all levels of primary and secondary education (URT, 1995). It is believed that primary and junior secondary schooling is the appropriate place to lay down the foundations of biological principles and knowledge, and tertiary education, including vocational colleges and universities, should be responsible for educating future biologists who will specialise in the more advanced areas of the discipline. Given these initiatives, one of the most important considerations is developing content and pedagogies that promote sustainable social and economic development (Bakar, Bal, & Akcay, 2006).

In addition, as Osborne and Dillon (2008) argue, the school Biology curriculum needs to help people to deal knowledgeably with health problems. In Tanzania, Biology is a compulsory science subject for all junior secondary school students (URT, 1995). The study of Biology at school is seen as a way of laying a foundation in the biological principles, skills, and knowledge that will be useful in students' everyday lives (URT, 1995). Biology is compulsory at junior secondary school level and after their junior secondary education, students move to advanced secondary school science where many of them specialise in courses that do not involve

Biology. However, the issue of quality science education has been a matter of ongoing concern in Tanzania and a number of projects have been introduced in the past fifteen years that aim to improve the quality of science education. All of these projects focus on improving the way that science education is delivered (Kitta, 2004; Mafumiko, 2004; Osaki, Hosea, & Ottevanger, 2004). But, despite these initiatives, little research has been done to find out whether these programmes really help students to develop biological literacy. In light of this, this study investigates the situation in junior secondary schools in Tanzania because that is the stage of schooling where Biology education is compulsory for all students.

Currently in Tanzania, questions are being asked about how secondary school Biology education should be delivered and various studies, workshops, and seminars have been conducted to explore how Biology education might be improved. One idea that has been widely discussed is the need to integrate societal issues into the Biology curriculum (URT, 2007). These ideas are in line with international trends in science education. For example, Osborne and Dillon (2008) argue that students need to be active participants in their learning rather than passive recipients of knowledge. Furthermore, they need to acquire the skills of critical thinking if they are to make informed decisions about the biological challenges they face in their everyday lives. As will be discussed further in later chapters, these are social constructivist approaches and they have been incorporated into the national secondary school curriculum in Tanzania. The aim is to link social constructivist thinking with what is learnt at school so that it mirrors, as closely as possible, students' everyday lives (URT, 2009b). In this study I ask whether these aims have, in fact, been achieved in urban and rural classrooms because, despite these initiatives, research in Tanzania shows that the quality of Biology education has not greatly improved. The reasons for this relate to a lack of basic facilities and low levels of motivation among students and teachers (Chonjo, Osaki, Possi, & Mrutu, 1996; Mabula, 2012; Mkumbo, 2012). The main measure of the quality of Tanzanian Biology education has been the performance of students in national examinations (Hakielimu, 2012). However, it may be argued that it is

difficult to conclude that students cannot make informed decisions on socio-scientific issues based on national examination results because the nature of national examinations is not, in fact, a good measure of such ability (Hakielimu, 2012).

In light of my own personal motivation and commitment to Biology education and taking into consideration the current status of Biology education in Tanzania and its disconnection from the lives of young people and their communities, this qualitative ethnographic case study research focuses on Biology education in Tanzania. The study explores the factors that support and constrain school Biology education in developing the kind of science literacy that equips students with decision-making skills that could help them to tackle some of the challenges directly confronting Tanzanian society. The next section presents the research questions that guided my exploration of biological literacy in Tanzanian schools.

1.1 Major research question

The over-arching question that guides this research is, “How does the implementation of Biology education in Tanzania support or constrain students in making informed Biology-related socio-scientific decisions in their everyday lives?”

There are a number of related questions that ‘fall out’ of this main question as follows:

1.1.1 Sub-research questions

- 1) Does the Tanzanian Biology curriculum support or constrain the development of biological literacy?

- In what ways does the Biology curriculum support or constrain the acquisition of knowledge and skills that allow students to make informed Biology related socio-scientific decisions about their everyday lives?
 - In what ways do pedagogical approaches constrain or support the acquisition of knowledge and skills that allow students to make informed Biology related socio-scientific decisions about their everyday lives?
- 2) What is the impact of the institutional context (school environment and availability of resources) as it relates to urban and rural secondary school environments in Tanzania, and, how does this affect the development of biological literacy and the acquisition of socio-scientific decision-making skills that could potentially be applied to everyday situations in these contexts?

1.2 Contribution of this study to science education

As has been noted earlier, many commentators have argued that improving biological literacy levels through effective, responsive and relevant teaching and learning activities can help students to make informed socio-scientific decisions (Jarman & McClune, 2007; Miller, 2011). This study sheds light on how Tanzanian students go about making biological decisions that affect their everyday lives. The findings provide an opportunity for me as a teacher-educator to contribute to developing policy relating to the Tanzanian Biology curriculum and to improving the quality of Biology teacher education in my own institution and beyond. This can be achieved by preparing student teachers who have a passion for teaching and who are committed to social transformation and change that will benefit students and their communities, especially in rural areas where the need is greatest. Also, on my return to my home country of Tanzania, I will contribute my expertise by participating in community programmes aimed at developing biological literacy so that people can make clear and informed decisions and choices about matters relating to HIV/AIDS, since I am also trained in that area. Generally, my intention is to inform people in Tanzania about the need to increase public levels of biological literacy, and I hope that many will subsequently be informed through a type of

'cascade effect'. By cascade effect, I mean that by informing at least one person, he/she will be able to disseminate the information to several other people; hence, the chain of knowledge will grow, connect, and strengthen individuals and their communities because many people will, in turn, be informed. In this respect, I genuinely believe that one person can make a tangible difference.

1.3 Organisation of the thesis

There are nine chapters in this thesis. In this introductory chapter, I have explained the background of the research in terms of my own personal motivation and outlined the rationale for this study.

In Chapter Two, I examine various definitions of biological literacy and discuss the definition I have used in this study. I provide contextual information about Tanzania, the country where this study was conducted.

Chapter Three outlines the theoretical framework for this study which draws mainly on social constructivism and social constructionist ideas. The qualitative methodologies applied in this study are discussed in Chapter Four.

In Chapters Five, Six and Seven, the findings of the study are presented. In Chapter Five, I introduce findings relating to students' perceptions about teaching and learning and the development of biological literacy. I also discuss students' views about the school curriculum in terms of content, teaching methods, assessment techniques, availability of resources, and extracurricular activities. Students' perceptions about young people's health challenges and needs in Tanzanian society are elaborated in Chapter Six. In Chapter Seven, teachers' perceptions about their pedagogical practices are examined and their views on the Biology school curriculum in their classrooms are elaborated.

In Chapter Eight, I discuss the findings from Chapters Five, Six and Seven. I describe these findings in relation to the influence of the school curriculum on students' development of biological literacy and explain how the school curriculum can both support and constrain students' acquisition of biological knowledge. The concluding chapter, Chapter Nine, presents a summary of the findings, discusses implications of the study, and makes recommendations for further study.

CHAPTER TWO

CONTEXTUAL BACKGROUND AND REVIEW OF THE LITERATURE

2.0 Introduction

This chapter provides a contextual background to the study and includes a review of the literature about school Biology and its relevance to everyday life in the Tanzanian context. It is divided into three main parts. The first part explores definitions of biological literacy and outlines how I have used this term in this research. The second section of the chapter examines the aspects of the Tanzanian context of this study and includes a discussion about the historical contexts of education in Tanzania, socio-economic influences on schooling, the structure of the schooling system in Tanzania and science education. The aim of this chapter is to show how cultural, economic, political and social factors can both support and constrain the development of biological literacy in Tanzanian schools. The third part of the chapter reviews the literature about the Tanzanian school curriculum and the pedagogical and assessment approaches that are in play. In addition, this part of the chapter explains the influence of extracurricular activities on learning, the debates about English as the language of instruction in Tanzanian secondary schools, and gender and streaming issues in Biology classrooms in Tanzania.

2.1 Definitions of scientific literacy and their relationship to biological literacy

There are various understandings about what scientific literacy means. I consider that biological literacy is a sub-set of scientific literacy and for that reason the working definition used in this thesis draws on debates about scientific literacy.

Uno and Bybee (1994) argue that a common understanding of a scientifically literate person is needed if educators, teachers and scientists are to achieve the goal of scientific literacy in science education. The term scientific literacy has been defined in different ways over time and is the subject of much debate (Holbrook & Rannikmae, 2009). Some authors define the concept as the acquisition of skills and

knowledge that are useful for everyday life situations (Uno & Bybee, 1994) while others define it as the ability to read and write scientific concepts (DeBoer, 2000). Britt, Richter, and Rouet (2014) argue that scientific literacy is the ability to understand and critically evaluate scientific content. Jarman and McClune (2007) define scientific literacy as having a knowledge and understanding of the scientific concepts and processes that are required for personal decision-making, participation in civic and cultural affairs, and economic productivity. Other authors define scientific literacy in terms of the ability to think scientifically and critically, being able to use scientific knowledge to develop decision-making skills, or to understand the nature of science (Fan & Geelan, 2013; Holbrook & Rannikmae, 2009).

Despite many attempts to define scientific literacy, its meaning is still debated. One specific aspect of scientific literacy that is used in this study is the notion that it involves educating young people so that they have a broad and functional understanding of science; and this is seen here as a different issue from preparing them, at more advanced educational levels, to enter specific science and technical careers (DeBoer, 2000). As some commentators argue, when a broad understanding of science is held by many people within a society, they have greater access to participating in the cultural, economic, and political life of their communities. In this respect, scientific literacy contributes to the work of participatory democracies (Miller, 2011; Smith-Greenaway, 2014). These ideas have guided my thinking in this thesis.

According to Shwartz et al. (2006), scientific literacy is a broad term that encompasses a range of scientific views and perceptions within and across scientific disciplines and practices. Biological scientific literacy is the focus of this investigation and is seen as a subset of scientific literacy. Biological literacy deals with the acquisition of biological attitudes, skills, and knowledge that allow people to participate in biological debates and develop problem-solving and decision-making skills in their everyday lives (Miller, 2011; Uno & Bybee, 1994). Uno and

Bybee argue that biological literacy is important because it helps people to think logically and critically about issues they encounter in their lives that involve biological problems or puzzles.

2.2 The Tanzanian context of this study

This study was undertaken in junior secondary schools in rural and urban Tanzania. The national, cultural, economic, political, and geographical contexts of schooling play an important role in the delivery of the Biology curriculum and these contextual factors are discussed in this section.

2.2.1 Location and historical overview

The United Republic of Tanzania (URT) is located in the eastern part of the African continent. The nation was founded in 1964 as a result of the union of two separate countries, Tanganyika and Zanzibar. The country shares borders with eight other countries. In the north, Tanzania is bordered by Kenya and Uganda, and by Rwanda and Burundi in the northwest. The Democratic Republic of Congo is located to the west; Zambia and Malawi lie to the southwest while Mozambique is in the south. The Indian Ocean lies to the east of Tanzania where the Zanzibar, Pemba and Mafia Islands are situated. The country has a total area of 885,803 square Kilometres with an estimated population of 44,928,923 (URT, 2013). Approximately 70.4% of the Tanzanian population lives in rural areas where the main agricultural activities are crop cultivation and farming (i.e., cattle, goats, sheep and poultry) and in coastal areas where fishing and related industries are the main form of income (URT, 2013).

Tanzania was colonised at different times by Germany (1886-1916) and Britain (1919-1961). In the early twentieth century, under the German colonial administration, Christian missionaries from Germany, and Muslims from other parts of the region established formal systems of education. A predominantly western style of education was established by Christian missionaries who saw education

both as a means of teaching their converts to read religious literature and as a vehicle for gaining new converts (P.A.K. Mushi, 2009). During German colonial rule, state schooling was restricted to a small number of individuals most of whom received an education to equip them for work within the colonial administration (P.A.K. Mushi, 2009). The public schooling system was racially segregated during the German colonial administration; Europeans were trained to be senior managers, civil servants and professionals, Asians were educated to occupy middle managerial positions, while Africans were downgraded to serve as assistants, teachers, nurses, and medical auxiliaries (P.A.K. Mushi, 2009). In this respect, the entire education system was designed to further the interests of the German colonisers both politically and economically.

German colonial rule over East Africa ended after the First World War and at that time a British mandate was introduced whereby Britain took control of the area that is now known as Tanzania, as a trusteeship territory. After the Second World War, the British extended educational provision for Africans although schooling continued to be heavily focused on serving the needs of the region as a primarily agricultural economy. During the British colonial administration, the education system also continued to be highly elitist. Educational provision was based on the priorities of the white settlers and continued to be segregated according to race, religion and gender (P. A. K. Mushi, 2009). For example, Europeans, Indians and Africans were educated in separate schools. In addition, the British colonial authorities were seen as playing different tribes off against each other in order to weaken the increasingly widespread nationalist movements. During this era, many Tanzanians who did not belong to any religious faith were also barred from receiving an education (P. A. K. Mushi, 2009). As P. A. K. Mushi (2009) notes, in the post-independence period, the newly elected Tanzanian government dismantled much of this system because it did not meet the needs of local Tanzanian communities.

In 1961, the region that later came to be known as Tanzania gained independence and the new government quickly established a wide-reaching educational policy that explicitly banned the practice of racial discrimination. In 1967, this policy was extended in what is famously known as the Arusha Declaration. It was named as such because it emerged out of a political movement that originated in the Arusha region of Tanzania. The Arusha Declaration aimed to eliminate racism in all sectors of Tanzanian government and society. Its primary purpose was to improve political, economic, and social conditions for the majority of Africans who had been left behind in terms of education during the colonial era. In 1967, a national philosophy of Education for Self Reliance (ESR) was launched under the Arusha Declaration. ESR became the guiding philosophy in the reform of the curriculum and aimed to make schooling more immediately relevant to learners by integrating abstract and theoretical thinking with practice. In line with this, a science curriculum that emphasised inquiry-based learning was imported from abroad to achieve the goal of ESR (Osaki, 2007). Wedgwood (2005) notes that the original intention of the ESR curriculum was to equip students with the skills required for self-reliance in rural life rather than for further academic education. Later, however, the priority shifted towards promoting a more academic curriculum that was intended to take the Tanzanian economy into the twenty-first century and beyond. The aim here was not only to equip young people to become effective rural labourers but also to encourage them to undertake further education.

The current Tanzanian curriculum continues to advocate ESR but in a more contemporary way (URT, 2009a). For example, while there is a continued emphasis in the curriculum on the integration of theory with the development of practical skills, there is a new commitment to student-centred learning geared towards helping young Tanzanians make informed decisions in their everyday lives (URT, 2009a). In light of this, the junior secondary school Biology curriculum also aims to develop students' scientific competency in various areas of their lives (URT, 2005). In this respect, education policy-makers in Tanzania consider that Biology education

needs to be contextualised and rooted in the students' cultural and social worlds (Haight & Gonzalez-Espada, 2009).

Since independence in 1961, the goal of improving science education through a range of interventions at all levels of education has been central to educational policy, and the importance of science for promoting sustainable development is widely recognised (Tanzania National Business Council, TNBC, 2009). In this regard, using the education system to promote scientific literacy is seen as a priority by many people and organisations both within government and beyond (Kisinja, et al., 2002; Mbeba et al., 2012; Mtengeti, Jackson, Masabo, William & Mghamba, 2008; TNBC, 2009). To improve science education, various nation-wide professional development programmes for science teachers have been established by the Tanzanian government over the years (Ottevanger et al., 2007). The Science Education in Secondary Schools Programme (1996-2003), for example, was offered to in-service science teachers to improve their pedagogical approaches in science education by emphasising practical work (Osaki, 2007). Another programme known as the Teacher Education in Mathematics and Science focuses on on-going reviews of undergraduate science teacher education programmes at the University of Dar-es-Salaam (Osaki, 2007). In addition, this group is involved in training postgraduates in science education and developing in-service teaching materials. Apart from these programmes, Christian Social Services has established the Science Teacher Improvement project focusing on the "Starter Experimental Approach" (Osaki, 2007). However, these programmes do not appear to have made a significant difference and Ottevanger et al. (2007) report that science education in Tanzania continues to face many challenges.

2.2.2 Socio-economic status

The Tanzanian economy is heavily dependent on agriculture which accounts for more than one-quarter of the GDP (Gross Domestic Product) (IFAD, 2011). Education is seen as one way of improving socio-economic conditions, especially in

rural areas where poverty is widespread (Wedgwood, 2005). Providing quality education and ensuring equal access to education for all Tanzanian citizens is also seen as a way of creating a well-informed population that will contribute to increased economic productivity and progress (URT, 2009b).

Central to an understanding of the situation in Tanzania, however, is an awareness of the massive disparities that exist between urban and rural education and between the education of the poor and the education of the wealthy (Wedgwood, 2005). Contemporary Tanzanian education policy is geared towards creating a 'knowledge society' that will emphasize creativity and innovation especially in areas of science and technology (URT, 1995). Afgan and Carvalho (2010) characterise a knowledge society as one that is able to distribute knowledge, provide access to information, and use information to create knowledge. This paints a picture of an ideal future society where everybody has equal access to information. However, at present, this is a far cry from the reality of most people's lives in Tanzania. In fact, as Evers (2002) argues, the knowledge gap has widened between rich and poor and between rural and urban centres at the same time as the knowledge society has been promoted in Tanzanian education policy. To become a knowledge society it is clear that we will first have to address issues of social inequality.

In addition, Tanzanian education policies have not yet fully addressed how educational disparities between rural areas and urban centres will be managed. Advocating a knowledge society is unlikely to have much impact if the country's social, cultural, economic and political situation is not taken into consideration. The section below discusses this issue further.

2.2.3 Disparities between urban and rural secondary education

Disparities between urban and rural education have been observed in many developing countries across the world. Agrawal (2014), for example, argues that young people in rural India lack quality education due to a scarcity of schools and

many are forced to travel long distances to attend their nearest school. Agrawal also comments that schools in rural India are more likely than urban schools to have inadequate facilities, such as there being no actual classrooms or toilets or access to clean drinking water, or a lack of basic classroom resources and technology. Similarly, in a study conducted in northern Africa, Boutayeb, and Helmert (2011) argue that young people in rural areas often live in poor conditions compared with their urban peers, and despite many initiatives aimed at improving economic, social and health conditions over time, there is still an economic gap between urban and rural communities. They note that this deprives rural young people of many educational and economic opportunities compared with their peers in urban areas.

If young people in Tanzania are to become scientifically literate then close attention needs to be given to rural education. Wedgewood (2005) argues that Tanzania, like many other developing nations, has a large gap in educational achievement in urban and rural education. In light of this, the Tanzanian government aims to improve educational access, equity, quality and delivery of secondary education across the nation through the Secondary Education Development Programme II (URT, 2010a). These efforts are hampered by a severe nation-wide shortage of science teachers and on-going problems with teacher recruitment and retention, but the situation is considerably worse in rural schools (Wedgewood, 2005). Wedgewood's argument is supported by the IIEP (2006) which notes that many teachers are reluctant to live in rural areas because of the poor standard of accommodation and teaching facilities as well as having very limited access to health and leisure than in urban centres. With fewer science educators available, the workload of existing science teachers increases and this has an impact on the quality of the classroom experience. Additionally, in classroom environments where the teacher-student ratio is high, it is difficult for science teachers to use effective student-centred pedagogies (Jones, 2007).

Aside from classroom and school disparities, many students in rural areas face significant economic and social challenges compared with their urban peers. For

example, rural families generally have lower incomes and less formal education than people living in Tanzanian cities and they have limited means with which to support their children's schooling (Taylor & Mulhall, 2001). Indeed, in some rural areas, students are forced to rent rooms for accommodation because their schools are far from their homes; often there are no boarding school facilities available (Wedgwood, 2005). Most of these students live in poverty; they need to work long hours after school to earn money for rent, food and basic survival (Wedgwood, 2005). Many parents also need their children to help them with agricultural activities which increases school absenteeism, particularly at certain times of the year such as during harvest time (Taylor & Mulhall, 2001). In addition, many homes and schools in rural areas are ill equipped to meet students' learning needs; for example, they often lack electricity or families do not have ready access to clean water (Taylor & Mulhall, 2001). These young people's lives differ markedly from students in urban areas, many of whom have privileges, like good facilities in schools and homes, and their families tend to be more affluent (Wedgwood, 2005). The disparities between urban and rural educational and social environments contribute to these inequalities in education provision between rural and urban areas and are responsible for a lower level of biological literacy in rural areas (Wedgwood, 2005).

2.2.4 The Tanzanian education system

The Tanzanian education system is divided into three sectors: primary (7 years duration); junior secondary (ordinary level, 4 years duration) and senior secondary (advanced level, 2 years duration); and tertiary (2+ years). Most infants between the ages of 0 and 6 years attend pre-primary education which is provided through day-care centres, nurseries, kindergartens, and pre-schools although many remain at home. There is greater access to pre-school education in urban areas however, and pre-school attendance is patchy or non-existent outside the cities.

Although primary education is compulsory for all Tanzanians, not all students attend school and this is usually because of economic or social constraints (Wedgwood, 2005). When students successfully complete their primary education they can progress to secondary education while others who fail to matriculate do not continue with further education. Sometimes the successful completion of primary education does not lead to secondary education and this is particularly the case in rural areas because the cost of private schooling and the limited number of free places in state schools is prohibitive for many families (Wedgwood, 2005). On the other hand, those urban families who are relatively well off can afford to send their children to private schools if they do not get into government schools (Wedgwood, 2005).

'Ordinary' secondary education is a form of public schooling that is offered to students who have successfully completed their primary education. In addition to schooling, there are also private secondary schools that enrol students provided they have passed the entrance examination. Sometimes students are selected for private schools even though they have not qualified to study in government schools because their parents can afford the school fees. There are also students whose parents prefer to pay for private school secondary education even if their children have been selected for government secondary schools. This is because some private schools provide a more prestigious education and this is especially the case for missionary schools, which are often equipped with superior resources and learning environments compared with most government schools. There are two types of private secondary schools in Tanzania; firstly, there are a few well-funded, elite and well-equipped private schools most of which are missionary schools. However, some private schools have a lower quality of teaching and fewer facilities than many government schools. Many of these less well-resourced private schools have a poor reputation due to poor achievement rates in national examinations. In these schools, school fees are kept low to allow children from local communities to attend, but the problem is that there are often insufficient funds to acquire educational resources. There are also cases where students have met the academic

criteria but do not have access to secondary education because of a shortage of places in government secondary schools.

In the first two years of junior secondary education, students study a range of compulsory subjects including English, Swahili, basic Mathematics, Civics, Biology, Geography, History, Chemistry, Physics and sometimes Book-keeping, and Commerce. Some schools offer electives such as French, cookery, and fine arts. At the end of the second year of junior secondary school students sit national examinations. These examinations are important because afterwards students are sorted into disciplinary streams for their third year of secondary schooling. There are three main streams at this stage which are: science, arts, and commerce. Most schools offer only arts and science streams, however, because of the scarcity of Commerce teachers. Students in all streams take seven compulsory subjects including Biology. Science stream students take additional science subjects such as Chemistry and Physics, while in the commercial stream; students can study additional subjects such as Bookkeeping and Commerce.

At the end of junior secondary school, students sit national examinations that select students to advance secondary school studies. At advanced secondary school, the science curriculum is divided into three major subject-combination, such as Physics, Chemistry, Biology (PCB), or Chemistry, Biology, Geography (CBG) and so on. At the end of these two years of advanced secondary school education, most students will sit yet another national examination. Students who successfully complete advanced secondary school can progress to further studies in tertiary education, either diploma studies or degree studies.

2.2.5 Overview of science education

Coll and Taylor (2008) argue that most developing post-independence nations need to establish a coherent framework for educational decision-making that will guide the creation of policies and strategies that cater to societal needs and challenges as

well as meeting global demands. In addition, schooling systems in developing countries, like Tanzania, with a history of British and German colonisation, often retain a pervasive western influence long after independence has been granted. In Tanzania, many initiatives aimed at creating a closer fit between westernised schooling and Tanzanian cultural and community contexts have been established over time but many challenges still remain. In terms of science education, Semali (2014) argues that a much more culturally responsive curriculum is needed that has a particular focus on skill and knowledge development in secondary schools, and is tailored to meet the needs of Tanzanian communities.

In formerly colonised nations, Shumba (1999) contends, science education initiatives frequently do not foster on-going scientific literacy amongst local, tribal and indigenous populations. He argues that the relevance of western science and western teaching approaches to local contexts requires thoughtful and critical examination. The problem, he suggests, lies with education authorities in previously colonised countries who consider western science education to be more modern and superior to local models of science education and traditional knowledge systems. Consequently, they develop policies that encourage people to abandon their own values and cultural practices. Shumba argues that a better way would be to accommodate western science education as a supplement to locally developed initiatives rather than as a substitute for them.

Since the 1990s, Tanzanian education policy has linked high quality education and training with social development (URT, 1995). In addition, as noted earlier, contemporary Tanzanian education policy is underpinned by the belief that investment in education has a high correlation with the creation of national wealth (URT, 2005). However, despite these beliefs, the reality of educational practice in schools and communities across Tanzania is much more complex and diverse. In Tanzania and other African nations, many initiatives aimed at poverty reduction through education have been under-resourced and of poor quality (Sumra & Rajan, 2006). Perhaps this is because some political leaders often seem to think about

education from an ideological and political perspective and see it primarily as a means of increasing national economic and social development. Political leaders need to broach educational issues with a comprehensive understanding of the lives of the poorest and most marginalised communities that are often overlooked in the drive to develop national economies. Beyond the political rhetoric, many political leaders do not fully recognise the complexity involved in improving the quality and quantity of education in a highly diverse nation (Sumra & Rajan, 2006).

Sumra and Rajan (2006) highlight the issues of poor planning when government authorities attempt to improve national education systems. They argue that the Tanzanian education system, like many other countries in Africa, is focused on quantifying what goes into education (in terms of funding and resources and examination results) rather than looking at the outcomes of new initiatives for diverse communities. In this respect, they argue, there is a disconnection between the outcomes of education and the conceptualisation of education (Sumra & Rajan, 2006; Vavrus & Bartlett, 2013). Thus, for example, education policies and syllabi may well be carefully and thoughtfully written but the implementation of policies and curricula is sometimes poorly executed. In this respect, Tanzanian education policy and the secondary school curriculum have been carefully aligned with national and international educational trends' but the problem is how to translate those ideas into reality on the ground and produce problem-solving graduates who can survive in a fast-changing world (Sumra & Rajan, 2006).

The national education policy of Tanzania maintains a strong focus on citizenship (URT, 1995). In science education, citizenship is framed by the concept of scientific literacy and the need to develop a scientifically literate citizenry (Hodson, 2014). In line with Hodson, I argue that a scientifically literate citizen needs to be able to make informed decisions about socio-scientific issues. In Tanzania, ideally, the science curriculum needs to be responsive to the needs of the students; and in that respect, teachers need to think about the science curriculum in terms of how it can best serve the needs of students who are themselves members of communities and

a society that has its own particular challenges and priorities. Teachers therefore need to be familiar with the range of biological and health-related issues that students experience in their daily lives. For this aspiration to be realised, I shall argue that a strong level of public commitment to biological literacy needs to be central to the science curriculum. Biology is a compulsory subject in Tanzanian junior secondary schools (URT, 2007) but as Laugksch (2000) argues, most Tanzanian students do not go on to become Biology specialists in their later lives, so the school curriculum needs to identify and prioritise those aspects of the Biology curriculum that are most relevant to the students. These priorities differ in different parts of Tanzania.

2.2.6 Health challenges faced by Tanzanian young people

According to 2012 census estimates, young people between the ages of 15 and 24 years comprise approximately 20% of the Tanzanian population (URT, 2013). The majority of this population live in rural areas (IFAD, 2011). The comparative youthfulness of the population places an additional responsibility on the Tanzanian government to ensure that the physical as well as social, and economic wellbeing of youth are taken into account in government policy. Kaptan and Timurlenk (2012) support the notion of biological literacy amongst young people for this reason.

Many of the most common challenges that Tanzanian young people face are related to their health. These include communicable diseases, non-communicable diseases, and sexually transmitted diseases (STIs) amongst others (Kwesigabo, Mwangu, Kakoko, & Killewo, 2012). These problems are exacerbated by a range of factors including a lack of education about health issues (Kwesigabo, et al., 2012). For example, Kwesigabo et al. (2012) argue that prevention and control of health problems sometimes requires interventions beyond health sector programmes and initiatives. They contend that public education is needed and that schools need to play a role in educating young people about human Biology so that a greater understanding of individual and community health can be fostered.

In Tanzania, young people also face various reproductive health issues such as unprotected sex, a lack of awareness about the consequences of unprotected sex, and a lack of counselling services relating to reproductive health among youth (Mbeba et al., 2012). The lack of reliable information about reproductive health is considered to be closely linked to unplanned pregnancies, HIV infections, and STIs amongst young people and rates are especially high amongst those living in rural areas (Mbeba et al., 2012; URT, 2010b).

Many young Tanzanians lack a basic education about disease prevention and treatment. Many others do not have the biological literacy they need to make informed choices about a range of cultural practices that directly affect their wellbeing, such as early marriages or FGM (Shemsanga, 2013). Some of the cultural practices that pose a risk to human health continue to be part of life in Tanzanian communities, so in this respect schools can make a useful contribution to providing students with information about staying healthy. Certainly, Fonner, Armstrong, Kennedy, O'Reilly, and Sweat (2014) argue that sex education in schools can effectively promote more healthy sexual practices. Leshabari and Kaaya (1997) note that many young people lack basic information about human Biology and they attribute this to a lack of formal and informal education both in schools and in the home. This is problematic because as Kajula, Sheon, Vries, Kaaya, and Aarø (2014) found, young people often find it difficult to talk about sexual matters with responsible adults such as parents. Shemsanga (2013) contends that this lack of information from significant elders contributes to a culture of silence about sex and sexuality that is widespread in Tanzanian society.

For these reasons, having access to accurate and reliable information about sexual issues is a major challenge for young Tanzanians. Leshabari and Kaaya (1997) argue that most young people learn about sex from their peers who are often themselves very ill informed. They argue that this becomes a case of the “blind leading the

blind” (p. 35). On the other hand, the evidence suggests that well-educated peers can also play an important role in disseminating information about health issues to their friends and this may well help with reducing the incidence of HIV infections amongst the youth (URT, 2001).

Despite various HIV/AIDS awareness initiatives, Tanzania has a very high prevalence of HIV infection amongst young people (URT, 2010b). According to Hellandendu (2012), poverty, risky cultural practices, health inequalities and a lack of knowledge are responsible for continued prevalence of HIV. Political corruption is also a factor in the HIV/AIDS epidemic, for example, health funding for the treatment of the disease is sometimes misused by officials and politicians; the sale of counterfeit medicines to the public is also a corrupt practice that is widespread in some areas. Kisinza et al. (2002) argue that stigmatisation and discrimination against people with HIV/AIDS have a profound impact on the spread of the disease. For example, some people refuse to check their HIV status for fear of being judged and discriminated against if they have the virus (Kisinza et al., 2002). Furthermore, it continues to be the case that some people who have HIV/AIDS are not honest with their sexual partners about their HIV status (Kisinza et al., 2002).

Risky sexual behaviour increases the spread of HIV (Busza, Besana, Mapunda, & Oliveras, 2013) but poverty is also cited as another major factor in increased HIV infections. For example, some young people living in poverty become sexually active as a means of survival. Some turn to prostitution in order to survive but many sex workers operate in environments where AIDS prevention is not practised (Hellandendu, 2012). In some cases, young girls engage in sexually risky behaviours with parental consent because it pays for basic needs such as school expenses or food. In other instances, condoms are too expensive or are not made available to young people.

Other risky cultural practices are also common in some Tanzanian communities. For example, in some areas, traditional ceremonies are carried out that involve male circumcision, female genital mutilation (FGM), and widow inheritance. The unhygienic conditions under which some of these activities take place can also increase the risk of HIV infection (Gausset, 2001). According to Gausset, it is more effective to provide education that informs people about safer ways of carrying out traditional cultural practices rather than attack African cultural values or norms themselves. Gausset argues that rather than completely abandoning cultural practices or traditions and replace them with western cultural practices and beliefs; it would be more effective in the long run to look for ways of modifying traditional practices for the betterment of health and wellbeing of the society. For instance, instead of government or educational authorities (who are often community outsiders) insisting that people should abandon traditional male circumcision rituals altogether, they might instead ensure that community members are shown how to use disposable blades during circumcision ceremonies that are discarded after each circumcision, which is a much safer practice. This would not in any way address some of the ethical, moral and cultural issues relating to these practices, but it would at least reduce the spread of disease.

Another area where biological literacy is important and relevant to this research is climate change and its impact on health. Climate change is a global issue but different countries experience the impact on human and environmental health in different ways. Hanna and Spickett (2011) argue that climate change has a direct environmental impact which leads to extreme changes in temperature and rainfall causing heat waves, fires and flooding. The indirect impact of climate change affects environmental conditions such as water, air, food production and vector-borne diseases and other infectious diseases (Hanna & Spickett, 2011). Both the direct and indirect effects of climate change increase health risks to human beings. Changes in rainfall as a result of climate change also affect the spread of diseases such as malaria and diarrhoeal diseases (Haines et al., 2006). In countries like Tanzania, where malaria is common, there is a need to establish strategies to manage the

damage done by climate change in order to prevent occurrence of these diseases. Mahaffy, Martin, Schwalfenberg, Vandenbrink, and Eymundson (2013) suggest that climate literacy is particularly significant for African students and teachers. They argue that because Africa is more vulnerable to climate change, the current modelled impact of this change is likely to affect water availability which is a major concern. Related to this is the fact that changes in rainfall patterns are likely to adversely affect agricultural and economic productivity and this would increase the risk of widespread food shortages (Mahaffy et al., 2013). World Health Organisation (2013) statistics highlight that health issues may be exacerbated by climate change, particularly resulting in higher child mortality. Young people therefore need access to reliable education in their science classes at school and for this reason, I argue that climate change education should be a priority in Tanzanian schools.

Hanna and Spickett (2011) argue that the impact of climate change on human health needs to be contextualised according to the burden it places on human health and the spread of disease as well as the increased demands that are placed on health-related public infrastructure. For instance, the ability of developing nations to mitigate the effect of an increase in malarial illnesses that maybe a consequence of climate change depends on establishing sustainable programmes to control these diseases (Haines et al., 2006). Haines et al. (2006) contend that the diseases caused by climate change in developing countries such as Tanzania mainly affect young people and they argue for cost-effective intervention in health and other sectors that deal with human health and climate change. With this in mind, the education sector can also play an important role in equipping young people with knowledge about the impact of climate change on human health.

A separate but related issue concerns the debates about biotechnology. Biotechnological knowledge is still a relatively new phenomenon; however, it is important that Tanzanian peoples are able to contribute, to and participate in public debates about biotechnology. Usak, Erdogan, Prokop, and Ozel (2008) contend that biotechnological issues highlight the importance of public discussion

and debate about ethics, the associated risks of biotechnology and the overall usefulness of new products such as food and medicine that is produced biotechnically (see also Conner, 2000). In this regard, people need to be aware and well informed about biotechnologically engineered products that are available to them so that they can make informed choices about their use (Usak et al., 2008). Usak et al. found that most young people are not well informed about these matters and I argue in this thesis that schools have a role to play in informing young people about developments and debates in the field.

Efforts to improve young people's health involve many government systems in Tanzania including the education sector. Secondary school Biology education can help students to understand and deal with biological challenges that confront their communities, but more work needs to be done to bring this about (Leshabari & Kaaya, 1997). Boger, Yule, and Sparrow (2013) argue that well-informed Biology teachers are needed to provide education and psychological support to students. Overall, the literature shows that junior secondary students in Tanzania face many health-related challenges and that education is needed to prepare them to confront the issues in an informed and biologically literate fashion.

2.3 Using the curriculum to promote biological literacy

In the international academic literature, biological literacy is viewed as a primary goal of Biology education (Coll & Taylor, 2009). Abimbola and Abidoye (2013) highlight the following goals for Biology education:

1. To provide basic literacy in Biology for functional living.
2. To acquire essential scientific skills and attitudes as a preparation for the technological application of Biology.
3. To acquire basic concepts and principles of Biology as a preparation for further studies.
4. To stimulate and enhance creativity.

These authors place considerable value on the importance of Biology in everyday life and the need for students to develop biological literacy both to function effectively within society and to contribute to it constructively. Selvi (2007) argues that the school curriculum plays a crucial role in this respect (see also Conner, 2004). Schooling systems across the world, however, continue to face the challenge of a lack of student interest in school Biology and many teachers struggle to find ways of making the subject relevant to students' lives. The issue for policy-makers and teachers is to ask what needs to be included in the school curriculum that is useful and relevant to the members of that society. Coll and Taylor (2009) argue that this requires a careful investigation into the societal challenges that face young people and the ways schools, through the medium of the curriculum, can help them to confront these challenges.

Selvi (2007) contends that curriculum issues relating to content, pedagogy, and assessment need to be shaped by the relevance of curriculum material to the present and future lives of students. The Biology curriculum in Tanzania emphasises the need for students to acquire relevant information about biological science for life-long learning (URT, 2005), but this does not always happen in practice. Although national curriculum documents do not explicitly refer to biological literacy *per se*, it is implied that students will develop useful knowledge and life skills. The following section focuses on biological literacy as a component of scientific literacy in Tanzanian secondary school education.

2.3.1 Content

Chamany, Allen, and Tanner (2008) note that some science educators have concerns about shifting the educational focus away from more abstract biological principles and concepts towards an emphasis on applying biological knowledge to social issues. They argue that students need time to reflect on the social usefulness of the biological concepts they learn at school and suggest that an awareness of social contexts can be woven into Biology content. For example, learning about

sickle cell anaemia may not appear to be immediately useful or interesting to students; however, if teachers use the teaching of sickle cell anaemia in the context of genetic screening programmes in hospitals, learning may seem more relevant and meaningful. In this way, students can see the real life applications of biological principles and concepts in relation to social issues.

Haight and Gonzalez-Espada (2009) contend that the Biology curriculum needs to be rooted in the culture and experiences of the students' society. They argue that Biology education needs to meet the demands and challenges of the society in which it is situated. The problem for former colonies in the developing world is that schooling often owes more to the legacy of colonisation than to a genuine engagement with indigenous cultures and peoples (Shumba, 1999). This is largely because western ideas are often adopted uncritically and without much contextualisation (Abrams, Taylor, & Guo, 2013; Shumba, 1999). With reference to Tanzanian society, there is a need to identify the biological issues that are major social concerns such as malaria and HIV/AIDS. Students need to learn what causes malaria and how to avoid contracting the disease. They also need to learn about the influence of the disease on individuals and their communities. In this respect, Chamany et al. (2008) argue that the contextualisation of curriculum content can help students to see the relevance of studying Biology at school.

The Tanzanian Biology syllabus in junior secondary schools emphasises the importance of developing students' competency in different areas of their lives (URT, 2005). In particular, it addresses two major goals of science education which are preparing students to be experts and to increase their biological literacy (URT, 2005). The main intention of the syllabus is to equip students with competencies for their future lives. In line with this, the syllabus identifies the skills and knowledge that will be taught in classrooms and the attitudes that need to be developed. In addition, the specific objectives, teaching strategies, assessments and resources to be used are set out in full.

The Tanzanian Biology syllabus is divided into four levels (URT, 2005). In Year One of their junior secondary education, students are expected to acquire skills and a knowledge of the basic principles of Biology. At this stage of schooling, students learn biological procedures, the classification of organisms, and the appropriate use of biological concepts. Students also learn about preventive measures and precautions against common accidents, infections and related health problems but in the main, sexually transmitted diseases or infections that come about as a result of specific cultural practices are not discussed. In Year Two of junior secondary education students are taught about sustainable interactions between organisms and their natural environments. In Year Three, students learn about various physiological processes in plants and animals. The syllabus also promotes the development of positive attitudes towards community, social values and skills about how to deal with a limited range of health-related problems. In Year Four of junior secondary education, the knowledge and skills learnt during the previous three years are consolidated and students also learn the principles of genetics and evolution. This study explores how successfully schools are communicating these ideas to students.

The Tanzanian junior secondary school Biology syllabus objectives state that students shall develop the appropriate skills and knowledge they need to carry out biological investigations, including the recording, analysis, and interpretation of biological data. In addition, students are expected to use technology to access appropriate information in Biological science. The syllabus does not, however, provide guidelines for teachers to help students to develop the decision-making skills that would help them to make informed decisions about the biological issues that they encounter in their social worlds outside of school. These are the sorts of skills that would allow them to participate meaningfully in public debates, and make decisions about scientific issues that they are likely to encounter in their everyday lives (ICSU, 2011).

2.3.2 Pedagogy

The previous section reviewed issues of curriculum content and its contribution to students' development of biological literacy. This section reviews the research on pedagogical practices in Tanzania.

Over the past three decades, student-centred teaching practices have been promoted internationally as a preferred pedagogical approach for student learning (Zeilder, Sadler, Simmons, & Howes, 2005). Student-centred learning in Biology, it is argued, encourages curiosity and this is important in developing students' ability to participate in social decision-making about Biology-related issues (Kolstoe, 2010; Staver, 2007). Mabula (2012) argues that in Tanzania, however, classrooms tend to be highly teacher-centred and the curriculum is frequently delivered by the lecture method. The main reasons that teachers in Tanzania give for adopting these more traditional approaches are: a lack of time to develop and implement student-centred approaches, inadequate teaching facilities and resources, an already overcrowded curriculum, heavy assessment schedules, and a lack of familiarity with student-centred pedagogies (Mabula, 2012; Osaki, 2004; Ottevanger, et. al, 2007).

Schweisfurth (2011) has argued that when educational ideas, like student-centred pedagogies, enter public policy in developing nations, they are often imposed on teachers without consultation and due consideration for the realities of teaching children who live in extreme poverty. For example, Jones (2007) argues that student-centred methods are more suitable for smaller classes of around twelve pupils. In Tanzania, however, class sizes are typically very large; many have 50 to 80 students or more. One approach that may be possible in this sort of environment would be to give a measure of control over learning to students and encourage them to learn from their peers, although this is more likely to be effective in urban schools where resources tend to be better (Kessler & Agert, 2012). Kessler and Agert's Tanzanian research found that learning from peers promotes students' confidence and that peers can be good role models. In addition, they found that

learning from peers changes young people's attitudes towards gender relations. Educating young people to discuss issues related to sexuality in a mixed gender setting is an effective practice that promotes development of biological literacy in some Tanzanian schools (Kessler & Agert, 2012). How these ideas might work in rural schools is not known and further research is therefore needed.

Tanzanian secondary school Biology teachers are expected to be conversant with a competency-based curriculum and their task is to ensure that students have acquired the required skills and knowledge (URT, 2010a). In addition, they are also required to use a range of techniques and methods to facilitate student learning (URT, 2010a). These expectations are explicit in curriculum policy documents and the assumption is made that teacher education programmes will adequately prepare teachers to achieve this. However, the reality is, as Osaki (2004) suggests, that Tanzanian teachers are not well prepared to deliver the curriculum as intended. Osaki points out that in most teachers' colleges inadequate teacher preparation is linked to an over-emphasis on building teachers' content knowledge rather than developing strong pedagogical skills. Osaki also attributes a degree of teacher incompetence to the quality of the student intake in teachers' colleges. Candidates with poor educational backgrounds who would not be accepted in the university teacher education programmes are currently being accepted and trained in diploma colleges. Other teacher education problems include the nationally available 'induction training and licensing programme' which makes it possible for advanced level (Form Six) candidates to become teachers through a one-month induction programme. This short period of induction is insufficient to prepare most teachers for the classroom environments they will be working in (Osaki, 2004).

2.3.3 Assessment techniques

Assessment is an important aspect of education accountability in terms of monitoring student learning and progress and evaluating the quality of what is taught (Moeed & Hall, 2011). It is also important as a means of ascertaining

whether the science education goal of biological literacy is being achieved. The major question we need to ask is “Are the current assessment practices adequate to evaluate students’ decision-making ability on socio-scientific issues? In most sub-Saharan African countries, the focus of assessment policy documents is on school-based assessments that focus on investigations, group work, and journal entries (Ottevanger et al., 2007). Ottevanger et al. argue that alternative approaches to pen and paper examinations, such as internal assessment, are better ways of assessing whether students are developing the requisite knowledge and skills and ways of understanding the content. The major obstacle to the implementation of school-based assessment in Tanzania is that high stakes national examinations are a high priority and school-based assessment is seen as less of a concern. Moreover, Ottevanger et al. (2007) argue that a lack of teacher understanding about developing sound school-based assessment systems is a further obstacle to implementing this form of assessment.

In Tanzania, recommendations are made in official Biology curriculum documents that teachers assess a range of skills, such as students’ ability to identify and explain various biological concepts and principles (URT, 2005). Students are assessed on their ability to make accurate observations and to carry out simple experiments (URT, 2005). The most common form of assessment in Tanzanian schools is a test that is administered at the end of each unit, although this usually only measures how much students can recall (Sumra & Rajan, 2006). At the end of each level of education, students sit national examinations which are also heavily focused on memorisation and recall (Sumra & Rajan, 2006). This in turn perpetuates the practice of training students to pass examinations rather than getting them interested and engaged in the subject. As with many memory-based assessments, students tend to forget what they have learnt shortly after examinations have been completed (Sumra & Rajan, 2006).

The introduction of the national science practical examinations known as ‘Alternative to Practical’ in the 1980s ended the use of practical work in many

secondary schools (Osaki, 2007). The practical examination was replaced by a written examination in the final year of secondary schooling (Year Four). It is expected that practical work will continue to be carried out in schools but because it is no longer assessed as a practical examination that contributes towards the final grade, teachers tend to focus on preparing the students for the theory-based examinations.

Due to a large amount of content to be covered in a short period of time, teachers often try to rush through the curriculum as quickly as possible in order to cover all the material needed for the examination. This is often done at the expense of student learning and engagement (Ottevanger et al., 2007). For many teachers, the simplest way of covering large content in a short time is to use methods that do not encourage student involvement, such as lecturing. Consequently, students have difficulty in understanding the relevance of the concepts, theory and principles of Biology they learn and the use they have in their daily lives.

The next section explores the learning opportunities offered through extracurricular activities.

2.3.4 The role of extracurricular activities in developing biological literacy

In this thesis, I argue that extracurricular activities can help young people to develop life skills. In Tanzanian schools these activities are usually offered outside of school hours. In Massoni's (2011) view, these activities can lead to a positive change in student behaviour, better grades, and the acquisition of socio-scientific skills. He argues that it may also lead to gains in student confidence and better problem solving skills. Lunenburg (2010) contends that participation in extracurricular activities helps students to make links between new knowledge and real-life experiences. Mгимwa and Thulstrup (2011) suggest that students' engagement in extracurricular activities may enhance critical thinking about healthy lifestyles. The

literature reviewed in this section indicates that extracurricular activities may help Tanzanian students to broaden their knowledge and develop useful skills.

The secondary school curriculum in Tanzania includes a range of extracurricular activities such as sports, school clubs and athletics which are promoted by each school individually and differ from school to school depending on the interest of students, school management and staff (Osaki, 2000; Rutagumirwa & Kamuzora, 2006). These activities are voluntary and informal and are not assessed. Mgimwa and Thulstrup (2011) argue that extracurricular activities provide models of positive and healthy life styles to young people and are important in connecting schools with their local communities.

School clubs in Tanzania cater to a range of interests. For example HIV/AIDS clubs play an important role in improving Biology education in schools. These clubs can be initiated by individual schools but most of the time they involve a collaborative relationship between schools and non-governmental organizations (NGOs) or sometimes the Ministry of Education. An example of one such club is Fema. This school club runs in many schools and is organised by the Femina Health Information Project, which is a NGO. Fema aims to promote healthy lifestyle choices, and knowledge about reproductive health (Mgimwa & Thulstrup, 2011). This particular school club is discussed further later in this thesis.

2.3.5 The language of instruction in Tanzanian schools

The language of instruction in Tanzanian schools is the subject of ongoing debate (Qorro, 2013). The reason for this is that Swahili is the medium of instruction in primary schools (Sumra & Rajan, 2006) but a legacy of British colonisation is the continued use English as the language of instruction in secondary schools (Swilla, 2009). The change from Swahili as the medium of instruction at primary school to English at secondary school is underpinned by the misguided belief that students who have learnt English as a school subject at primary school will be proficient

enough in English to cope with it as the medium of instruction in secondary schools (Sumra & Rajan, 2006). Qorro (2013) argues that students lack proficiency in English because about 99% of young people are taught in Swahili during their primary education years. In addition, Swahili is the first language for most Tanzanians and is in fact, the lingua franca of Tanzania (Sumra & Rajan, 2006). For most students, it is a substantial leap to speaking English at secondary school. In Qorro's (2013) view, a widespread lack of English proficiency hampers students' learning at secondary school level and makes communication between teachers and students difficult. The language debate in Tanzanian schools may well have an impact on the development of biological literacy because secondary school Biology is taught and studied in English, a language that many students struggle with.

2.3.6 Gender and Biology education

Studies show that there are differences between boys and girls in their interest and attitudes towards science (Jones, Howe, & Rua, 2000). The evidence suggests that of the science disciplines, Biology tends to attract more girls than boys. Jones et al. argue that there is a socio-cultural reason for this in that in Tanzania male and female roles are culturally and socially defined; girls are entrusted with the roles of supporting and caring for others whereas boys are seen as being more interested in competitive activities and sports (P. S. D. Mushi, 1996). Girls and boys bring this social conditioning into their schooling with girls more often choosing the so-called soft topics of which Biology is included, while boys tend to opt for Physics and Chemistry. Although girls are more likely to enrol in Biology, boys tend to outperform them in examinations, particularly in co-educational schooling environments (P. S. D. Mushi, 1996). Meena (1996), however, has found that given a favourable environment such as boarding schools, girls can perform equally well or better than boys in Biology.

2.4 Chapter summary

This chapter has outlined aspects of the Tanzanian educational, economic and social contexts. The influences of socio-economic status, disparities in urban and rural education and the structure of the education system have been discussed. Tanzanian schools face many challenges but this study focuses on the biological challenges of health and related issues.

Much of the international literature on pedagogy comes from research that has been conducted in developed nations with much longer histories of political independence than many African nations. Many post-independence nations in Africa carry the legacy of former colonial administrations in their schooling systems and many African nations also rank high on the United Nations Human Poverty Index. Poverty and colonisation in Africa have a profound effect on every aspect of education and while the international literature on science education carries considerable weight, it does not always speak to the realities of schooling in developing nations. In Tanzania, environmental and curriculum contexts differ enormously from those of developed countries. Official curriculum policy documents in Tanzania advocate student-centred teaching and the application of social constructivist pedagogies in schools, and this is in line with educational thought internationally. But the endemic problems of education in Tanzania, such as inadequate teacher training and professional development, large class sizes, controversies over the language of instruction, disparities between rural and urban education often lead to teacher-centred pedagogies being the default position. The exploration of biological literacy in this thesis shows that teaching and learning are very closely linked to the cultural, economic, geographical, and social contexts of schooling and this is discussed further in the findings chapters.

The next chapter discusses the theoretical framework of this study which is based on social constructivism and social constructionism. Constructivist theories of learning favour student-centred teaching and these ideas can be connected to

Tanzania's ESR policy, which are promoted in the Tanzanian curriculum (URT, 2009a). In this respect, there is a degree of resonance between the post-independence ideals of Tanzanian society as discussed in this chapter and the international literature on learning. These concepts are explored further in the next chapter.

CHAPTER THREE

THEORETICAL FRAMEWORK

3.0 Introduction

This research is informed by two separate but related theories of learning; namely, social constructivism and social constructionism. In the first section of this chapter I discuss these theories and identify the key theoretical principles that have guided my thinking throughout this study. In the second and third sections of the chapter, I explain how social constructivism and social constructionism are applied. The fourth section outlines how these ideas are used in the Tanzanian educational context.

One of the main reasons that social constructivist theory is used in this study is that this approach has been adopted as a theory of learning in the Tanzanian secondary school curriculum (URT, 2009a). In order to make sense of everyday practices in the Tanzanian Biology classroom, an understanding of the theory that informs the official educational policies that surround school Biology in Tanzania is therefore important. The extent to which these ideas actually inform teaching and learning in Biology classrooms is, however, open to debate and this is an issue that is explored further in later chapters of this thesis.

A related theoretical framework, known as social constructionism, has also been selected to inform the study because these ideas allow me to incorporate social-cultural and historical analyses into my exploration of the Tanzanian contexts of schooling (Burr, 1995; Conrad & Barker, 2010; Young & Collin, 2004). The responses of people within school communities are central to this research and social constructionism has been used as a theoretical lens through which I have analysed and interpreted this kind of data.

3.1 The principle that learning is personally constructed but socially mediated

Before discussing how social constructivism and social constructionism are used in this study, it is important to differentiate between the two theories. Burr (1995) argues that the terms social constructionism and social constructivism are sometimes used interchangeably, although Young and Collin (2004) contend that despite the similarities between them, the two terms reflect different theoretical worldviews. Young and Collin note that constructivism is concerned with meaning making and the construction of knowledge by an individual, while social constructionism, on the other hand, focuses on the construction of meanings and knowledge that emerge through social interactions and negotiations. Hruby (2001) refers to constructivism as being a more psychological approach to knowledge production while social constructionism often takes a more sociological approach (as indicated in Table 3.1 below).

Table 3.1 Comparison between social constructivism and social constructionism as constructs of knowledge production

Social constructivism	Social constructionism
Psychological description of knowledge; knowledge produced within the individual mind through social processes (Hruby, 2001).	Sociological description of knowledge; knowledge produced through social interactions between the participants in social relations (Hruby, 2001).
The process of knowledge construction occurs within the individual's mind as a result of his or her social interactions (Young & Collin, 2004).	Less interest in what happens psychologically; the focus is on the meanings and interpretations generated between members of a group, community or society (Young & Collin, 2004).
Less focus on critically challenging existing knowledge to come up with new meanings (Young & Collin, 2004).	Focus on critically challenging existing knowledge to come up with new meanings for the wellbeing of the society (Young & Collin, 2004).

As highlighted in Table 3.1 above, social constructivism takes more of a psychological focus while social constructionism tends to take a sociological approach to understanding knowledge production as a process that is socially and culturally mediated by and within the collective. Young and Collin (2004) describe the process of constructing knowledge through social constructionist discourse as an “externalization of the mental world” (p. 376). In line with this, Gergen (2009) argues that within constructionist thought, meaning is created through the

interactions of people within a social community who use words and actions to express their views on a particular issue, event or action. Gergen (2009) further comments that during these kinds of interactions group participants have opportunities to challenge or question received knowledge that exists in the world they live in. In sum, in social constructionism, the emphasis lies with the negotiations that take place as knowledge is constructed and shared within the collective (Young & Collin, 2004).

In this study, I argue that biological knowledge and the act of 'knowing' Biology is part of a complex socially constructed process that emerges from a range of social relations, interactions, negotiations and practices that are, in turn, shaped by the history and culture of a particular society (Jha, 2012). However, at an individual level, biological knowledge and skills are constructed cognitively through interaction with others (Ültanır, 2012). Building on the works of both social constructivism and social constructionism I argue in this study that people cannot contribute to the social negotiations of knowledge construction (social constructionism) if they have not yet constructed that knowledge in the mind (social constructivism). Also, during the process of constructing knowledge through social negotiations (social constructionism), individuals have the opportunity to create individual knowledge (constructivism). Thus, I argue that learning is personally constructed but socially mediated (Hruby, 2001).

Distinguishing between social constructivism and social constructionism and also explaining the usefulness of these ideas in educational research is not always straightforward because researchers sometimes use the terms interchangeably, although there are useful differences between the two that I have taken into consideration in this study (Hruby, 2001; Young & Collin, 2004). Indeed, I contend that both these theories can usefully complement each other. Social constructivism can facilitate an exploration of the ways that students construct their own individual knowledge that comes about from their social interactions while social constructionism helps to explain the ways in which biological meanings and the

application of that knowledge in daily life are constructed and interpreted within the context of Tanzanian society (Jha, 2012). Thus, in order to understand the contributions of both social constructivism and social constructionism in this research, it is important to unpack the usefulness of each theory individually.

3.2 Social constructivism as a theoretical framework in research

This section focuses on the principles of social constructivism as a theory of learning.

3.2.1 Main principles of social constructivism

In recent years, constructivist theoretical frameworks have been widely used in science educational research internationally and have gained much attention (Palmer, 2005). However, in using social constructivism in education research, the researcher needs to be clear from the beginning about the scope of his/her use of constructivism (Matthews, 2002). Matthews argues that constructivism has many different manifestations which can create problems when it comes to educational appraisal. With this in mind, Matthews has called constructivism the “Broad Church doctrine” (p. 124), meaning that the theory has many faces: it is a theory of learning, knowledge, pedagogy, education, philosophy, cognition, science, ethics, politics, and worldviews. Because each of these aspects can be treated separately, its applications in educational research can be quite complex. For this reason, Matthews argues, researchers and science educators need to clearly state their position as constructivists and state whether they are applying it as a worldview or as a way of thinking about pedagogy or as a theory of learning.

With this mind, the constructivist ideas that have particularly influenced my thinking for this research centre on notions of learning and meaning making. Within educational contexts, for example, constructivists advocate pedagogical approaches that encourage students to build new knowledge on pre-existing knowledge

(Conner, 2014). Pre-existing knowledge (or prior learning) comes largely from students' personal experiences of the world beyond the classroom (Baviskar, Hartle, & Whitney, 2009; Conner, 2014; Hartle, Baviskar, & Smith, 2012). This happens most effectively when an individual compares new information with his or her existing knowledge and in doing so is able to create new knowledge, awareness or understandings (Ültanır, 2012). This new knowledge can either be added to, or assimilated with, existing knowledge or if the new knowledge does not fit with pre-existing knowledge, then existing knowledge is restructured with respect to the new knowledge. This suggests that an individual needs to be aware of the difference between his or her prior knowledge and the new knowledge that is acquired (Baviskar et al., 2009). Within schooling contexts then, becoming consciously aware of the differences between existing knowledge and new knowledge therefore allows students to assess how the new knowledge fits in the pre-existing knowledge (Inch, 2002).

As a theoretical framework for research on Biology learning, I have drawn on the social constructivist argument that students formulate and organise knowledge and meaning most effectively when they have access to socially interactive learning methods (Burrowes, 2003; Young & Collin, 2004). Thus, the application of social constructivism to the construction of knowledge in educational environments takes place when individual students interact with others, for example, through classroom discussions, cooperative learning, interactive demonstrations, small group discussions and any other form of interactive learning methods (Seimears, 2007).

Despite the widespread popularity of constructivist theories in educational contexts internationally, however, Haight and Gonzalez-Espada (2009) argue that it is important for Biology education researchers to explore whether the constructivist approaches used in classrooms do in fact provide students with an opportunity to acquire useful biological skills and knowledge that is directly relevant to their particular society. With this in mind, Biology educators and researchers need to ask

questions like, “Are the knowledge and skills that students acquire useful in tackling the specific social challenges and needs in their own communities?” and also; “Do the teaching and learning approaches used in the classroom help students to acquire the biological knowledge and skills that will be useful in their daily lives?” Selvi (2007) contends that researchers and educators need to take into consideration whether the kind of constructivist content, teaching methods, and assessment techniques used in Biology classrooms are directly meaningful for students and whether they do, in fact, acquire the skills and knowledge they need to deal with the socio-scientific needs and challenges in their everyday lives.

3.2.2 Social constructivism in learning

Baviskar et al. (2009) suggest that a major concern for teachers is to design and implement learning activities in a way that ensures that students’ opportunities for learning are maximised regardless of the pedagogical techniques used (see also Adams, 2006; Gordon, 2009). Key features of social constructivist pedagogies include:

- explorations of students’ prior knowledge
- a focus on the active construction of knowledge
- cooperative learning
- teacher acts as a facilitator of knowledge rather than an instructor/transmitter
- constructivist content is emphasised and teachers look for synergies between curriculum content and students’ interests and priorities and,
- constructivist methods of assessment where assessment is integral to teaching and learning activities and students are able to demonstrate an understanding of new concepts.

These ideas are discussed further below.

3.2.2.1 Exploration of students' prior knowledge

Social constructivists consider that the exploration of prior knowledge is an important aspect of knowledge construction (Baviskar et al., 2009; Hartle et al., 2012). Gordon (2009) asserts that students bring a wide range of experiences, beliefs, interests, and prior knowledge into the classroom and in the context of Biology, this knowledge can often help them to better understand socio-scientific issues. Driver, Asoko, Leach, Mortimer and Scott (1994) note that students acquire prior knowledge informally in the world outside of school, and educators need to create opportunities to bring this kind of informal prior learning into contact with new knowledge introduced in the more formal educational context of the classroom. Baviskar et al. argue that a failure to explore and elicit students' prior knowledge can lead to students ignoring or insufficiently integrating new knowledge.

Morrison and Lederman (2003) note that within constructivist classrooms, teachers use various pedagogical approaches to measure and explore students' prior knowledge, including concept mapping, pre-tests, journal writing, and interviews. These techniques allow teachers and students to conduct in-depth explorations of other types of prior knowledge that can then be connected with new knowledge (Baviskar et al., 2009). Morrison and Lederman have found that teachers often use questions that require students to recall factual knowledge rather than elicit prior knowledge. They argue that teachers need to use questioning techniques that evince in-depth information rather than mere facts.

Cobern (1993) notes that constructivist educators do not simply focus on the construction of new knowledge; they also aim to modify or even reverse pre-existing knowledge. In this respect, Palmer (2005) argues, they should elicit students' prior knowledge as a means of addressing or correcting misconceptions

(see also Baviskar et al., 2009, and Cobern, 1993). This is seen as being important because new knowledge takes hold more readily when it is constructed within, and extends, existing frames of awareness or understanding (Morrison & Lederman, 2003).

Cakir (2008) argues that students often find it difficult to abandon their misconceptions especially when they have put considerable time and energy into acquiring them. Cakir further contends that the challenge occurs when new knowledge conflicts with the existing misconception. The difficulty increases when a student attaches importance or value to the fallacy, and ceding it would create discomfort or unease. Also, as Cakir states, it is not always easy to identify the misconceptions that students hold. As will be discussed later in the findings chapters of this thesis, however, Biology teachers in Tanzania frequently prioritise rote learning and the memorisation of facts as a means of getting students through their national examinations, and little attention is given to students' prior learning or identifying and addressing their misunderstandings or misconceptions (Sumra & Rajan, 2006).

The exploration of prior learning in classroom contexts can also provide students with opportunities to share Biology-related social experiences (Gordon, 2009; Zeilder et al., 2005). Zeilder et al. (2005) argue that this kind of informal knowledge sharing may help them to engage in the sorts of discussions that will lead them to gain insight into the kinds of challenges facing their communities that require a working understanding of Biology. In this regard, students are encouraged to develop socio-scientific knowledge through learning from each other within the social setting of the classroom (Zeilder et al., 2005).

3.2.2.2 Active knowledge construction

One of the most important features of social constructivist educational theory is the notion that knowledge is constructed most effectively when active learning

techniques are practised (Conner, 2014; Palmer, 2005). Adam (2006) argues that constructivist educators seek to engage students in activities that trigger their enthusiasm and promote active participation (see also Gregory & Clemen 1994). Moreover, Lunenburg (2011) contends that active learning in social settings provides opportunities for students to develop ideas in the course of their interactions with each other, allowing them to reflect and clarify not only their own ideas but also those of their peers. Lunenburg adds that in these kinds of situations, students come to regard their peers as resources rather than competitors. In line with this, Grace (2009) asserts that this kind of active learning facilitates the development of knowledge that is relevant and useful in their daily lives. With this in mind, the effective use of social constructivist pedagogies fosters the development of transferable and active knowledge. By active knowledge I mean knowledge that can be directly applied in students' daily lives outside school (Gregory & Clemen, 1994).

3.2.2.3 Cooperative learning

Cooperative learning can be used as a social constructivist pedagogical tool to promote social interactions amongst students for developing socio-scientific knowledge (Day & Bryce, 2012). It should be noted here that the term cooperative learning is sometimes used interchangeably with group learning and peer learning (Day & Bryce, 2012). Palmer (2005) argues that the use of cooperative group interactions in educational environments facilitates an understanding of the social world. In this respect, students engaged in cooperative learning activities can share ideas and perspectives, and give and receive help from each other about how to resolve complex socio-scientific issues (Day & Bryce, 2012). Zeilder et al. (2005) note that when students are encouraged to share their social experiences in groups of their peers, they are more likely to come up with solutions.

Day and Bryce (2012) comment that cooperative learning can shift the focus of power within the classroom away from being teacher-centred to a more student-

centred environment. The cooperative interactions that take place between the teacher and students as well as between groups of students can challenge the more traditional structures of the classroom and generate new forms of interactions that are geared to supporting students' experiences of learning (Day & Bryce, 2012). Palmer (2005) refers to these interactions as taking place within a 'communication-rich environment' (p. 1855). In these circumstances, the teacher works alongside students to facilitate students' learning rather than controlling and transmitting knowledge (Day & Bryce, 2012). However, Day and Bryce have found that even when students are engaged in collaborative and interactive classroom activities, a degree of dependence on their teacher's directives is often retained.

3.2.2.4 The teacher as facilitator and guide

From a social constructivist perspective, the desired role of a teacher is that of a facilitator of learning rather than an instructor (Adams, 2006; Conner, 2000). In these kinds of classrooms, teachers provide opportunities for students to self-regulate their learning and seek ways of reducing students' dependence on him/her (Adams, 2006; Conner, 2014). According to Airasian and Walsh (1997), students need to learn to 'own' their learning and correspondingly, teachers also need to create an environment where students are free to explain their own ideas in their own words.

However, despite the fact that teachers aim to act as facilitators and guides in constructivist learning environments, Day and Bryce (2012) claim that they often continue to control both the exchange of ideas and the topics of discussion. Likewise, Sumra and Rajan (2006) note that in Tanzania, many teachers continue to control classroom learning although curriculum policy documents direct them to act more as guides and facilitators of learning and this is a contradiction between official aspirations and on-the-ground classroom realities that I explore in the chapters ahead.

3.2.2.5 Constructivist content

Duit (1996) argues that constructivism not only offers new ways of thinking about learning; it also provides new ways of thinking about curriculum content. Educators have long drawn on the ideas of the educator philosopher, John Dewey, who argued that subject matter should be relevant to the interests of the learners' interests and include contemporary themes and ideas from a across a range of subjects (Dewey, 1947). Dewey noted that textbooks carry information about the knowledge of the past. He argued that a primary role of teachers is to ensure learners engage effectively with textbook material but he also emphasised that students' informal learning is central to the formal learning process and needs to be included in classroom activities.

Students' prior knowledge of Biology is often based on what they have learned in other school subjects that have either a direct or an indirect connection with biological issues (Haight & Gonzalez-Espada, 2009). Haight and Gonzalez-Espada (2009) argue that students need to learn biological principles and concepts and integrate them in a wide range of school subjects. Indeed, they contend that students need to be able to link their understanding of biological concepts with other kinds of knowledge in order to be able to make well-informed socio-scientific decisions in their lives. In this respect, they are arguing that a knowledge of Biology does not occur in isolation from other kinds of knowledge. They suggest that people make decisions in their daily lives about a range of socio-scientific issues that not only require a measure of reliable biological knowledge but also the ability to integrate those understandings with other kinds of knowledge, such as geographical knowledge for example. Teachers therefore need to facilitate students' ability to combine and integrate what they learn in school Biology with other knowledge disciplines if they are to develop effective decision-making skills (Haight & Gonzalez-Espada, 2009).

3.2.2.6 Assessment of learning

Adams (2006) argues that constructivist learning takes teachers beyond merely teaching students how to pass examinations. Constructivists focus on the learner and the learning process as a whole when they develop their assessments (Adams, 2006). Duit (1996) suggests that the major role of constructivist assessment is to facilitate students' intellectual development and engagement. This allows students to demonstrate their understandings of new concepts in relation to pre-existing ones (Duit, 1996). In line with this, constructivist assessment is not viewed simply as something that is done at the end of class or term but as integral to the whole process of learning (Duit, 1996).

In Tanzania, teachers are expected to practise constructivist pedagogies and related assessment formats as part of learning activities (URT, 2009a). Sumra and Rajan (2006) contend, however, that Tanzanian classrooms continue to be dominated by the kind of assessment that forces students to recall and reproduce what they have been taught in class rather than encourage their critical thinking skills. They argue that this situation encourages teachers to teach students to pass examinations rather than critically engage with the material. It is little surprise, they contend, that shortly after their examinations students forget what they have memorised (Sumra & Rajan, 2006). Gregory and Clemen (1994) argue that it is much easier to test memorisation and rote learning than to test thinking skills or decision-making skills of students. In this respect, Tanzanian education officials need to re-assess the assessment techniques that are commonly practised and seek ways of establishing constructivist assessment, and I argue that this is important in Biology classrooms.

3.3 Social constructionism and meaning-making in research

Social constructionism focuses on the understandings and meanings that emerge from the interactions and negotiations amongst people within a society, cultural group, or community (Gergen, 1985). Cohen, Duberley, and Mallon (2004) describe this process of knowledge production as having a collective focus rather than

emphasising more individualistic perspectives of knowledge production. Cohen et al. argue that it is during the process of social interaction that individuals negotiate their understandings that allow them to engage with meanings that are local, relevant and authentic (Cohen et al., 2004; Hruby, 2001).

3.3.1 Essential features for meaning making

In this study, social constructionism is used as a theoretical framework that is concerned with meaning making. Following Gergen (1985), I have drawn on a range of ideas including:

- understanding biological knowledge as being historically and culturally situated
- seeing biological knowledge construction as a social process
- taking a critical stance towards biological concepts and processes
- recognising the role of language in social interactions.

These ideas are discussed in more detail below.

3.3.1.1 The historical and cultural specificity of biological knowledge

Young and Collin (2004) argue that meaning is constructed historically and culturally and it changes over time. It also varies from place to place (Burr, 1995). For example, the way that Tanzanians view educational meanings within the curriculum differs markedly from western worldviews despite the fact that a legacy of British colonialism survives in the education system. In this study, I have taken a constructionist approach to analysing Tanzanian perspectives about Biology in the school curriculum and I have focused on the ways in which they are culturally and geographically situated particularly with reference to differences between schools in urban and rural centres (Burr, 1995).

Gergen (2009) argues that in a rapidly changing world, new meanings are constantly being created. Jha (2012) contends that a range of complex social negotiations are needed to bridge the gap between new and old meanings. Consider the contemporary epidemic of HIV/AIDS in Tanzania which forces many communities to reconstruct cultural beliefs and practices (Jha, 2012; URT, 2009c). For example, in the years before the HIV epidemic, the cultural practice of widow inheritance (where widows are taken as wives by their husband's kinsmen) was practised and new marriages consummated without either party taking precautions to avoid sexually transmitted diseases. Nowadays, however, people are more aware of the risks of having unprotected sex and people are more likely to check the HIV status of their new spouse, but more needs to be done to prevent the spread of AIDS through these cultural traditions (URT, 2009c). For this to happen, difficult and sometimes uncomfortable new social dialogues need to be initiated in order to arrive at new meanings that will lead to changes in cultural beliefs and behaviour (Gergen, 2009). Gergen argues that the hope of social constructionism researchers is to modify problematic behaviours and improve people's lives.

3.3.1.2 Biological knowledge construction as a social process

According to social constructionist theories, people create knowledge about their social worlds through their interactions, interpretations and negotiations of meaning (Crotty, 1998). When people are engaged in these negotiations, some interpretations are privileged over others while some interpretations are set aside or rejected (Cohen et al., 2004). Cohen et al. add that the prevalence of those privileged interpretations depends on broad agreements between different groups of people.

In line with these ideas, I argue in this thesis that the material taught within the Biology curriculum is socially constructed and interpreted (Conrad & Barker, 2010). For example, understandings about particular biological conditions, such as diseases, can be shaped, framed and disseminated by the social interactions and

cultural practices within a society (Conrad & Barker, 2010). With this in mind, a social constructionist approach to biological knowledge provides an opportunity for researchers to explore social meanings relating to young people's understandings of various socio-scientific issues and this is a task I have undertaken in this thesis.

3.3.1.3 Taking a critical stance towards biological concepts and processes

Burr (1995) argues that a social constructionist perspective allows the researcher to take a critical stance in relation to social meanings. Drawing on this idea, I argue here that socially constructed understandings of biological knowledge within the Tanzanian context can be identified and scrutinised carefully and even challenged if need be. In this thesis, social constructionist research perspectives have also provided a conceptual framework for critiquing controversial cultural practices that pose risks to human health (Schultheiss & Wallace, 2012). In this respect, social constructionist approaches allow the researcher to negotiate with participants about possible new meanings relating to biological socio-cultural practices for the betterment of Tanzanian society (Leshabari & Kaaya, 1997; Schultheiss & Wallace, 2012). For example, in Tanzania a culture of silence surrounds young people's sexuality and this silence contributes directly to the spread of disease or has other negative effects on their health (Leshabari & Kaaya, 1997). These matters are discussed further in the findings section of this thesis.

3.3.1.4 Recognising the role of language in social interactions

Social constructionists recognise the role of language in the social construction of meaning (Schultheiss & Wallace, 2012). Gergen (2009) argues that human relationships in the social world are tied to language. The words people speak during negotiations and what is agreed by the members of the group become a form of "truth telling" (Gergen, 2009, p. 10). With this in mind, social constructionism provides an opportunity for me as a researcher to scrutinise the kind of language used by participants during my interactions with them in the field

to arrive at a meaningful interpretation of what they told me during the course of the research (Schultheiss & Wallace, 2012).

To this end, the social constructionist thinking has guided the research process in this thesis; it has provided me with a way of interpreting and analysing data as well as giving me a way of taking a critical stance on emerging practices in the Tanzanian education system (Burr, 1995).

3.4 Contextualization of the theoretical framework in the Tanzanian context

Building scientific literacy has been a central focus in the reform of science education programmes in many developing nations (Abrams et al., 2013). Abrams et al. argue that the contextualisation of scientific ideas and theories is a critical issue in educational contexts, particularly those that lie outside the West. This is a particularly important point because many developing nations draw heavily on western educational frameworks and intellectual traditions when developing national science curricula (Shumba, 1999). Shumba argues that ideas that are drawn from different intellectual and political systems need to be critically interrogated before applying them in non-western contexts. In line with these ideas, this research applies elements of both social constructivism and social constructionism as a theoretical frame for analysing Biology education in Tanzania.

Coll and Taylor (2008) argue that curriculum development and reform in developing countries tends to take a top-down approach rather than engaging grassroots communities and groups. Thus, many reforms ignore or overlook the contribution that teachers, parents, students and tribal or community members can make to these debates (Coll & Taylor, 2008). Yet, if educational ideas which are imported from wealthy nations abroad are to be effective in the context of developing nations, Coll and Taylor (2008) argue that the views of stakeholders need to be actively sought. With this mind, this study has included the perspectives of teachers and students.

3.5 Chapter summary

In this study I have applied perspectives from social constructivism and social constructionism. Social constructivism provides me with an opportunity to explore teaching and learning activities in terms of students' and teachers' perceptions as well as observing what is taking place in Tanzanian Biology classes (URT, 2009a). Social constructionism allows me to examine emerging biological meanings and interpretations in the Tanzanian context, especially with regard to Biology-related socio-scientific issues that arose in my discussions with participants and during my classroom observations.

In the next chapter I discuss the qualitative methodological approaches employed to gather data in this research.

| CHAPTER FOUR

RESEARCH METHODOLOGY AND DESIGN

4.0 Introduction

The methodological approach that was used in this study is explained in this chapter. In the first section, the qualitative research procedures and design are outlined and the rationale for selecting an ethnographic case study approach is set out. This is followed by a discussion about the sampling techniques that were used. The research sites in Tanzania are described and the data collection processes, which included semi-structured interviews, classroom observations, questionnaires, and focus group interviews, are elaborated. This is followed by an explanation about the ways in which data were analysed and a discussion about research ethics is also included. The last section addresses issues relating to research trustworthiness.

4.1 Qualitative research

Denzin and Lincoln (1995) argue that qualitative research approaches often involve a range of theoretical viewpoints. While this can add richness to an analysis, Dillard (2006) comments that it is important to assess the knowledge claims that sit beneath theoretical worldviews, particularly when they drive the methodological analytical approach. As discussed in the previous chapter, I have drawn on social constructivist and social constructionist theories in this research. These theoretical frameworks are bolstered by the assumption that reality is created from the interactions that take place between social actors and their understandings of these interactions. In this respect, people's understandings and experiences are viewed as being both subjective and changeable (Krauss, 2005). These theoretical worldviews underpin this study and have influenced the methodological and analytical approach, as is explained further in the sections below.

Yin (2011) argues that using a qualitative research methodology is well suited to exploring the meanings people give to their lives and their understandings of the world around them. Focus group interviews, for example, are a particularly useful means of eliciting these data. During qualitative investigations, a researcher needs to pay careful attention to the meanings participants give to the issues that are being studied and to the meanings they accord to them (Creswell, 2007). In addition, participants' social and cultural contexts are seen as playing a significant role in the kinds of interactions that they have with the world around them and the meaning they draw from those interactions. In line with this, participants are encouraged to tell their stories but consideration is given to the social and cultural contexts in which these stories take place (Creswell, 2007). Ryan, Coughlan, and Cronin (2007) contend that, in this regard, qualitative researchers need to approach their research problems in a holistic and context-sensitive manner rather than view data as a series of isolated and context-free variables. As Creswell (2007) argues, it is through these more holistic approaches that an authentic understanding of the research problem can be acquired.

Carefully designed questions are critically important in eliciting in-depth information from participants (Agee, 2009; Creswell, 2012). These questions need to provide participants with opportunities to express their beliefs and understandings about the phenomenon under investigation (Agee, 2009). In qualitative research situations, interviews often begin with a broad sweep of discussion that covers the phenomenon under study but later the interview questions become more specific so that the themes that emerge during the wider and more general discussion can be followed up and pertinent sub-questions put to participants (Agee, 2009). Well-structured qualitative questions should arouse the curiosity of both the researcher and the participants because this can trigger discussions that foster a deeper level of engagement with the topic that is being researched (Agee, 2009). In this respect, the qualitative methodological approaches used in this study are very closely linked to the theoretical frameworks outlined in

the previous chapter and this has informed the way the research was designed and carried out.

4.2 Case study approaches

Baxter and Jack (2008) argue that qualitative case studies enable researchers to study a specific issue or problem within a particular context. Hatch (2002) suggests that careful attention to context can generate detailed information about case study phenomena. As a result, the case study approach can provide insight through intensive investigation and rich description of the research context (Hatch, 2002). A case study approach is often taken when the phenomena under study and the context in which they occur are closely interconnected (Baxter & Jack, 2008). In this thesis, a case study approach was chosen because the phenomena in question, namely students' Biology learning and their application of this knowledge to their daily lives as biologically literate citizens, could not be studied without taking into account the institutional contexts in which Biology is taught and the wider socio-cultural contexts in which schools operate. This involved a close examination of classrooms, pedagogical practices, resources and the geographical location of schools. In addition, the cultural and social beliefs, values and practices that teachers and young people bring to these environments was also an important consideration in shaping the case study.

In case studies, the unit of analysis under investigation needs to be identified very clearly; a sweeping statement about a broad research topic is not helpful in distinguishing phenomena (Baxter & Jack, 2008). According to Baxter and Jack, researchers need to ask themselves whether the unit of analysis is an individual, a programme, a process, or an analysis of differences between organisations. In this regard, the overall research question determines the unit of analysis (Baxter & Jack, 2008). This study is concerned with the guiding question, "How does the implementation of Biology education in Tanzania support or constrain students in making informed Biology-related socio-scientific decisions in their everyday lives?"

The phenomenon of interest in this thesis is biological literacy which is explored through classroom observations as well as through an analysis of students' and teachers' perceptions about biological literacy, school Biology, science pedagogies, the institutional frameworks of science education, and the geographical contexts of Biology classrooms. Each of these factors is brought to bear on shaping and defining the 'case' which, in this study, is biological literacy.

There are different types of case studies. For example, Yin (1984) classifies case studies as exploratory, explanatory and descriptive. Exploratory case studies are used to generate hypotheses that can be tested, while explanatory case studies rely on interpreting cause-and-effect relationships between the phenomena under study (Cohen, Manion, & Morrison, 2007). Descriptive case studies illustrate the phenomena under study and provide rich detail about contextual factors (Cohen et al., 2007). Merriam (1988) categorises case studies into four types: ethnographic (investigates sociocultural aspects), historical (investigates phenomena over a period of time), psychological (investigates the psychological dimensions of a specific programme, event or process) and sociological (investigates social characteristics of phenomena). This study takes an ethnographic approach to the investigation of biological literacy as a sociocultural phenomenon in Tanzania that is experienced by those who are immersed in that setting (Merriam, 1988).

4.2.1 The ethnographic case study approach

The ethnographic case study approach is a qualitative methodology that explores social and cultural aspects of the lived world of the participants (Hatch, 2002; Merriam, 1998). Merriam (1998) argues that ethnographic methodologies emphasise the importance of sociocultural interpretations of the unit of analysis. In this study, the interpretation, analysis and discussion of data draws heavily on the sociocultural theoretical frameworks of social constructivism and social constructionism that were discussed in the previous chapter. The ethnographic case study approach taken in this thesis provided me with an opportunity to explore the

ways in which school communities in particular, and wider society more generally, frame biological literacy within the Tanzanian context.

Ethnographers assert that researchers need to establish close and long-term relationships with the society under study (Hatch, 2002). In my own case, over many years within the Tanzanian education system, I have acquired a deep understanding of junior secondary schools in many different roles, first as a secondary student myself, but later as a science teacher, and then more recently, as a teacher educator. As someone with a long history of engagement with these schooling environments, I am particularly interested in the rich data that can be drawn from those who operate within these contexts on a day-to-day basis. But I also wanted to look beyond my own insider status as a Tanzanian science educator in this thesis so in order to gain a deeper understanding of the data, I decided not to limit the case study or myself to data collection in one geographical area or one kind of school. For that reason, I designed this study to include participants from rural and urban schools as well as from private and government schools because this allowed me to study multiple perspectives about biological literacy from 'social actors' in a range of educational settings. Dwyer and Buckle (2009) argue that personal experiences can positively influence research observation in the course of data collection. In this respect, my own familiarity with the context under investigation allowed me to recognise and understand the views, perspectives and beliefs that my participants expressed. Dwyer and Buckle comment, however, that it is crucial for the researcher, where possible, to occupy the positions of *both* an insider and outsider in research rather than settling for being merely an insider or an outsider. This is because there needs to be as much of a balance as possible between the insider perspective (where the researcher has considerable familiarity with the context) and that of the outsider (where the researcher is able to step back and think critically about what is being observed).

4.3 Sample selection and procedure

A central aim of the ethnographic case study approach is to select information-rich cases that foster in-depth understanding about the phenomenon under study (Patton, 1990). Patton explains that the criteria for choosing purposive samples relate to the amount of rich data they provide. Purposive sampling is a qualitative approach to the selection of participants. In this study I have applied a form of purposive sampling known as critical case sampling. Onwuegbuzie and Leech (2007, p.112) describe critical case sampling as follows: "In critical case sampling, individuals, groups or settings are selected that bring to the fore the phenomenon of interest such that the researcher can learn more about the phenomenon than would have been learned without including these critical cases". The selection of research sites for this study was guided by this principle and this is discussed further in the section below.

4.3.1 The research sites

In ethnographic case study research, descriptions of the context play an important role in the interpretation of data (Hatch, 2002). The fieldwork in this study was conducted in urban and rural secondary schools in Tanzania and these radically different geographical contexts also influenced the interpretation of data, especially in relation to the analysis of social, cultural and economic factors (Wedgwood, 2005). For example, urban Tanzanians, in general, enjoy greater levels of affluence compared with their rural counterparts (Wedgwood, 2005). Further, many rural young people are less privileged in terms of access to quality education (Wedgwood, 2005). There are also significant disparities in access to basic facilities such as clean water, good sanitation, transport, remedial health care or electricity. In addition, many traditional cultural practices are still maintained to a much greater degree in rural areas than in the cities. Some of these traditional ceremonies involve bloodletting rituals or sexual practices that pose risks to human life and health (Shemsanga, 2013). The inclusion of site schools in both rural and urban centres therefore provides rich data about the sometimes quite dramatic

differences between geographical locations and the diverse range of perspectives that are brought to bear on the concept of biological literacy.

The study was conducted in two regions of Tanzania: Dar-es-salaam and Tanga. Dar-es-salaam was selected because it is a large urban city where most people have access to educational resources and there is a larger pool of qualified and experienced teachers compared with Tanga (URT, 2010c). In addition, well-equipped social services, such as hospitals, are available in Dar-es-salaam and living standards are reasonable. For that reason, many teachers choose to work in this area (IIEP, 2006).

In stark contrast to Dar-es-salaam, I selected rural site schools in the Lushoto district, which is in the mountain regions of the Tanga region in the northeast of Tanzania. I chose Lushoto because of its relative distance from large urban areas and because I believed that it would give me a good picture of the specific factors that shape people's levels of biological literacy in a rural schooling context.

In each area I was given permission by education officials to conduct my research in four schools; two schools were government-funded junior secondary schools and the other two were private junior secondary schools. The government junior secondary schools that were included in this study are known as 'community' or 'ward' schools and these are the most highly attended government junior secondary schools in Tanzania (URT, 2010c). Wedgwood (2005) has observed that private junior secondary schools generally offer students better resources than community junior secondary schools and students' achievement levels are also consistently much higher. I selected junior secondary schools in the private and government sectors that were relatively disadvantaged in terms of resources. This was because there are very few Tanzanian secondary schools that are 'resource-rich' and as such I considered that wealthy schools were less representative of young people's educational experience in Tanzania (Wedgwood, 2005).

During my investigation, I had the opportunity to visit two private boarding secondary schools in the rural Lushoto area. Wedgwood (2005) argues that few rural communities in Tanzania are served by boarding schools and notes that these kinds of schools are considered to be very desirable by many families because they are seen as providing a high standard of education. The reason that many families take this view is because secondary schools with boarding facilities provide students with the time they need to study. Unlike day school students, private school students do not have to travel exceedingly long distances or depend on expensive or unreliable transport to and from home. Boarding school students are also released from the need to work long hours for their families to earn money for basic food and shelter as do many young people in Tanzania (Wedgwood, 2005). In contrast, most secondary school students in day schools live far from their homes and often have no choice but to find money to rent accommodation close to where they go to school (Wedgwood, 2005). According to Wedgwood (2005), most students who attend day schools cannot afford good quality accommodation and they also have to fund their living expenses by working after school. On the other hand, most private boarding schools are expensive and as such they are beyond the means of many rural families, and for this reason, most rural students attend the more affordable day community government schools (Wedgwood, 2005).

All eight-school sites were co-educational and this provided me with data about the impact of gender on biological literacy. In a study conducted in Tanzania by P. S. D. Mushi (1996), it was found that teachers perceived boys to be more competent in all science subjects except Biology where girls were seen as performing the same or better than boys. This indicates that teachers believe that there are few differences between girls and boys in their performance in Biology (P. S. D. Mushi, 1996). There is little research about gender and science education in Tanzania, so it is difficult to assess whether this study is significant in understanding how gender might (or might not) influence the way that boys and girls make decisions about biological issues in Tanzania. My study has, therefore, sought the views of both males and

females about the ways in which Biology education in schools facilitates their thinking about the role of Biology in their daily lives.

4.3.2 Gaining access to the site schools

Before discussing how I gained access to the schools, it is worth explaining how some of the terms used in this thesis are applied. As noted earlier, students in Tanzania enter junior secondary school after seven years of primary schooling. At the beginning of junior secondary school, most students are aged between 13 and 14 years. There are four years of study at junior secondary school and my student participants were all in their fourth and final year of junior secondary school study. For that reason, throughout the thesis I refer to this level of schooling as 'Year Four'. The age range of the Year Four participants in this study is between 16 and 18 years of age.

Wang (2012) argues that decisions about access to research sites are not only made in the early stages of a study but are part of an on-going process across the full duration of a research project. This sometimes involves negotiations about gaining 'informal access' to sites which means that the researcher may choose not to follow pre-arranged organisational protocols for getting access to research sites (Wang, 2012, p. 766). Creswell (2007) notes that researchers need to be flexible about these matters because the original plan can change once they are out in the field. This was the situation I faced during my field research because I went with pre-conceived ideas about how I would secure access to the site schools, but it did not always work out in the way I expected so I had to change my plans fairly frequently.

My experience, especially in relation to access to government secondary schools, involved lengthy negotiations with education officials. I went into urban schools during the first part of the data collection process and the lesson I learnt from getting access to urban government schools guided my thinking about how I was going to gain access to government schools in rural areas – so I changed my original

plans, made at a distance in New Zealand, to better fit the situation on the ground in Tanzania. Essentially, this involved navigating the highly formal, top-down bureaucratic structures of educational officialdom in order to gain local government approval to approach the site schools and this was a time-consuming process. In the first instance, I left a letter seeking approval to conduct my study in urban municipal secondary schools in the hands of registrar officials who channelled it to the urban municipal executive director for consideration. The process took more than a week to get a reply and I was on a tight time schedule for the field research which needed to be completed before I returned to New Zealand. I was worried that the rural officials would take even longer to send my letter of request through the system so when I arrived in the rural municipal offices; I decided to change my original plan. First, I asked for permission to see, in person, the executive director who had the authority to grant me permission to conduct the research in the municipal secondary schools. Then she sent me to her subordinates to be given a letter of introduction that permitted me to do research in secondary schools. It took me almost a day to get the letter. In this regard, my experiences as I sought approval from government officials involved with the urban part of my investigation were very useful in planning my access to rural schools.

Receiving approval to start my investigation in the urban and rural schools was an interesting process. In the government secondary schools, I showed the letter of permission that I had been given by the district officers to the head of schools and in each case, I was accepted without hesitation. In the private schools, I showed the letter intended for the head of schools that I had written as part of my research ethics application at Victoria University (see Appendix A) and they gave me verbal approval to do my investigation in their schools.

In both the private and government schools, the Heads of schools introduced me to the academic master/mistress who made arrangements for me to meet with the Year Four Biology teachers. The Biology teachers in each school were also responsible for making all the arrangements for me to set up my data collection

process. So, in each school, I explained to the Year Four Biology teachers what help I needed from them so that they understood and were willing to help when I introduced the study to the students. In each of the schools, the Biology teachers introduced me to students once when I administered the questionnaires and then again when I conducted the classroom observations. There was good cooperation between the teachers and me and this smoothed my investigation in both the urban and the rural schools.

My experience of getting permission to carry out my investigation in private schools was quite different from that of government schools. It was a straightforward task to gain access to private schools because there was less bureaucracy involved and I could apply directly to the Head of the school in question. So, in both cases, rural and urban, I started data collection in private schools first, then went on to collect data in the government schools.

4.3.3 Participants

In qualitative research, participants are selected depending on their experience of the phenomenon under investigation (Ryan et al., 2007). This kind of selection ensures the richness of data (Ryan et al., 2007). For instance, in this study, I selected three categories of participants, namely teachers, club teachers, and students in their fourth year of junior secondary school in both rural and urban schools. The reason I chose these particular groups was because I considered that they would have more direct experience with the Biology curriculum than other groups in secondary schools.

The first group of participants that I interviewed in the site schools were Biology teachers who taught students in their fourth year of secondary schooling (referred to in this thesis as Year Four). I worked with eight Biology teachers in total: one teacher in each school, because it was hard to find more than one teacher teaching Year Four students in any one school which was my original plan. They were

selected because they taught Year Four Biology in the participating schools and were therefore familiar with the Biology curriculum, the Year Four students, and their school environment. In the urban schools, there were two male Biology teachers and two female Biology teachers, while in the rural schools there were three male Biology teachers and one female Biology teacher. All the teacher participants were highly cooperative and were eager to make my job of data collection as easy as possible.

The second group I interviewed was teachers who were involved with school clubs that required a degree of biological knowledge or awareness (such as health, HIV/AIDS or/and environmental clubs). Club activities in Tanzanian secondary schools are conducted as extracurricular activities. They are not compulsory and it is up to individual schools whether they run clubs or not. I interviewed club teachers who were not necessarily Biology teachers but who had knowledge and skills that would help develop specific components of biological literacy within the club. In total, I interviewed five club teachers in different schools. In urban schools, only one of the four site schools offered club activities to students. In that particular school, I had the opportunity to conduct an interview with two male teachers who were club teachers. In the rural schools, club activities took place in three of the four schools, although in two schools, the clubs were quite newly established and for that reason they had not yet had enough time to have much of an impact in the period that I was present.

The third group of participants were Year Four Tanzanian junior secondary school students aged between 16 and 18 years who were enrolled in the Biology classes of the teachers I had interviewed. These students were invited to fill in the questionnaires. A smaller number of these students were later invited to participate in a focus group discussion with six or seven students. This group of participants had almost completed the entire Biology curriculum for Tanzanian junior secondary schools and had good insights about school Biology in their school. They talked about the skills and knowledge they developed during their schooling.

4.4 Data collection methods and procedures

Qualitative researchers frequently include several sources of data in their research design (Yin, 2011). Baxter and Jack (2008) argue that the use of a variety of data offers multiple lenses that expose different components of the phenomenon. For this reason, I selected a qualitative approach that drew on several data collection methods including semi-structured interviews, classroom observations, questionnaires and focus group discussions.

4.4.1 Sequence of data collection

I started the data collection process at each site by interviewing the Biology teachers. The purpose was to explore their general perceptions about students' Biology learning and also to talk about their pedagogical practices. These semi-structured interviews were followed by a classroom observation which I carried out myself. Depending on the availability of rooms, I conducted the teacher interviews in a separate room from the staffroom. Sometimes the interviews took place outside under the shade of trees where we could not be overheard. I conducted a second set of interviews with the teachers after the classroom observations were completed. The aim of the second interview was to talk further about what I had observed in class. In addition, semi-structured interviews were conducted with club teachers. I was able to interview the club teachers at a time that was convenient for them and since those data did not depend on any prior collection of data, there was quite a bit of flexibility in the timing of these interviews. The purpose of running semi-structured interviews with club teachers was to get a picture of the sorts of club activities that supported students' development of biological literacy. I have discussed data relating to school clubs in Chapters Five, Seven and Eight.

The student questionnaires were administered either before or after the classroom observation. There was some flexibility around the timing of this part of the data collection process because it did not affect the classroom observations or the interviews with the teachers so the questionnaires were given to the students at a

time that was convenient for everybody (i.e., both teachers and students). Once the questionnaire was administered, a smaller group of students were invited to participate in focus group discussions that were run a day or two afterwards.

4.4.2 Semi-structured interviews

My aim in conducting semi-structured interviews with Biology teachers was to explore their perceptions about the development of biological literacy. Bisman and Highfield (2012) argue that semi-structured interviews can be a useful way of exploring multiple views and allows the researcher to probe for further information. Interviews are usually based on a set of open-ended questions that prompt participants to talk about their experiences (Creswell, 2012). The use of semi-structured interviews therefore allowed me to gather in-depth information by encouraging participants to tell their stories about how students acquire and apply biological knowledge (Bisman & Highfield, 2012; Creswell, 2012). A set of interview questions for this group of participants can be found in Appendix B.

I also conducted semi-structured interviews with a second group of teachers in the site schools who were involved with school clubs that were associated with the development of biological literacy, for example, a secondary school HIV/AIDS club (See Appendix C). One Biology teacher was interviewed in each site school, with a total of eight teachers in all schools. In addition, five club teachers were interviewed; three of these teachers taught in rural schools and two taught in urban schools. In each interview, the participants were encouraged to share their ideas and I was conscious of finding ways of maintaining their sense of comfort and ease (Creswell, 2012).

The interview sessions with each of the Biology teachers were divided into two parts; the first session took place before the classroom observations and a second follow-up interview was conducted afterwards. The purpose of the interview before the classroom observation was to gain insight into teachers' views and to canvas

their beliefs about teaching and learning of biological literacy. The interviews conducted after I completed the classroom observations allowed me to follow up on the insights gained during the classroom observation and ask further questions about the discussions that took place during the first interview. Each interview session took approximately 45 minutes to one hour, although the interviews that were carried out after the classroom observations were usually much shorter. This was because I did not always have a lot of additional questions to ask and it was usually the case that most issues had already been discussed in the first interview.

During the interviews, I recorded data on audio tape and also took extensive notes. Both these methods of recording interviews complemented each other (Halcomb & Davidson, 2006). The tape recorder allowed me to record the conversation while I was concentrating on developing probe questions and actively listening to the participants. On the other hand, note-taking was a useful way of capturing my thoughts and interpretations both during the conversation, and later, when I listened to the audio tapes (Halcomb & Davidson, 2006). Both forms of recording played a crucial role during the analysis and interpretation of the findings. I present the findings from this part of the field research in Chapters Seven and Eight.

4.4.3 Classroom observation

In school settings, classroom observation methods can be an effective means of showing the researcher how teachers teach (Estacion, McMahon, Quint, Melamud, & Stephens, 2004). The observation process often involves collecting data in a cooperative manner which includes both the researcher and the participants (Mulhall, 2002). Mulhall argues that a key reason for doing classroom observation is to explore whether people do what they say they do or whether there is a mismatch between what they say they do and what actually happens. In light of this, I conducted classroom observations after each of the initial interviews with the Biology teachers to find out what it was they claimed to do in their classroom teaching and also to ascertain what the syllabus required them to do. Since this

study concentrates on the implementation of the Biology curriculum and its role in the development of biological literacy, the classroom observations focused on the content covered, the teaching approaches that were used, and other information regarding the evaluation of student learning during the Biology lesson. The main intention of observing these concepts being put into practice in the classroom was to find out the extent to which teachers' perceptions about what they did were played out in their actual teaching practice.

Subsequently, in this study, I was a non-participatory observer. This is a role that maintains a degree of distance with the participants and is focused on witnessing and interpreting events as they take place (Halcomb & Davidson, 2006). It enabled me to observe and record the classroom activities that took place and provided me with a clear picture of the overall pedagogical process (Creswell, 2012). In line with this, the students were informed about my presence before the class by their teacher and they were told what I was going to do during the class. Throughout my observations, students in different schools seemed to be relaxed and did not appear to be bothered by my presence. This made my observations very straightforward because I was not anxious about students being distracted or not concentrating on the lesson. In this regard, I was able to take a non-participatory role because I was not a source of interruption in the classroom.

During the classroom observation, I also observed Year Four classes where topics of particular interest to this study were taught, such as health issues like reproduction. Fortunately, I had an opportunity to observe classes at a time of the year when most of the teachers were teaching topics related to health and biological literacy as whole. This was possible because most Tanzanian secondary schools use the same syllabus and follow the same school calendar throughout the year so it is likely that teachers in different schools teach the same topic concurrently. In this regard, the observations gave me considerable insight into the way that topics related to health issues for students were taught.

In addition, each observation session took place over a period of one hour and ten minutes, which is the normal time for double periods in Tanzanian junior secondary school classes. I observed each teacher teaching all Year Four lessons in one week, providing more in-depth information than a single lesson observation (Creswell, 2012). This study did not employ video recording because Tanzanian classes are very large (e.g., about 50 students on average in rural classrooms and around 70 or more in urban schools) and it would have been difficult to capture multiple events occurring at the same time, especially when students worked in groups. My approach allowed me to capture most of the information I required.

To this end, I used a 'running record' style of observation (see appendix D) which is an open-ended template for the systematic recording of the events (Creswell, 2012). The use of 'running records' provides an extensive process of recording events during classroom observations (Serafini, 2010). In this study, the running record template followed the stages of the lesson plan as it unfolded during classroom instruction. These stages include the introduction, the presentation, reinforcement, and evaluation of students' understanding. This kind of recording template was useful in observing classroom practices in Tanzanian classroom settings because their lesson plan is also organised in that manner. The use of running records during classroom observations using the observational template in the Tanzanian context therefore made the whole process of classroom investigation very straightforward. These data are discussed further in Chapter Seven.

4.4.4 Student questionnaires

In qualitative research, questionnaires can be a useful way of gathering information about people's perceptions (Bird, 2009). However, in qualitative research there are debates about whether questionnaires should include closed questions or open-ended questions (Bird, 2009). Open-ended questions are often used in qualitative research and are aimed to elicit more in-depth data about participants' perceptions, while closed questions are frequently used in quantitative research and are usually

aimed at eliciting factual data (Bird, 2009). I argue that it depends on the aims of the qualitative researcher and what he or she hopes to gain from the questionnaire and whether the goal is to produce qualitative or quantitative results or both. In light of this, I contend that questionnaires can be used to produce qualitative findings using closed questions when the researcher uses them to get useful information for further in-depth exploration.

In this study, the questionnaires consisted of closed questions which provided circumscribed responses and this was useful because at that stage of the study my aim was to gather information about general trends rather than in-depth and highly detailed data (see Appendix E - English version and Appendix F - Swahili version). Baxter and Jack (2008) argue that questionnaires are helpful in providing an overview of the phenomenon under study. In light of this, my intention was to identify ideas that could be used for further exploration during the focus group interviews with students which were structured around open-ended questions. For example, if an item on the questionnaire was answered in a particular way by most participants, then it was used in focus groups to probe why this was so, or not. The questionnaire also gave me an overall picture of the perceptions of the whole class and not just those discussed by members of the focus groups. The closed questions in the questionnaire also allowed me to make a comparison of the responses within the class and also across the site schools.

Questionnaires usually consist of standardised questions (Creswell, 2012) and in this study, the questions were designed to explore the level of agreement with a series of statements. To that end, I constructed a Likert scale. The statements that appeared in the questionnaire were based on a five-item Likert scale that ranged from (a) "strongly disagree", to (d) "strongly agree" (1-4) and "I don't know (5). In one section of the questionnaire, I used slightly different wording of the Likert scale, inserting items that used the terms 'rarely', 'sometimes', 'very often' and 'never'. This was because the nature of the statement demanded that level of response. There is debate about whether or not the 'don't know' item should be included on

the scale (Williams, 2003). Williams notes that some researchers prefer questionnaire respondents to give an answer rather than leave the question blank while others think the questionnaire should include the 'don't know' item in order to give an opportunity for respondents to give an explanation of why they responded that way. In this study, this has been achieved by giving some of the respondents the opportunity to make additional comments during focus group discussions.

I divided the questionnaire into five sections. The first section explored students' perceptions about learning Biology. This set of questions canvassed students' views about the usefulness of school Biology as well as their levels of interest in learning Biology at school. The second section of the questionnaire aimed to find out how students responded to different kinds of teaching methods in their Biology classes. In the third, fourth and fifth sections of the questionnaire, I explored the students' levels of agreement with statements about the usefulness of health-related Biology knowledge in challenging or understanding of cultural practices, climate change and biotechnology. All five sections of the questionnaire were useful in capturing students' levels of agreement about matters relating to their development of biological literacy.

In each school, approximately 40 questionnaires were administered and students from both the science and the non-science streams were invited to fill in the questionnaires which made a total of approximately 40 questionnaires from both streams in each school. This gave me a total of 322 completed questionnaires across all eight site schools. Before I administered the questionnaires, I explained the purpose and content of the questionnaires to the students. I also ensured that the students were given time to ask questions before and during the filling in of the questionnaire. The questionnaire took approximately thirty minutes to complete.

The students were asked not to write their names on the questionnaire, instead, they were assigned numbers in order to protect their confidentiality. These numbers were useful in preventing teacher bias later on when it came to the selection of participants for the focus groups. In order to ensure that I made as random a selection of focus group participants as possible, I arranged for numbers to be allocated to each questionnaire that was filled in. Then, I used those numbers to select students for focus group discussion. The students' selection for focus group discussion depended on the ways they answered their questionnaires as will be discussed in the next section.

In this study, I offered students the choice of two versions of the questionnaire that were identical in every respect except that one version was written in English and the other was written in Swahili. Students were given the freedom to choose between the Swahili and English versions of the questionnaire. The students were given this choice because most Tanzanian students are fluent in Swahili although there are a few students who are also conversant in English depending on their academic background. Offering students a choice of which versions of the questionnaire they answered did not have an impact on their responses because a thorough translation of the questionnaire from English to Swahili was made with the help of a Tanzanian Swahili teacher. The students were also given an opportunity to ask for further explanations if they did not understand an item or a question that appeared in the questionnaire. The findings from the questionnaire are referred to throughout the findings chapters in this thesis but they are discussed in detail in Chapter Five.

4.4.5 Focus group interviews

Focus group interviews involve conducting interviews with groups of people who share an understanding of the phenomenon under study (Creswell, 2012). Wilkinson (1999) further notes that focus group discussions are usually conducted amongst individuals who share similar experiences and are able to discuss the

phenomenon under study. The shared experience aspect of the focus group discussions was achieved in this study by selecting participants from Year Four students who had been in the same cohort for their Biology classes throughout their four years of schooling in their particular school. As noted earlier in this chapter, in this thesis, 'Year Four' refers to the fourth year of junior secondary schooling where students are aged between 16 and 18 years.

The focus group interviews were conducted in order to get more nuanced information about the students' responses to the questionnaires. In this regard, I followed Creswell (2012), who argues that focus group discussions can provide a great deal of detailed information about their answers in the questionnaires. Focus group students were selected from those who responded to the questionnaires. Each questionnaire was numbered by the students who were then asked to remember which number they had assigned to the questionnaire they filled in. After I had looked over the questionnaires and analysed them to the extent that I could see some initial themes and patterns beginning to emerge, I set aside questionnaires that provided me either with typical responses or in some cases, where students had made comments that I wanted to explore further in the focus groups. During the administering of the questionnaire, the teachers were responsible for making sure that each student remembered his/her number for future use in focus groups. However, in the exercise of selecting students, gender balance was also considered. I included approximately three boys and three girls for each focus group. I developed a set of probe questions to elicit this information. The focus group questions can be found in Appendix G. I conducted the focus group discussion in a careful and considered way and tried, as far as possible to avoid looking for responses that fit with any pre-conceived ideas I may have had.

I conducted one focus group discussion in each of the eight secondary schools. In each group, gender balance was considered and each group included either 6 or 7 students. The focus groups included students from science and non-science streams in order to ensure that I was hearing a range of views from students in both

streams. This was important because there is a general belief amongst science teachers in Tanzania that non-science students are less interested in Biology compared with their peers in the science streams. Both Swahili and English languages were used as the medium of communication during the focus group discussions. This was because English is the medium of instruction in Tanzanian secondary school subjects and students tend to be more familiar with using technical biological terms in English than in Swahili. On the other hand, in their everyday conversations, many students are more likely to speak Swahili, especially in the cities. Swahili is the national language of Tanzania and most people are reasonably fluent speakers, even in rural areas where students are more likely to communicate in their own tribal languages when they are at home. For this reason, I encouraged students to speak in either English or Swahili, depending on what they felt most comfortable with.

Sheila (2000) argues that participants in focus group discussions need to feel that they are in an environment where they are comfortable about expressing their opinions. During my investigation, I conducted several focus group discussions after school hours when students were less anxious about missing class. In the boarding schools, I had plenty of time to carry out the focus groups and the students seemed quite relaxed during the discussions because they did not need to worry about finding transport for their journey back home. In contrast, the situation was more difficult in day schools because students had to make sometimes very lengthy trips after school to get back to their homes and this reduced the length of the discussions. In some day schools, I was able to run focus group discussions in between classes and this was helpful because it meant that students were not anxious about getting transport home after school; the drawback was that students had to rush so they arrived at their next class on time.

The focus groups were conducted in a different place from the students' classrooms. In some schools I was given a vacant room or a space in the school grounds where we could not be overheard. Some schools offered me a separate

room away from others, and this was a quiet environment where we were not disturbed by other people. In these focus groups, students were able to share their stories without worrying that they would be overheard. In a few cases, I conducted focus groups outside in the school grounds but this proved tricky in one of the urban schools as it was surrounded by busy shops and roads. I also noticed that in the urban schools, it was not a good idea to conduct focus group discussions in the evenings because the students became anxious about securing late transport home. For that reason, when there was little choice but to run a focus group in the late afternoon or early evening, I tried to manage the time so they could leave early enough to secure their passage home.

One limitation of focus group approach was that students from the rural schools were less forthcoming in expressing their views. This is probably because they are not used to expressing their opinions freely, especially about sexual matters. By contrast, the urban students were open and talkative and willing to share their views. It is noteworthy that this may have led to some views from rural students not being expressed during the focus group interviews. In future, researchers who investigate similar issues or gather data in these environments may need to design research tools that allow rural young people to express their views in writing rather than talk about them. Additionally, open-ended questions may well provide more insightful responses from these students.

I tried to ensure that the focus group environment was relaxed and friendly. For example, I assured them that their names and the name of their school would not appear in the thesis and that I would not personally identify them or pass on their comments to their teachers. However, Hollander (2004) suggests that focus group participants may be uncomfortable about speaking openly if they have not developed a trusting relationship either with each other or with focus group facilitators. This may be applicable in Tanzania cultural contexts where young people are expected to demonstrate quiet respect for their elders and are also likely to be reluctant to discuss sexual matters if the facilitator is of the opposite sex. This

was observed in some of the rural schools where participants were uncomfortable about speaking about some issues, especially those relating to sexual matters. Hollander (2004) argues that this situation may affect the quality of data even when participants are given assurances about confidentiality. In my study, I encouraged the young people to speak freely and openly although in the rural schools it was difficult to know if they were comfortable about articulating everything they wanted to say.

The social constructionist approach in this research was helpful during the focus group phase of data collection. In the focus groups that I conducted it was often the case that one student would raise an issue and then the others contributed enthusiastically. In these situations, I interpreted this behaviour as the students sharing similar views. Where they disagreed and they gave different answers I have encouraged them to provide further information. Hollander (2004) argues that in focus groups, participants often influence each other's responses and for this reason data are more often indicative of group opinions rather than individual points of view. In contrast with social constructivist theorists who believe that individuals construct their own meanings from social interactions, social constructionists believe that individuals do not construct their own meanings, rather, ideas are constructed through interactions (Hollander, 2004). In this regard, social constructionist perspectives helped to me to negotiate meanings with the students as a group as opposed to individual views (Hollander, 2004).

4.5 Piloting the research methods

In this study, I piloted each of the research methods before I went into the field to check their effectiveness. Hassan, Schattner, and Mazza (2006) argue that research pilots are essential both for identifying what does not work and what needs to be revised. According to Hassan et al. (2006), the researcher needs to make sure that the participants involved in the pilot clearly understand the questions. Pilot participants may also suggest additional questions that will clarify data or elicit

more information (Hassan et al., 2006). In addition, researchers have the opportunity to gain familiarity and confidence with the procedures when they pilot their research (Hassan et al., 2006). This also allows the researcher to alter the procedures that were originally planned, if necessary (Hassan et al., 2006). As I discuss below, in this study, the pilot provided me with helpful information about the aspects of the research process that needed to be improved before I went into the field (Hassan, et al., 2006).

Prescott (2011) notes that an effective way of getting feedback during piloting is to interview people who are familiar with the research setting. In light of this, I piloted the interviews and focus groups with several fellow PhD students from Tanzania who were enrolled at Victoria University of Wellington in New Zealand. This process helped me to get feedback that was used to modify the interview questions. In addition, this process gave me a sense of how long each interview might take although I knew that it would take more time once I was in Tanzania. This was because I knew that the study participants had many more experiences of the issues related to my study compared with those of my fellow Tanzanian students at Victoria University. Generally speaking, the pilot showed that the interview questions were framed clearly and the participants were able to give me the information I sought but, it was clear that the interviews with participants in Tanzania would take much longer than those with pilot participants in New Zealand.

The student questionnaire was designed during the development of the thesis proposal while I was resident in New Zealand. I piloted the questionnaire online because of the distance between me, as the researcher, and the participants who needed to be students based in Tanzania. After I received ethics approval from the University, I contacted Tanzanian students online, approaching my own relatives, the children of friends and their friends. I asked them to read the questionnaire online and give me feedback by e-mail. I explained the nature of the research to the pilot group participants and the purpose of the pilot study, and encouraged them to fill in the questionnaire and email me their feedback. I sent almost 20

questionnaires out but I received feedback from only 10 young people with a few suggestions for improvement of the questionnaire. The main comments I was given focused on the need to improve the way I explained a few questions. The online pilot questionnaire was useful in providing me with feedback, although I was only able to contact students in urban centres who had access to the internet.

The classroom observation schedule was piloted in a Tanzanian secondary school that did not participate in the field research proper. The pilot site was an urban secondary school. I explained my reasons for wanting to do the pilot to the Head of school and asked for permission to conduct the observation. I also used the Head of school information sheet (see Appendix H) to explain my research objectives. During the classroom observation I explained to the students and teachers why I was doing the observation and they were most cooperative. The pilot trial of the running record, which involved a simple template of recording what happened in the classroom, was successful and I did not need to make modifications. The major issue I learnt from piloting the classroom observation related to the way I was going to capture multiple events concurrently. This was an issue because sometimes many things were happening at once. For example, the teacher might be explaining a certain concept in front of the class while the students were busy with other off-topic activities. I dealt with this by making sure that, in each classroom observation, I sat at the back of the room and kept scanning the room to check what was going on in different parts of the classroom and tried to capture as much as possible.

4.6 Data analysis using constant comparison methods

In this research, I carried out an ethnographic case study with the aim of understanding how biological literacy develops amongst Tanzanian secondary school students. Eight schools were included in the case study. These schools were divided into two major groups, namely urban and rural schools. Throughout the research, I saw a number of common themes emerging across the schools and these became the basis of a comparative analysis between the two groups that

were the key unit of analysis. These comparisons shed light on the development of biological literacy within a culturally, socially, linguistically and geographically diverse nation, like Tanzania.

While I have taken a qualitative approach in this study, I have used some quantitative data methods and terms to present my findings. For example, I have used percentages and graphs to describe some of the aggregated data. During the data analysis phase of this study, I kept the interview and observation data in a separate database from the questionnaire data. I used NVivo computer software in the analysis of the one-to-one interviews with teachers, the focus group interviews and the classroom observations and this helped me with data storage, organisation, and coding, and also assisted me in the identification of some of the broad themes of this study (Creswell, 2012). Ozkan (2004) argues that the use of NVivo increases the speed and flexibility of coding, and the retrieval and linking of data, and I found that this was certainly the case in this study. However, while NVivo is a very useful analytical tool, I made all decisions regarding how data were organised, coded and analysed.

Quantitative data from the questionnaires included closed questions so I used a different system of analysis which included the Statistical Package for Social Sciences (SPSS) software programme. The data from the SPSS package translated to graphs, charts, and tables and in later chapters of this thesis, I have made use of the frequencies, percentages and means that were generated by this software package. Some of the data in the SPSS package were translated into Microsoft Excel graphs and tables. This is because graphs and tables from Microsoft Excel were more convenient to use.

All data were transcribed and translated from Swahili to English before they were imported to NVivo. Qualitative data from the teachers' interviews, students' focus group discussions and classroom observations were subject to an on-going or

'constant comparison' analysis using NVivo software. Cohen, et al. (2007) describe constant comparison analysis as a process whereby the researcher compares new data with existing data and categories. I chose to use constant comparison analysis because the participants who shared a category, such as Biology teachers, were involved in the same kind of interview with similar questions that fitted within similar nodes such as professional background. I found that constant comparison analysis was most useful when comparing data across the participants as well as through the range of research tools (Cohen et al., 2007).

In applying a constant comparison analysis, I first read through all the interview transcripts of the teachers several times and this allowed me to come up with codes that were then used to form nodes using NVivo software. I began with the first transcript which was coded and then nodes were formed; sometimes sub-nodes were created under one major node using NVivo. Then, I read the second interview transcript while comparing the emerging nodes with the previous existing nodes. The new nodes that fitted with the existing nodes were classified under those existing nodes. Sometimes a few new nodes seemed to be a poor fit with the existing ones so I created new nodes or sub-nodes, most of which fell under the existing major nodes. The whole process was repeated until all the transcripts were coded under their respective participant categories, such as teachers' interviews. The same procedure was used with the students' focus group discussions and the classroom observations.

4.7 The unit of analysis in focus group data

Focus group research methods are considered controversial by some researchers and there are debates about whether the unit of analysis should be the group or the individual (Kidd & Parshall, 2000; Morgan, 1995). Morgan suggests that the social context is an important component in much qualitative research, and focus groups are a good way of capturing these kinds of data. Hollander (2004) defines the social context in a focus group in terms of the relations that are established

between the participants and the facilitator as well as the social structures within which the discussion occurs. She argues that analysing social interactions rather than individual experiences (as might be the case in one-to-one interviews) is an important aspect of focus group methodology. In this respect, it can be argued that the social context affects the nature of the data that are collected as well as the way they are interpreted (Hollander, 2004). In this study, focus groups have been used as a way of understanding how young people think about health, human Biology and the Biology curriculum through listening to their social interactions with each other. This method was used instead of conducting one-to-one interviews about their individual experiences. In this respect, the focus group data in this study can be seen as representing the voice of the group rather than the views of individual participants.

4.8 Research ethical considerations

According to Creswell (2012), formal ethical approval is an important part of the research process. In some cases ethical approval is given by institutions, such as universities. In other cases, ethical principles are monitored and upheld by professional bodies. These kinds of ethical approval mechanisms are intended to protect participants' rights in the research process and reduce or eliminate harm (Orb, Eisenhauer, & Wynaden, 2000). Orb et al. (2000) argue that researchers need to be aware of ethical dilemmas that may arise during field research and they must act in ways that minimise or eliminate risks to participants. With this in mind, this study followed the ethical guidelines of the New Zealand Association of Research in Education. The study also received ethical approval from the Victoria University of Wellington Research Ethics Committee.

In relation to the ethics of gaining access to Tanzanian government secondary schools, it was necessary to seek permission from the government agency that administers these secondary schools. To that end, I sent my University's letter of introduction to district administrators to begin the process of seeking permission

from the local government bodies responsible for secondary schools (see Appendix I). The district administrators issued me with a letter of introduction to each of the government secondary schools where I conducted my research. In contrast, in private secondary schools, I sent the letter to the Head of school that was approved by the Victoria University of Wellington Research Ethics Committee (Appendix A) to serve as an introduction to these schools and did not need to approach any government officials.

In qualitative research, informed consent is important because researchers need to be able to provide written evidence, where appropriate and possible, that participants are fully informed and have engaged in willingly and voluntarily in the research (Orb et al., 2000). Kegley (2004) notes, however, that university ethics committees do not always recognise that informed consent is constructed within specific cultural, political and social contexts and this can influence the way that consent is framed and understood by participants. Entering into verbal, as opposed to written agreements, is a much more culturally appropriate means of coming to an understanding in Tanzania. There are socio-historical reasons for this. During the colonial era, it was not uncommon for the activities of African people to be reported to colonial authorities; informers also reported dissident activities. This created a culture of fear and mistrust and many people lost their lives, their freedom or their livelihoods after being betrayed in this way by people within their communities. For many people in Tanzania, to sign a form is therefore to make something official, bureaucratic and formal and this can be an uncomfortable reminder of things they would rather forget, so most people prefer not to commit themselves in writing. It also seemed to be a contradiction, to some participants, that I was asking them to write their names on a piece of paper at the same time as I was promising them confidentiality. Despite this, I asked my participants to sign formal consent forms because that was what I agreed to do as a condition of my research ethics approval from the Victoria University of Wellington Research Ethics Committee. I explained to all my participants about the study and what was required of them during the research, and I also explained how their confidentiality

would be protected even though I was asking them to sign consent forms. During the field research, I treated my participants with respect and courteousness and that helped to establish a good rapport and gain their trust (Mertens, 1998). I also ensured that the participants were well informed and assured them that their autonomy was and will be protected (Creswell, 2012).

The participants were asked to sign consent forms at each stage of data collection and I have included the consent forms in Appendix J. Fortunately, in all cases, the participants agreed to sign the consent forms and none of them withdrew from the research. Throughout the thesis, I have maintained my participants' confidentiality and I have not disclosed the identities of participants or named the site schools (Wiersma & Jurs, 2005).

4.9 The research trustworthiness

In qualitative research, trustworthiness is associated with the extent to which the findings of the research are regarded as worthy of attention (Lincoln & Guba, 1985). Guba and Lincoln (1994) argue that the criteria for judging the trustworthiness of qualitative constructivist research are its credibility, transferability, and confirmability.

Guba (1981) refers to credibility as member checking (p. 85) which involves asking participants to check data they have provided. In this study, the research participants were invited to check transcripts for accuracy. Yin (2011) argues that this kind of transparency is crucial and that one's peers, colleagues, and participants should have the opportunity to scrutinise the data so that the final study is able to withstand scrutiny by others. In this study, I transcribed interviews and focus group data from the tape recorders into Swahili, and then participants were asked to comment on transcripts which were subsequently refined in light of these comments.

It was not possible to seek member-checks of the classroom observations as I was not collecting the data about identifiable students. In this respect, the classroom observation records were a form of researcher-generated field notes which are not generally given to participants unless there is an extraordinary reason. In the follow-up interviews with teachers, I discussed my impressions (drawn from my observations of their Biology classes) and asked them to discuss and/or elucidate further. They had an opportunity to correct my impressions of the classroom process at that time.

Transferability is another criterion for judging trustworthiness of qualitative research. Transferability is concerned with the extent to which findings can be related to other situations (Shenton, 2004). Guba (1981) asserts that the possibility for transferability depends on the degree of the similarity between two contexts. In this study, I hope I have provided sufficient contextual data for readers to transfer at least some of the findings to their own contexts (Shenton, 2004).

Confirmability is described by Guba (1981) as a further criterion for judging the trustworthiness of research. Confirmability refers to the extent to which the findings can be determined by the participants and the respondents rather than the biases, motivations, or perspectives of the researcher (Lincoln & Guba, 1985). In this study, confirmability was achieved through the triangulation of data from multiple sources; that is, collecting data from multiple perspectives (students and teachers) and using a variety of methods and sources for analysing data (Guba, 1981). In addition, I ensured that detailed methodological descriptions were given so that readers can determine the extent to which the data and emerging constructs may be accepted (Shenton, 2004).

4.10 Trustworthiness across languages translation

There are many issues associated with conducting field research in one language and translating it into another language, as is the case in this study. Problems arise

when an idea, word or concept does not have an identical or even similar meaning in another language (van Nes, Abma, Jonsson, & Deeg, 2010). I have followed van Nes et al. (2010) who suggest that the way to ensure trustworthiness in cross English qualitative research is as follows:

It is important to check the interpretations by going back to the codes and preliminary findings in the source language [...] and the researcher operates as a translation moderator in cooperation with a professional translator. This would involve explaining to the translator the intended meaning and its context in the source language. (p. 315)

In this study, the interviews and focus group discussions were conducted in both Swahili and English although amongst the participants, there was a lot of code switching between the two languages. When it came to preparing the material for analysis, I first transcribed the audio taped interviews which were in Swahili. The transcripts were then given to the teachers to check for accuracy after which I translated the transcripts from Swahili to English. To ensure that the translated scripts were as trustworthy as possible, I spent a lot of time going back and forth between the Swahili and the English versions and I also asked a Tanzanian colleague who is a language specialist to re-check the translation of the transcripts.

4.11 Chapter summary

In summary, the intention of constructing an ethnographic case study approach was to explore students' development of biological literacy in the context of Tanzanian secondary schools. I used multiple research methods, including interviews, focus group discussions, classroom observations and questionnaires, to generate data. Social constructivist and social constructionism theoretical frameworks guided the choice of methods and the process of analysis in this study. In the next three chapters, the findings are presented.

CHAPTER FIVE

STUDENTS' PERCEPTIONS ABOUT THE DEVELOPMENT OF BIOLOGICAL LITERACY

5.0 Introduction

In this chapter, the research findings are discussed in relation to my first research question about the extent to which students believe that the school Biology curriculum facilitates the development of biological literacy amongst young people (see Chapter One). The second research question about the influence of the schooling context as it relates to urban and rural secondary schools is also addressed.

Secondary school curriculum policy in Tanzania aims to equip students with biological knowledge that is immediately relevant to their lives. In line with this, and as has been discussed previously, social constructivist pedagogies are strongly endorsed in education policy documents including those that relate to the science curriculum (URT, 2009a). Zeilder et al. (2005) argue that social constructivist pedagogies can foster students' awareness about social problems in their communities and this can help teachers connect classroom learning to students' life experiences. I argue here that the way that young people think about their health and wellbeing and the level of biological literacy they bring to these matters is also socially constructed. Young and Collin (2004), for example, argue that scientific knowledge and skills, including a working knowledge of Biology, are shaped by the cultural and historical contexts of learners and this view is supported in this chapter. With this in mind, I have applied a social constructionist theoretical framework to discuss students' thinking about school Biology and its relationship with their lived experiences.

Data were gathered through questionnaires and focus group discussions. A total of 322 Year Four students responded to my questionnaire (see Appendices E & F). Several of the survey questions used a five-point Likert scale. The five items on the

scale were: Strongly disagree (SD); Disagree (D); Agree (A); Strongly agree (SA); and, the fifth item on the scale was 'Don't know' (DK). One section in the questionnaire had a four-point Likert scale. These items were as follows: Never, Rarely, Sometimes and Very often. The decision to use a four-point scale was due to the nature of that question where the intention was to find out how often teachers used the teaching methods rather than whether they agreed or disagreed about using teaching methods. In addition, a total of eight focus group discussions were conducted in eight secondary schools, four schools being located in urban areas, and four in rural areas.

The analysis of the questionnaires and the focus group interviews included questions that I have grouped into four main categories as follows:

- 1 *Demographic data*: This included information about students' gender, their subject 'streams' (i.e., I asked whether they were science majors or non-science majors), and whether they were located in urban or rural areas.
- 2 *Students' attitudes about Biology*: This included information about students' level of interest in the subject, their beliefs about the usefulness and relevance of the subject, and biological knowledge they acquired outside of school.
- 3 *Students' perspectives about the implementation of the Biology curriculum*: This included information about Biology content, the teaching methods used in Biology classes, assessment techniques, English as the language of instruction, extracurricular activities and availability of Biology classroom resources. Each of these factors sheds light on whether students' acquisition of biological knowledge is facilitated or constrained by the curriculum and pedagogical approaches.
- 4 *Students' perceptions about the usefulness and relevance of the biological knowledge and the skills they acquire in school Biology, in their future lives.*

5.1. Demographic data

A total of 322 students responded to the questionnaire, and of this number, 162 respondents were located in urban areas and 160 respondents were based in rural areas. In all of the participating schools, Biology is a compulsory subject for all students at this level of schooling irrespective of whether they have been allocated to the science or non-science streams. The purposive sample included eight schools in total, four of these schools were private (independent) schools and four were government schools. They were located in both urban and rural areas. The demographic breakdown of the respondents is presented in Table 5.1.

Table 5.1 Gender, location and subject streams of students

Categories	Urban schools		Rural schools		Total
	Science majors	Non-science majors	Science majors	Non-science majors	
Male	44	40	62	23	169
Female	23	55	52	23	153
Subtotal	67	95	114	46	
Total	162		160		322

The data show that there were more science-stream respondents in rural schools (n=114) than science stream respondents in urban schools (n=67). Initially, I had intended to select an equal number of students from the science and the non-science streams but unfortunately not all schools had equal numbers of enrolments. In two rural private boarding schools, almost all the students took a science major. The reason for this might be that missionary schools are generally better resourced than government schools and can provide students with access to reasonably well equipped laboratories and trained science teachers. It is interesting to note that in rural schools, more students opt to take science majors while greater numbers of students in urban schools that have also commerce streams choose non-science majors. Twice as many female students took science in rural schools (n=52) compared with female students in urban schools (n=23). This may be due to the

high regard in which nurses and doctors are held and their elevated social status in rural areas. Although I do not have supporting data for this, it is also possible that female students in rural areas wish to emulate these professionals. In urban areas, there are many female role models who are successful in their careers and most of them are not scientists. So these situations could well lead rural female students to aspire to be like their role models. In urban schools, there were fewer female students (n=23) who took science compared with male students (n=44) in urban schools.

In selecting members of the focus groups, equal numbers of girls and boys and equal numbers of science and non-science majors were invited to participate in the focus groups. I did this so that there would be a gender balance and also a balance between the science and non-science stream students. Each focus group had six or seven members. I moderated the discussion during the focus groups depending on the interview questions (see Appendix G) and occasionally used prompts if further clarification was required.

5.2 Students' attitudes about Biology

This section includes data from the questionnaire and focus group discussions. The questionnaire data show the degree to which the students felt that what they learned in Biology was useful, interesting and relevant to them. The section also presents my research findings relating to knowledge and awareness about Biology that young people acquire outside of school through their families, communities, and the media.

5.2.1 The relevance of biological knowledge to young people's everyday lives

Miller (2011) argues that people need to be biologically literate in order to make informed decisions about their lives. The results of the questionnaire show that the majority of respondents (n=309) from both urban schools and rural schools agreed that a working knowledge of Biology is useful in their daily lives. Only a few of the

respondents (n=13) disagreed or strongly disagreed with the statement about the usefulness of Biology in their everyday lives that read: 'Biology knowledge and skills are useful in my everyday life'.

5.2.2 School Biology and its usefulness in students' everyday lives

In the questionnaire, students were asked to rate the degree of usefulness they found in the Biology they learned at school. The statement in the questionnaire they were asked to respond to reads: 'Studying Biology at school is useful in my everyday life'. Their responses are summarised in Figure 5.1 below.



Figure 5.1 The usefulness of school Biology in students' everyday life

The majority of participants from both urban (n=93) and rural (n=105) schools either strongly disagreed or disagreed that the biological knowledge and skills they learned at school had helped them in their lives. On the other hand, participants (n=124) either strongly agreed or agreed with the statement that biological knowledge and skills obtained at school are useful in their daily lives. The results show that some students, especially those in rural areas, did not feel that what they learn in Biology classes at school is useful or relevant to them. This might be due to the fact that the majority of rural people in the communities surrounding the school sites are farmers, so rural students appeared not to get sufficient biological

knowledge from school to help them understand or improve their daily farming activities. This contrasts with the responses of urban students whose daily activities in their surrounding environments are commercial, industrial and corporate businesses.

Students' feelings of disconnection from school Biology were even more evident during the focus group discussions. Participants in all eight groups pointed out various areas in the school curriculum that they felt needed to be improved if the aim of school science is to enhance their biological literacy. Many of the focus group participants said that they do not see the connection between what they learn in school and their lives outside of school. They mentioned aspects of their lessons that they did not much enjoy; for example, one student said:

We should learn about issues that are relevant to our daily life rather than learn the complicated names of insects. Sometimes we learn details about the digestion of cattle. I don't see the point of that. I think we should concentrate on issues that are related to human beings, or other things that people need to know about if they want to specialise in Biology at a higher level. (Female student, urban private school)

It is perhaps understandable that the urban student was not interested in learning farming issues as this was not likely to be included in her daily activities and that could be the reason why she showed less interest in learning about cattle and insects. On the other hand, this sort of education is highly relevant to students in rural areas and they showed even less interest in Biology than their urban counterparts.

The participants further commented that they wanted more information about human Biology, particularly as it related to their own health, wellbeing and sexuality. One participant noted:

Reproductive health content is there in the school curriculum but it's taught at a low level. We still need to know a lot more about the subject. Also, I

think the reproductive health programmes need to be extended into our community because some young people do not have the privilege of attending secondary education. (Female participant, urban government school)

The desire to understand more about human Biology was shared by many participants and this will be discussed further in the next chapter.

5.2.3 Students' interest in studying Biology

In the questionnaire, the students were asked to respond to an item that read: 'I find studying Biology at school interesting'. As indicated in figure 5.2 below, the results show that majority of students (n=194) from both urban and rural schools had little interest in studying Biology. In total, 128 students expressed an interest in studying Biology at school.

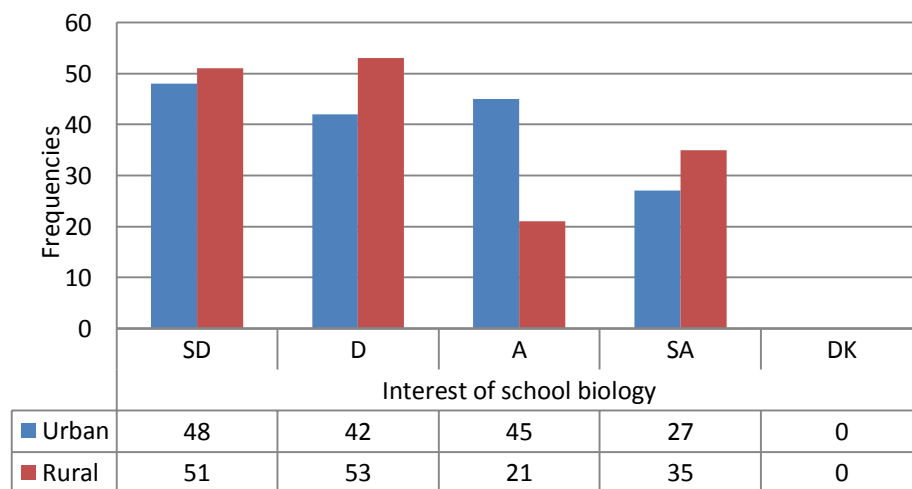


Figure 5.1 Students interest in studying Biology at school

Lyons (2005) argues that a major reason for students' lack of interest in Biology at school is because of the way Biology is taught. For instance, during one of the focus group sessions, one student explained:

Here in school, we do usually learn things but it is better to learn a few things effectively rather than study so many issues that you can't keep up. I think there should be less content in the curriculum. (Male student, rural private school)

This comment shows that this student felt that the school curriculum is overloaded and much of it was not interesting to them. This feeling was reflected by other students who made similar comments. In this respect, they wanted to study a few important issues in greater depth.

5.2.4 Opportunities for learning about biological issues outside school

In the questionnaire, the students were asked to respond to an item that read: 'I learn about interesting biological issues outside of school which are useful in life'. The questionnaire data (see figure 5.3 below) show that the majority of respondents either agreed or strongly agreed that the biological information they acquire outside of school often had a higher level of interest and relevance for them than school Biology.

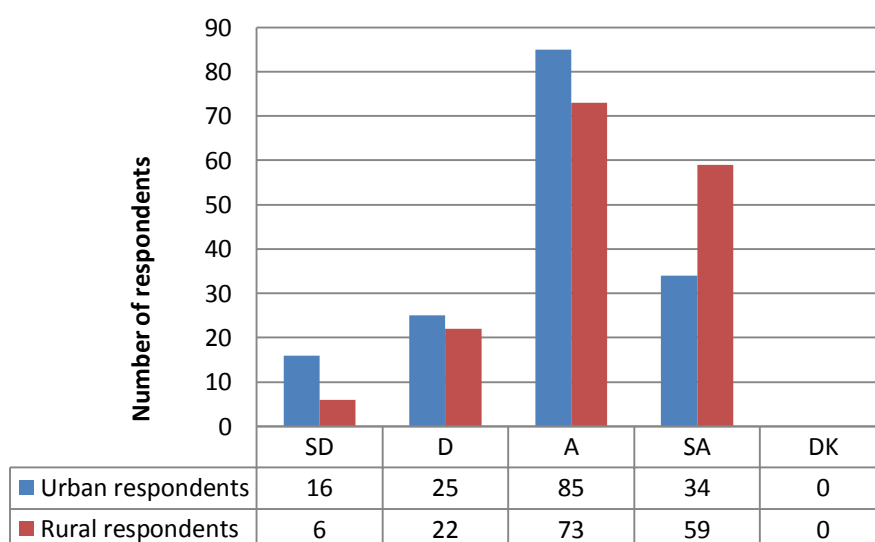


Figure 5.2 Knowledge about biological issues acquired outside school

During the focus group discussions, the participants also identified various places where they get information about biological matters relating to health and wellbeing that encourage them to put into practice things they have learned in their Biology classes at school. Amongst the out-of-school sources of information that they mentioned were:

- religious groups, based in churches and mosques
- home environments with parents and friends
- hospitals
- community health centres
- community organisations
- festivals, such as when young people perform dramas, sing and recite poetry to raise awareness about HIV/AIDS; and,
- community projects, such as HIV/AIDS awareness projects.

They also mentioned various media that provided them with information, such as:

- the internet
- television
- radio
- magazines; and,
- brochures.

In addition, participants in one urban group commented that they sometimes learn from the consequences of things that have happened to other people. For example, one participant explained:

When somebody gets into trouble over something that is health-related, you definitely learn from the bad consequences that the person suffers. For example, if a person gets a certain disease because they have been negligent about their health you can learn from the situation. (Female participant, urban government school)

This comment shows that some students not only learn from the positive things that happen around them in their communities and wider society but they also learn from observing the negative consequences that come about when people do not have healthy lifestyles or practice poor hygiene. This section has shown that the participants were aware that biological knowledge and skills are useful in their daily lives; however, most of them were not enthusiastic or engaged with the way that Biology is taught in school.

5.3 Students' perceptions about the implementation of the school curriculum

This section discusses how the school curriculum can either support or constrain students' biological literacy. Data relating to students' views about the school curriculum are drawn from the questionnaires and the focus groups. The first part of this section provides information about students' perceptions about Biology curriculum content which includes health issues, climate change and biotechnology. The latter part of this section discusses the kinds of teaching methods that are used in Biology classes, it also addresses a range of issues including discussions about assessment techniques, English as the language of instruction, extracurricular activities, and the availability of resources. Each of these curriculum-related issues is linked to participants' ideas about their usefulness in equipping them with decision-making knowledge and skills in their daily lives.

5.3.1 Content

The findings from the questionnaires are the main focus of this chapter and the key issues are introduced, but for the purposes of clarity, the discussion below is supplemented with a small amount of data from the focus group interviews. In the section that follows, focus group participants and questionnaire respondents talk about the Biology school curriculum.

Overall, most of the focus group participants in one group (6/8) said that school provides them with information and a level of knowledge about how to tackle

diseases that affect their community, such as malaria, cholera, HIV/AIDS, STDs (for example gonorrhoea). Members of two focus groups, one in an urban school and the other in a rural school, commented that they have learned about the prevention and symptoms of various diseases at school and would subsequently be able to recognise symptoms if a friend or family member contracts the illness. They would also know when to seek medical assistance. Mubyazi, Barongo, Kamugisha, and Njunwa (2013) argue that the way certain diseases are perceived and treated is influenced by cultural beliefs and practices. These practices are not always effective in saving lives and Mubyazi et al. contend that effective strategies need to be written into educational policy in order to address this issue. This matter is discussed further in Chapter Six.

Participants in seven of the eight focus groups talked about the way that reproductive health is taught in their schools. They learn about issues such as sexual abstinence, the risks of unprotected sex and family planning methods, including the use of contraceptives. However, young people in four of the focus groups said that what they learn at school is not adequate in helping them make informed decisions about the sorts of reproductive health issues they face. One participant said:

We young people need reproductive health education in order to be able to make decisions about sexual matters. What we get in class isn't enough to make decisions. For example, when a girl gets pregnant and wants an abortion, she needs to know enough about abortion to be able to make an informed decision about whether to abort or not. (Male participant, rural government school)

Members in each of the focus groups commented that education about reproductive health education needs to be reformed so that students have the knowledge and understanding they need to make informed decisions. They mentioned the following issues:

- the consequences of engaging in early sexual activity (for example, below the age of 18 years or while still at school)

- the need for reliable information about their reproductive health
- the desire to spend more time learning life skills that would help them to cope with peer pressure and stress, as well as the pitfalls of prostitution and sexuality which are rife amongst young people in some communities
- the need for reliable information about STIs
- the need for honest, reliable and accurate HIV/AIDS education, and
- the need for teachers to help young people build their confidence about making informed decisions.

Participants in two of the urban focus groups said that they learned how to do first aid at school and that this had given them the skills they need to help people at home when an accident happens. However, they also said that they did not learn practical first aid techniques from watching or participating in demonstrations; rather, they were told about first aid practices. One participant explained, “For instance, we were told about how to help a person who is drowning but we weren’t shown how to do cardiopulmonary resuscitation. We memorise the procedures and hope to remember them if there’s an accident at home” (urban male participant, government school). By contrast, a participant in another urban group said that it is difficult to practice first aid at home because his family do not own a first aid kit. He said:

In my opinion, I don’t think I’m getting enough support because there’s a lack of resources. For instance, if someone at home has an accident I can’t do anything to help because we don’t have first aid kit items at home. (Male participant, urban government school)

This finding shows that while the students thought that knowledge about first aid was useful, they also needed first aid techniques to be demonstrated rather than just explained verbally.

Aside from this, there was a certain amount of discussion about the things that students do think about in relation to what they learn at school. For example,

members of two of the urban focus groups commented that in school they learn about the consequences of anti-social behaviour, such as the misuse of drugs or theft. One participant commented:

We are taught about inappropriate and risky behaviour because they want us to take precautions against peer pressure when we are not at school. So they teach us that we shouldn't join up with people in bad groups who might lead us into bad behaviour, like taking drugs. (Male participant, urban government school)

This statement is in line with one of the objectives of the Biology curriculum which states that the intention of the curriculum is to help students to combat health-related problems such as drug abuse (URT, 2005). This is discussed further in the next chapter.

The findings in this section show that students want more information and education in their Biology classes about the spread of disease, but their main concern was being knowledgeable and informed about sexuality and reproductive health. Mkumbo and Ingham (2010) argue that the need for reliable information and knowledge about reproductive health among young people is important but they contend that young people's needs in this respect are more diverse than is sometimes given credit for, so there is a need to understand their views and priorities about these matters. These needs and priorities are discussed further in the next chapter.

5.3.1.1 Cultural practices and human health

The students responded to a statement in the questionnaire that read: 'I am interested in learning about health issues that are related to cultural issues'. In answering this statement, the students indicated their preferences in learning about health matters and its relationship to their culture. The respondents' interest levels were very similar in the urban and rural areas as is indicated in figure 5.4.

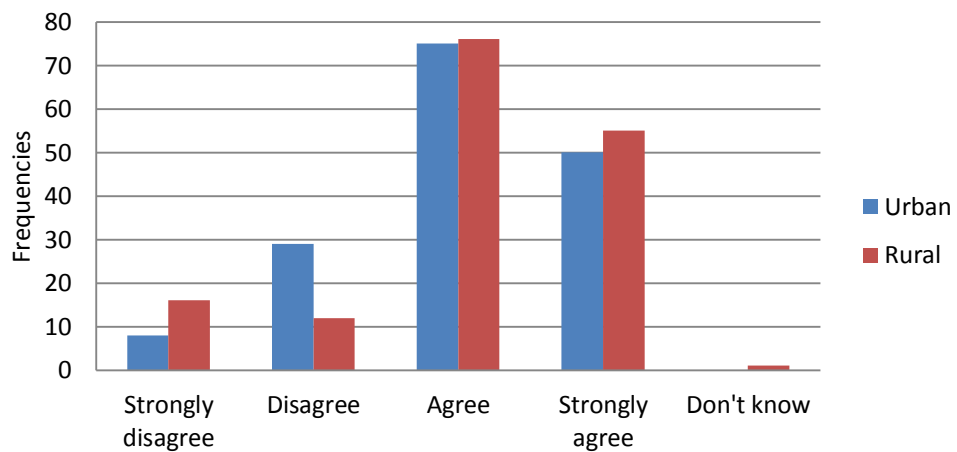


Figure 5.3 Students' interest in studying health issues in relation to cultural practices

Most of the participants in both urban and rural schools were interested or very interested in learning about health issues in relation to the cultural practices and values of their own communities and they saw this as being a legitimate part of the Biology curriculum. The majority of participants recognised the importance of learning about health in order to be able to make informed decisions in their cultural lives. This may be because in Tanzania, certain cultural practices are linked to specific health problems. For example, FGM is a cultural practice that has a significant influence on women's health. The few students who disagreed with the questionnaire statement and said they were not interested in studying health within their own cultural contexts were perhaps frustrated that the many initiatives currently taking place in Tanzania to combat unhygienic or dangerous cultural

practices in their society were having little effect. Their views about FGM became apparent during focus group interviews and this is discussed further in Chapter Six.

Figure 5.5 shows the students' responses to two questionnaire statements that relate to cultural practices. These statements were: 'In school, my understanding of health issues that are related to culture has improved'; and, 'Outside of school, I have learned interesting things about health issues that are related to culture'.

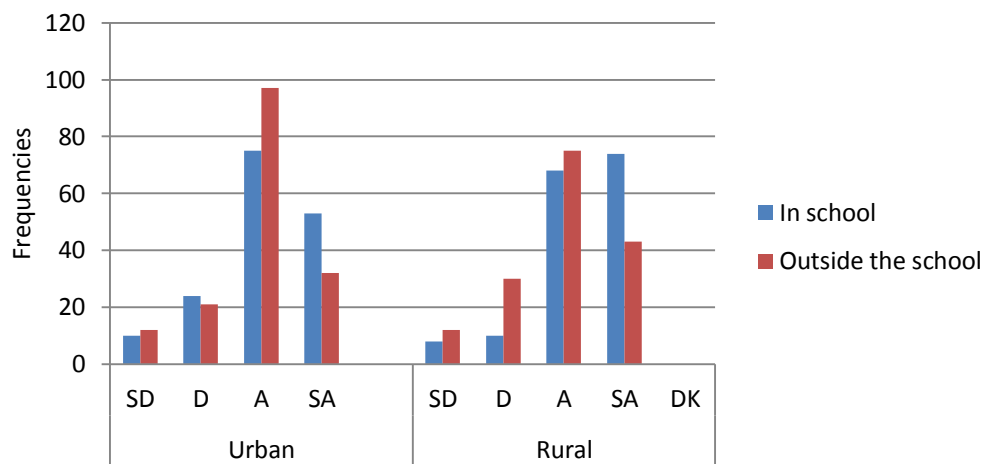


Figure 5.4 I have opportunities for learning about health issues in relation to culture and cultural practices

Both urban and rural students said that they have opportunities to learn about health issues that are relevant to their culture both at school and also outside of school. However, a small number of students were not satisfied with the opportunities they were given to learn about cultural practices that are related to health issues, as is also shown in Figure 5.5 above.

When responding to a statement about the usefulness of what they were learning in and beyond school, there was a greater difference between the urban and rural students' responses. Figure 5.6 below shows the responses to a questionnaire statement that read: 'What I have learned in school about health issues has little to do with my everyday cultural life'.



Figure 5.5 Students' learning at school about health issues and its relationships to students' everyday cultural life

More urban students (n=107) either agreed or strongly agreed that the knowledge and skills they learned in their school Biology programme provided them with useful information. This was not so for the rural students where a majority (n= 120) believed that what they learned at school was neither useful nor culturally relevant (see figure 5.6). This may be because rural students' experiences of cultural practices tend to be very different from those of their peers in urban centres. Students in rural areas are more likely to live in communities where tribal and cultural practices are part of their daily lives. In contrast, students in urban schools have a greater exposure to the more multicultural nature of the cities and are more likely to be interacting regularly with many diverse peoples from different tribes and other African countries.

The students also expressed their views about the usefulness of school Biology education in helping them to understand and challenge specific cultural practices, such as FGM. Students responded to a questionnaire statement that read: ‘What I have learned in Biology classes helps me understand and make informed decisions about ‘Female genital mutilation’ (FGM) issues’.

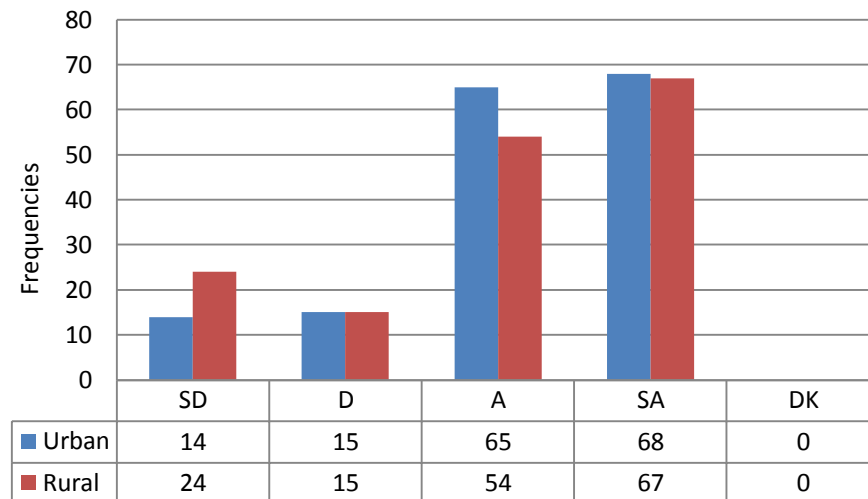


Figure 5.6 The Biology curriculum at school helps me to understand FGM

Both rural and urban students agreed that what they learned at school was useful in raising their awareness about practices such as FGM. As indicated in figure 5.7 above, 68 respondents from urban schools strongly agreed and 65 agreed that what they learned at school was useful in helping them to understand about the negative impact of FGM on women’s health. Similarly, 67 rural respondents strongly agreed and 54 agreed with the questionnaire statement. During the focus group discussions, participants in two focus groups, one in an urban school and the other in a rural school, said that the Biology school curriculum had facilitated their learning about the negative consequences of cultural practices such as FGM. The results from the focus groups were in line with the questionnaire results. However, a few questionnaire respondents (from both urban and rural schools) disagreed about the usefulness of what they were learning about FGM. This might be due to the fact that school education about FGM is mainly focused on the consequences of

FGM rather than on educating people about how to help those who have undergone FGM.

The next question explored the influence of cultural practices on HIV infections. The items (as indicated in the questionnaire) and the students' responses are presented in table 5.2 below.

Table 5.2 Student responses about cultural practices and Students' beliefs and the spread of HIV/AIDS

Item	Rural responses					Urban responses				
	SD	D	A	SA	DK	SD	D	A	SA	DK
What I have learned in Biology classes helps me make decisions about HIV/AIDS issues in my everyday life.	1	1	61	99	0	7	8	50	98	0
Cultural beliefs and explanations about sexuality and sexually transmitted diseases positively influence people's understanding about HIV/AIDS issues.	15	23	75	49	0	12	20	78	50	0
Woman who have undergone FGM are vulnerable to HIV infection.	13	18	58	73	0	16	13	54	77	0
Someone who is HIV positive should be willing to share this information with sexual partners.	13	20	63	65	0	24	23	62	51	0
Giving care and support to a person who is HIV-infected helps him/her to think positively about their life.	7	7	60	88	0	40	34	38	48	0
n=322										
Total	n=162					n=160				

As indicated in table 5.2 above, the majority of students in urban and rural schools agreed that what they learned in their Biology classes had helped them to make informed decisions about HIV/AIDS-related issues. In addition, the majority of respondents in both urban and rural locations either strongly agreed (n=99) or agreed (n=153) that cultural beliefs and explanations positively influence people's understanding about HIV/AIDS (table 5.3). Their agreement became clear during

focus group interviews when the majority of participants from both rural and urban schools showed their concerns on the effects of cultural beliefs on the spread of HIV infections.

Also, the majority of students agreed that what they learned at school helped them to acquire useful knowledge and skills for dealing with cultural beliefs and practices relating to FGM and the increased risk of HIV infection. For example, most were aware that FGM practitioners sometimes use the same unsterilised knife to circumcise different females. A small minority of respondents either strongly disagreed or disagreed with the statement that what they learn at school is helpful in raising their awareness about FGM. During the focus group discussions, two groups (one in an urban area and one in a rural area) said that what they learned in the school curriculum has facilitated their learning about the negative consequences of cultural practices such as FGM. Most participants agreed that HIV-positive people should declare their HIV status to current and prospective sexual partners although a considerable number disagreed. Generally, students agreed that care and support should be given to people who are HIV-positive.

Overall, the findings from this section show that the students were very interested in understanding how cultural practices affect people's health and wellbeing. However, they also said that they wanted more attention given to these matters in school and they saw Biology as playing a role in addressing their questions about these cultural practices.

5.3.1.2 Students' perspectives about climate change and its impact on human health

Climate change has an increasing impact on human health (Mahaffy et al., 2013) and Haines, et al. (2006) argue that many people want to be more knowledgeable about how to deal with the situation. In this section, I discuss students' responses to a questionnaire item that read: 'I am interested in learning about health issues that are related to climate change'. Their responses are summarised in figure 5.8 below.

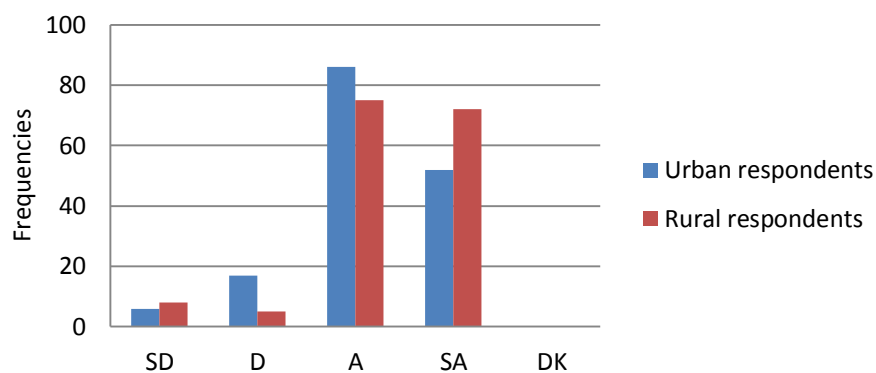


Figure 5.7 I am interested in climate change and health issues

These findings show that a large number of respondents (n=285) were aware of the potential effects of climate change on their health and were interested in learning more about these matters (figure 5.8). In Tanzania, people tend to see links to climate change in relation to droughts, floods, coastal storms and desertification since these conditions affect their wellbeing and many have already begun to directly experience these events (The Centre for International Governance Innovation, CIGI, 2009).

The students also responded to a related questionnaire item that read: 'In school my understanding of health issues that are related to climate changes has improved'. Their responses are summarised in figure 5.9 below.

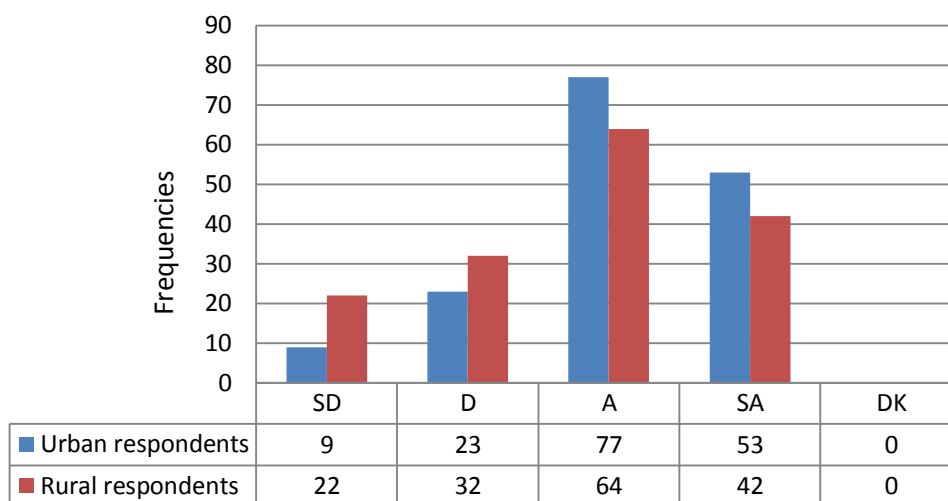


Figure 5.8 Students' understanding of health issues in relation to climate change improved in school

The majority of respondents either strongly agreed or agreed that education about climate change is improved and that what they had learnt at school had helped them to understand how climate change affects human health (see figure 5.9). However, in the current Biology syllabus, few connections are actually made between climate change and associated health issues (URT, 2005). These findings indicate that most students were satisfied with what they learned at school in relation to climate change despite the fact that the current Biology syllabus does not cover much about these issues.

The students' responses to a related questionnaire item that read: 'What I have learned in school about health issues in relation to climate change is useful for making decisions in my everyday life' are outlined in figure 5.10 below.

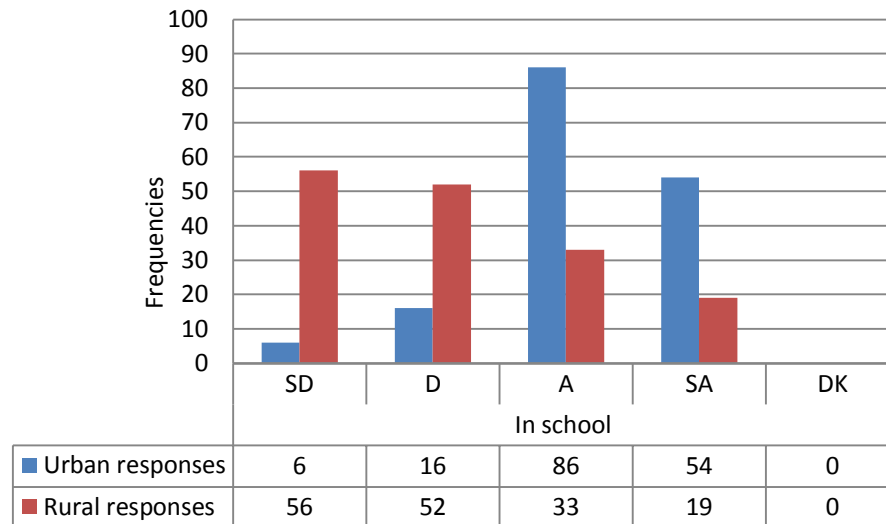


Figure 5.9 School learning about climate change in relation to human health and its usefulness in making students' daily decisions

The majority of urban respondents either strongly agreed or agreed that they learned about climate change at school (see figure 5.10). In rural schools, the majority of respondents (108 out of 160) either strongly disagreed or disagreed that school is the place where they learn about climate change and associated health issues. This may be due to the fact that these particular rural students were located in an agricultural community where the impact of climate change has been directly experienced, especially during dry seasons where increasingly severe droughts make agricultural activities much more difficult. CIGI (2009) also note that drought caused by climate change is seriously affecting agricultural activities and food security in eastern Africa. In this study, it was clear that students in urban areas, have not yet experienced the effect of climate change to the same extent and this may account for the variation in responses between rural and urban students.

The respondents were asked to indicate their level of agreement with an item that read: ‘Outside of school I have learned interesting things about health issues that are related to climate changes’. Their responses are summarised in figure 5.11 below.

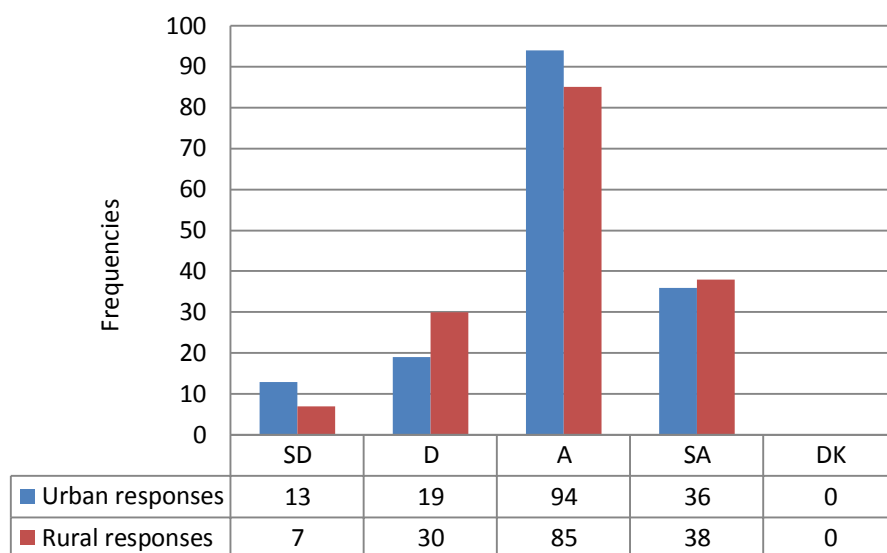


Figure 5.10 Usefulness of out-of-school knowledge about climate change and health

The responses to this item were very similar between urban and rural students. Overall, the respondents either strongly agreed or agreed that they had acquired the useful information from sources outside of school (see figure 5.11). From focus groups, they mentioned sources include the media, community projects, magazines and community meetings.

Participants in all eight focus groups believed that climate change is one of the factors that will create the most serious challenges in Tanzanian society in the future. The questionnaire respondents were asked to express their overall perceptions about different climate change scenarios and their effects on health. I developed a series of questions about this following Haines et al. (2006) who argue that when climate change increases rainfall and has an effect on temperatures, there is a subsequent increase in diseases such as malaria. Table 5.3 shows that the majority of students understand that climate change can be detrimental to human health.

Table 5.3 Beliefs about the effect of climate change on human health

Item	Urban responses (Frequencies)					Rural responses (Frequencies)				
	SD	D	A	SA	DK	SD	D	A	SA	DK
I believe that climate change poses risks to human health.	3	20	91	48	0	1	14	69	76	0
I believe that the effects of global warming such as flooding causes an increase in some diseases like malaria.	27	13	47	68	07	26	20	65	49	0
I believe that climate change causes an increase in asthma, respiratory allergies and airway diseases.	11	14	74	62	1	07	25	80	47	1
Total	n=162					n=160				
	n=322									

CIGI (2009) argue that African perspectives of climate change are mainly focused on climate issues in terms of the direct effect on human lives, although people are also concerned about the risks to national economies. Most of the respondents in my study also believed that climate change poses a risk to human health. For the most part, the respondents either strongly agreed or agreed with the statement that the effect of global warming such as flooding increases the occurrence of malaria. Also, four groups from urban schools (from private and government schools) and rural private schools argued that heavy rain provides favourable breeding sites for mosquitoes which facilitate the spread of malaria.

In addition, a large number of respondents either strongly agreed or agreed that climate change accelerates illnesses such as asthma, respiratory allergies and other airway diseases. These questionnaire data concur with findings from the focus group discussions. Participants in four focus groups in private and government schools believed that changes in temperature can exacerbate certain illnesses, such as asthma and respiratory infections. Participants in two other urban groups

suggested that heavy rain can cause flooding which can lead to an increase in some diseases, such as cholera and bilharzias.

During the focus group discussions, several participants also mentioned that drought caused by climate change can result in a variety of health problems. Members of four groups from urban schools (private and government schools) and rural schools (private and government schools) were aware that drought causes starvation because not enough food is produced to feed people. They were also aware that it causes malnutrition such as kwashiorkor (severe protein deficiency) and marasmus (severe energy deficiency). Members of three focus groups claimed that many of the factories in the urban areas increase global warming and contribute to ozone depletion. One of the urban government participants elaborated on this: “I think that not all the air we breathe is good for our health. Sometimes we inhale bad air which causes respiratory problems and that can cause infections or even cancer” (male participant, urban government school).

In summary, the findings from both the focus group interviews and the questionnaire indicate that the majority of respondents were aware of the effects of climate change on human health. The findings also show that rural students who have experienced the impact of climate change on agricultural activities were less satisfied with the level of information they received about these issues at school (see Figure 5.10).

5.3.1.3 Biotechnology and human health

The questionnaire respondents were asked to rank their level of agreement with a statement that read: 'I am interested in learning about health issues that are related to the use of biotechnology'. Their responses are summarised in figure 5.12 below.

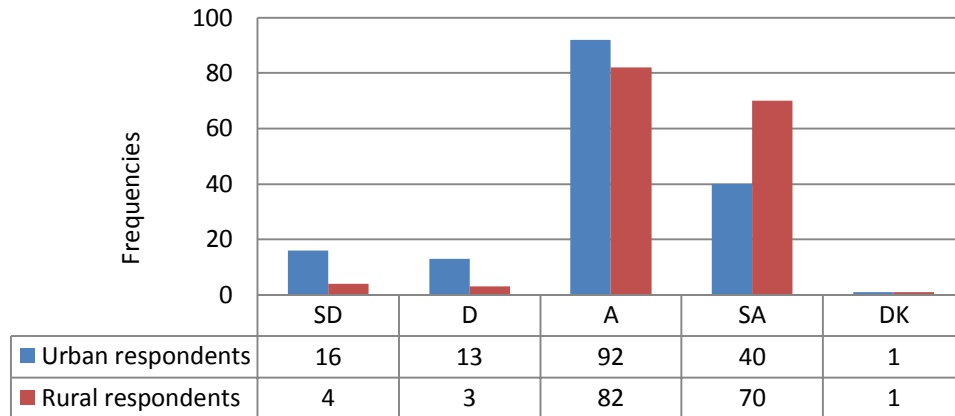


Figure 5.11 I am interested in learning about health issues in relation to biotechnology

Lewis, Newell, Herron, and Nawabu (2010) have found that farmers in Tanzania have little understanding or awareness about genetically modified crops. In some respects, this was reflected in the large number of respondents (n=284) in this study who indicated that they were interested in learning about health issues related to the use of biotechnology (as is indicated in figure 5.12 above), but during the focus group discussions it became evident that most of them have little understanding about biotechnology itself. Indeed, during the focus group discussions, it was clear that most students were not even able to define biotechnology. As will be discussed further in the next chapter, a few participants speculated about health hazards of eating genetically engineered food. Lewis et al. (2010) also found that very few Tanzanian farmers know about the potential hazards of genetically modified food and crops. Similarly, most of the participants including those in rural and agricultural areas, were unfamiliar with biotechnology but expressed an interest in knowing more.

Students were also asked to respond to a questionnaire item that read, 'In school my understanding of health issues that are related to the use of biotechnology has improved'. Their responses are summarised in figure 5.13 below.

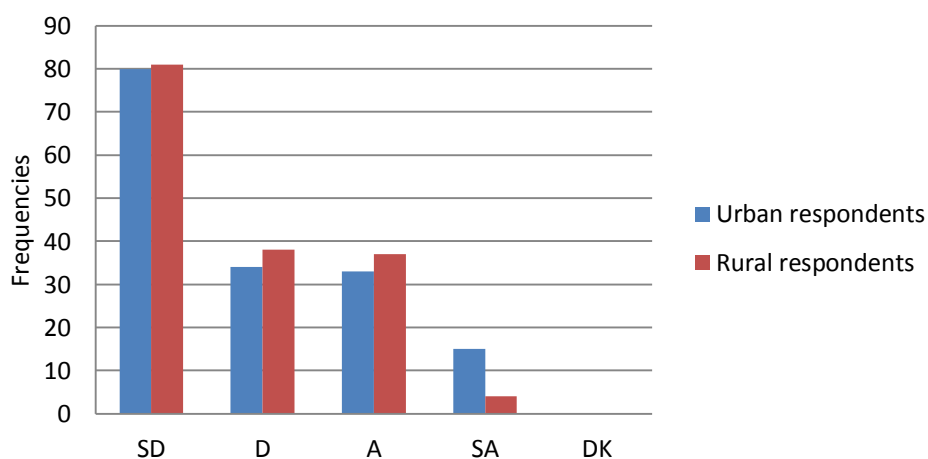


Figure 5.12 School learning improved students' decision-making about biotechnological issues in relation to health

The majority of the questionnaire respondents in both urban and rural schools either strongly disagreed ($n=161$) or disagreed ($n=72$) that what they learned at school had helped them to make informed decisions about biotechnological issues (see figure 5.13 above). Only a few either agreed or strongly agreed with this statement. This finding suggests that students are not satisfied with the current level of teaching about biotechnological issues.

The students were further asked to respond to a questionnaire item which read: 'What I have learned in school about health issues in relation to the use of biotechnology is helpful for making decisions in my everyday life'. Their responses are summarised in figure 5.14 below.

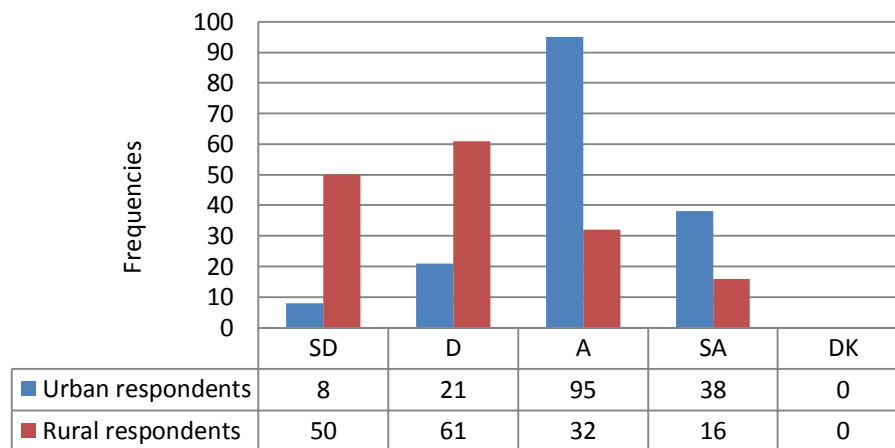


Figure 5.13 What I learn at school is useful in making decisions about biotechnological issues in relation to health

As indicated in figure 5.14 above, the majority of rural students either strongly disagreed (n=50) or disagreed (n=61) that what they learned at school was useful in making daily decisions about biotechnological issues. In contrast, the majority of urban respondents either strongly agreed (n=38) or agreed (n=95) that what they learned at school had helped them to make informed decisions on biotechnological issues in their everyday lives.

The students also responded to a questionnaire item that read: ‘Outside of school I have learned interesting things about health issues that are related to the use of biotechnology’ (see figure 5.15 below).

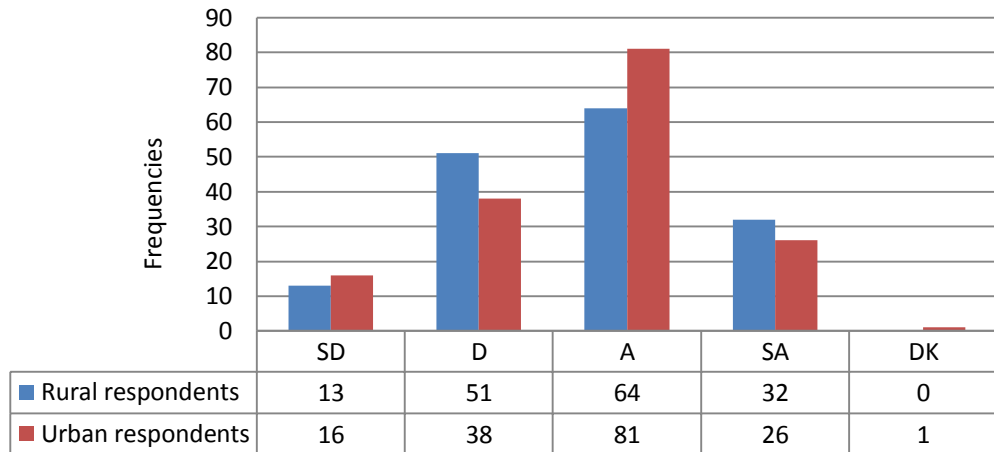


Figure 5.14 Information about biotechnology and health acquired outside school

The majority of questionnaire respondents indicated that they learned about health issues related to the use of biotechnology from sources outside of school. However, a good number (n=118) of respondents either disagreed or strongly disagreed that they learned about health issues related to biotechnologies outside of school. In this respect, the findings are inconclusive and are probably linked to the fact that the participants had very limited understanding or awareness of matters relating to biotechnology.

The students were also asked about various issues relating to the use of biotechnology as indicated in table 5.4 below.

Table 5.4 Beliefs about the effect of biotechnology on human health

Item	Urban responses					Rural responses				
	SD	D	A	SA	DK	SD	D	A	SA	DK
In school, students learn that biotechnology can be used to manufacture food and medicine.	9	26	76	51	0	12	29	75	42	2
Eating food from plants or animals that has been manufactured using biotechnology creates risks for my health.	19	25	68	29	21	12	43	56	26	23
The nutritional value of food is increased if the food is obtained from plants or animals that have been treated with biotechnology.	73	43	17	17	12	71	33	16	30	10
Total	n=162					n=160				
	n=322									

The questionnaire respondents were asked about their degree of agreement with statements about biotechnology and the manufacturing of food and medicine. The majority of respondents in both urban and rural schools either strongly agreed (n=93) or agreed (n=151) that they learned about biotechnological matters relating to the manufacture of food and medicine when they were at school (see table 5.4).

However, a good number (n=68) of respondents were not sure about the effects of biotechnological products on human health. A large number of urban respondents (n=21) and rural respondents (n=23) were not sure if eating food manufactured biotechnologically might constitute a risk to human health (see table 5.4 above). Similarly, Usak, et al. (2008) in their study of Turkish schools, found that students believed that genetically modified food could endanger human health because dangerous chemicals were used in the genetic modification process. In my study however, some urban students (n=12) and rural students (n=10) were not sure whether or not biotechnologically treated food increased its nutritional value (see

table 5.4). This indicates a reasonable number (n=68) of students do not understand the benefits and risks involved in the genetic modification of food.

5.3.2 Teaching methods used in Biology classes

All 322 students from the participating urban and rural schools responded to a questionnaire item about the teaching methods used in their Biology classes. One of the questionnaire items read: 'Please show how often you have experienced each of the following teaching methods in your Biology class.' Their responses are summarised in table 5.5 below.

Table 5.5 Teaching methods used in Biology classes

Teaching method	Never	Rarely	Sometimes	Very often
	Percentage (%)			
Lecturing	0.3	2.8	45.7	51.2
Whole class discussion	2.2	13.4	53.7	30.7
Small group discussion	0.6	18.9	42.9	37.6
Questions asked by the teacher	0.9	8.4	27.0	63.7
Question asked by students	0.3	15.5	28.0	56.2
Demonstration by the teacher	20.8	30.7	22.4	26.1
Laboratory work	34.2	36.3	26.7	2.8
Making observations during field trips	50	36.6	10.9	2.5
Using technology (CD, software, video)	76.7	18.9	3.7	0.7
Doing Biology projects	44.7	37.0	14.9	3.4
Total	n=322			

The most common teaching method in school Biology classes is the teacher-centred lecture method. Most participants (51.2%) reported that this method was used most often in their Biology classes and 45.7% said it was used sometimes (see table 5.5 above). This was followed by whole class discussion and small group discussion. According to 63.7% of the students, their teachers often asked questions during class and 56.2% indicated that students also asked questions often. In relation to practical work, teacher demonstrations were often practiced (26.1%) and over 70%

of the respondents indicated that they either rarely did laboratory work or never had the opportunity to engage in practical work. Field trips, the use of technology, and project work were also rare in Biology (see table 5.5). The questionnaire results agreed with the focus group results in this respect. In the focus groups, the students said that lecture methods and questions and answer techniques were most often used, followed by small group discussions and whole class discussions. Teacher-led demonstrations were also sometimes conducted. This shows that teachers more often use methods that require few resources. This is probably because of the nature of class sizes in Tanzania where classes of between 50 and 80 students are the norm. In addition, many schools have limited teaching resources. Overall, the results show that there is no significant difference between teaching practices in urban and rural schools.

During the focus group discussions, the students also mentioned other teaching techniques their Biology teachers had used in their classes such as copying notes from the blackboard, and occasionally, the use of real life examples. One student added that, "We often benefit from guest speakers who come to school to teach us about health issues" (female student, urban government school). In a few schools, the students participated in debates, did project work, and attended seminars presented by experts who had been invited to speak to their class. The focus group participants made it clear that their teachers usually opted for teacher-centred pedagogical approaches and rarely used more engaging student-centred methods. Zeilder et al. (2005) argue that these teacher-centred pedagogical approaches deprive students of the opportunity to acquire relevant decision-making skills and knowledge.

The use of hands-on teaching approaches was rare in most of the site schools (see Table 5.5), although students from one rural private boarding school, where teaching resources are more plentiful, said that they often did practical work in their school. At the same time, they complained that doing practical work meant that they have to learn a lot of rapidly paced content and that they would prefer to

learn a few things in more depth and at a more relaxed pace. Participants in one urban group in a government school commented that their school does not have a laboratory and as a result much of what they learned in Biology was taught as theory. In contrast, a student in a focus group in an urban private school commented, “A lot of the time, the teacher comes to class and mostly just writes notes on the blackboard. We don’t do laboratory work. We do actually have a laboratory but the teachers don’t use it” (urban male participant, private school). Another participant from the same group suggested that, “I think teachers need to do more demonstrations rather than just teach us only about theory because this helps us to remember things rather than just listening to lectures” (urban male participant, private school).

In social constructivist classrooms, providing students with opportunities to share their experiences based on their prior knowledge is considered to be an important component of learning. This notion helped me to shape a questionnaire statement that read: ‘In our Biology class we are often asked to share our everyday life experiences’. The majority of students who answered the questionnaire indicated that they do not have the opportunity to share their everyday life experiences in their Biology classes (figure 5.16).

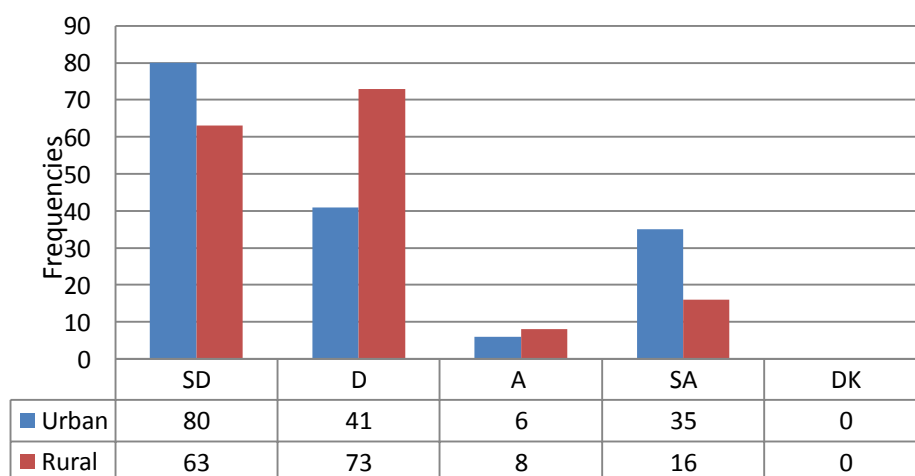


Figure 5.15 Opportunities to share everyday life experiences

This finding reveals that teachers rarely took the time to find out about the prior knowledge that their students bring to the classroom, nor do they attempt to identify and correct any misconceptions they may hold. The underlying constructivist belief here is that new knowledge can be constructed in relation to a student's existing ideas and beliefs. In the learning environments that the students were talking about, however, few teachers practice these pedagogies.

During the focus group discussions, the students talked about their preferred approaches to teaching and learning. Among the teaching methods they preferred the most were practical work, followed by field trips (see figure 5.17).

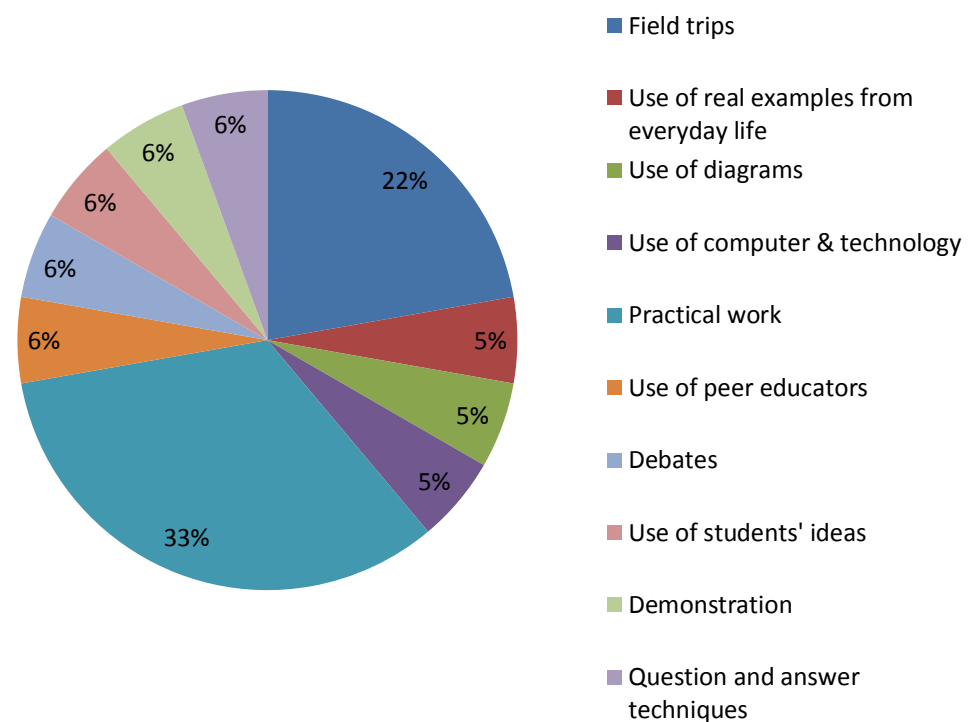


Figure 5.16 Students' preferred teaching approaches (data taken from student focus group discussions)

During the focus groups, the students noted that the use of the teaching methods listed in figure 5.17 above would help them to learn better. One student said, "We need to see what happens rather than learn from mere words." They expressed a

strong preference for practical work rather than teacher-led lectures. In summary, this finding shows that students prefer teaching methods that involve them rather than simply listening to teacher-centred lectures.

5.3.3 Assessment techniques

I think the education we get is geared towards the exams. I mean that education is all about answering exams and tests. That's clear to us when a teacher announces that we're going to have a test. People might pass but if students don't know in advance that they're going to sit a test, they just end up failing. In class, we should learn how to use knowledge in our lives and not just answer questions for the sake of the exam. (Rural male participant, rural private school)

The participants' comments show that they feel that much of their schooling is dedicated to preparing them to sit examinations and tests rather than prioritising their long-term learning. Similarly, Sumra and Rajan (2006) argue that the nature of the Tanzanian examination system encourages students to rote learn and to recall and reproduce what they have learned in the classroom rather than engage intellectually with curriculum material. In line with this, members of one urban focus group commented that examinations force them to focus on getting good test scores rather than the relevance of classroom content to their daily lives. One participant commented:

Someone might do well on tests but that doesn't mean they're educated. Likewise, a person might have a lot of education but still use illegal drugs. There is the issue of learning and the issue of being educated and these are two different issues. You can learn but not be educated. (Male participant, urban government school)

This participant was saying that learning is more than simply a matter of passing examinations. He argued that learning things that are relevant and useful in daily life is also important. Participants in one urban focus group said that the kinds of questions they are asked in Biology classes check only their ability to recall facts

rather than their ability to apply what they learn. This suggests that teachers ask students questions that are narrowly focused and designed to prepare them for exams and do not address the broader biological issues that have relevance to their everyday lives. For example, one participant commented that, “What we learn at school doesn’t help us to deal with things that happen outside of school. Sometimes we have questions that teachers can’t answer” (male participant, urban private school).

5.3.4 The language of instruction

Not everyone who performs poorly in examinations is unintelligent. The English language is a real obstacle because somebody may know the answer but fail to write it well in English. (Urban male participant, government school)

The students raised many concerns about the English language as the medium of instruction in Tanzanian secondary schools and most of them saw it as an obstacle to their learning. This view is supported by Qorro (2013) who argues that English as the medium of instruction in Tanzanian secondary schools causes serious problems for students’ learning.

All the participants talked about the challenges they face when English is the medium of instruction in classrooms. Young people in each of the focus groups agreed that switching from using Swahili, which is the medium of instruction in primary schools, to English as the medium of instruction in secondary schools, is a major challenge for them. Members of one focus group commented that English is taught as a subject in primary school and they expressed their dislike of the subject. They also commented that it is not always taught well and that poses problems for them when they reach secondary school and are required to write and speak in English. Swilla (2009) argues that the switch from Swahili as the language of instruction in primary schools to English in secondary schools negatively affects the majority of Tanzanian children who have attended Swahili-medium primary schools.

In the rural schools, the participants felt that English-medium schooling was more problematic for them compared with their peers in urban schools. Members of one rural focus group said that even speaking and writing in Swahili is a challenge for many of them and that English-medium instruction is yet another barrier to their learning. This is because in rural villages, tribal peoples speak their own languages and maintain their own distinctive linguistic traditions. In these communities, people communicate in their own tribal language at home rather than in Swahili and in this regard, Swahili is a second, third, or even fourth language for many. Once students in these areas reach secondary school and are required to speak English, they quickly begin to fall behind in their studies. One participant commented:

There is a need to improve the way that English is taught and spoken at school. Teachers need to give us more opportunities to practice speaking and writing in English. When we start off our schooling in Swahili and then at the end we have to do our examinations in English, we really struggle. That's because we still use English in our studies so it's important for us to be fluent in English. (Male participant, urban government school)

Another participant added, "I think English language teaching should be improved in primary schools. We see our peers in International schools; when they reach secondary school they are very fluent in English" (male participant, urban government school).

The participants in one focus group thought that establishing Swahili as the medium of instruction from primary school all the way through to university level would improve the quality of education rather than having to chop and change between primary and secondary schools. On the other hand, several participants believed that English should remain part of the education system because of global trends and the demand for fluent English speakers. They commented that Tanzania is not disconnected from the rest of the world in this respect.

5.3.5 Extracurricular activities and their role in developing decision-making skills

In the questionnaire, students were asked to indicate their level of agreement with a statement that read: ‘School activities that are not in the classroom curriculum, such as HIV/AIDS clubs, help me to make decisions about how I will look after my health.’ The results are indicated in figure 5.18 below.

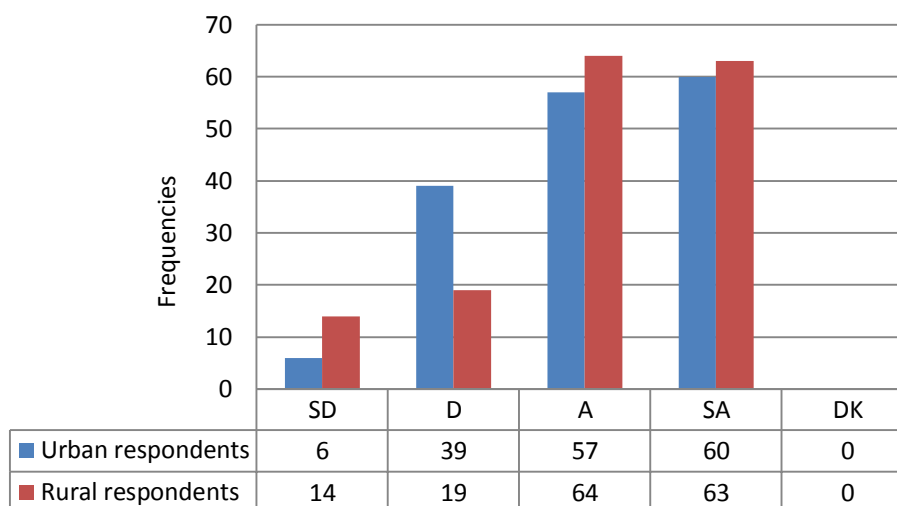


Figure 5.17 Extracurricular school activities help me to make decisions about health issues

The majority of respondents either agreed or strongly agreed that extracurricular activities provided them with information that helped them to make informed decisions about health issues. The questionnaire findings were similar to the focus group findings where members of five out of the eight focus groups noted that extracurricular activities, particularly in health-related club activities, had contributed to their biological literacy. One participant said:

We are lucky because our school has allowed different NGOs like AMREF and TAYOA to conduct their activities. We often get health education experts from NGOs visiting our school. In these clubs, we learn about reproductive health, how to handle sexual emotions and HIV/AIDS issues. (Male participant, urban government school)

They further commented that they often learn from peer educators in these clubs. In this respect, some students are trained about health information by NGOs and

they pass this information on to other students. The participants added that not all schools are able to offer club activities. One of the participants from an urban government school where school clubs activities were well established said, “Only a few young people in schools like ours benefit from NGOs’ club activities. So I think that head of schools should invite NGOs to conduct activities in their schools for the benefit of the young people” (female student, urban government school).

Participants in three focus groups talked about the ways that different clubs conduct their activities. They mentioned that clubs sometimes organise school festivals and invite students from other schools as well as members of the wider community. During these festivals, students perform dramas, dances and other social entertainments intended to educate the community about health issues. Counselling services are also often offered to young people. These kinds of activities give the students a sense of ownership, interest and pride in their learning.

In addition, the participants talked about extracurricular activities that provide them with biological information and knowledge about health matters. They mentioned a range of activities such as:

- individual counselling from teacher-counsellors
- inter-school programmes
- school meetings for dialogues and discussions about social issues
- sports activities aimed at promoting physical and psychological health, and,
- training about health and hygiene.

In summary, the students saw extracurricular activities as providing them with relevant and important knowledge for dealing with health matters in their daily lives.

5.3.6 Availability of resources

Taylor and Mulhall (2001) note that many schools in rural Tanzania have poor facilities and teachers often struggle to meet students' learning needs. Students in each of the eight focus groups also observed that there are few teaching resources available in many schools and in most schools there are very few books. There is also limited or no access to electronic media, laboratories and technological equipment in some schools, especially in rural areas. But in many rural schools it is also frequently the case that there are not enough classrooms, desks, or even chairs, for everybody. Members of two of the urban focus groups said that they were aware that they had greater access to resources than their peers in rural schools.

Several participants in the focus groups commented that schools need good resources and equipment to help them engage with science education. One member of an urban focus group said:

The government should be cautious about opening new schools because education isn't just about quantity; it's about quality. When they talk about building new schools they need to make sure that the schools are well equipped, like having laboratories. The government wants universal education but they don't care about how people get that education. (Male participant from urban government school)

This comment reflects Nyamba and Mwajombe's (2012) argument that the lack of teaching resources is a major demotivating factor in school science in Tanzanian classrooms. In this study, because of the lack of teaching resources, the students considered that their teachers were a very important resource in their learning. The problem, however, is that there is a serious shortage of qualified science and Biology teachers in Tanzania, particularly in rural areas. Participants in two of the urban focus groups commented that the shortage of Biology teachers in both urban and rural schools means that many students do not have equal access to learning about biological issues in their communities and many leave school with little Biology education. The participants also noted that many teachers prefer to work in urban areas because there are more facilities available compared with rural areas. One participant gave an example, saying:

For instance, when a teacher is selected to teach in a rural area, they usually don't go. That's because the environment can be quite challenging. You might find that a rural school has only two teachers, maybe only a Head teacher and his assistant but there might be many, many students. (Female participant, urban government school)

The UNESCO organisation IIEP (2006) reports that in different parts of Africa, many teachers refuse to work in rural areas because of a lack of hospitals, roads, transport, electricity, sanitation and comfortable and safe accommodation. Several of the focus group participants were also aware of the reluctance that many teachers have about living and working in rural Tanzania. Combined with the nation-wide shortage of science teachers and the lack of teaching resources in schools, this creates major problems for the implementation of the Biology curriculum in those areas.

Some of the urban participants recognised the advantages they have compared with their peers in rural communities insofar as they knew they have greater access to electronic technologies and the media. For example, participants in two focus groups, one in an urban school and the other in a rural area, asserted that students in urban areas have better access to technologies such as the internet and television. For this reason, urban students are more likely to come to school with some level of prior information gleaned from these sources. In summary, this section shows that all participants were very aware of the nation-wide lack of resources in secondary schools and they knew that the situation is more serious in rural schools.

5.4 Future prospects relating to the use of biological knowledge

The two doughnut charts (figure 5.19 & figure 5.20) below show the percentage of participants who were interested in pursuing a career in a Biology-related science profession when they leave school.

Percentage of students interested and not interested in Biology-related careers

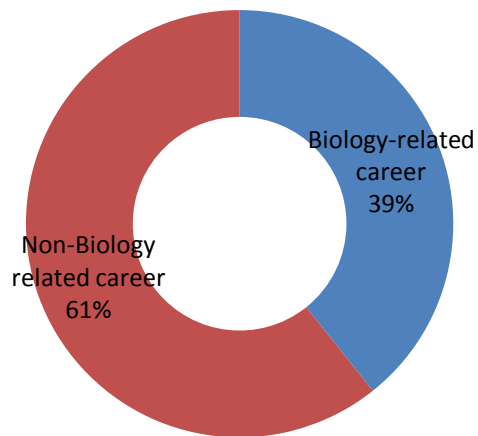


Figure 5.18 Urban participants: Future career interests

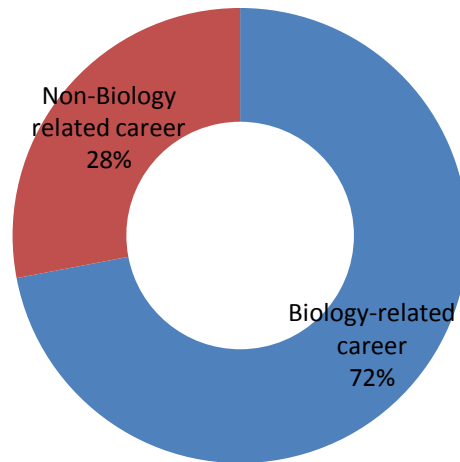


Figure 5.19 Rural participants: Future career interests

These charts show that urban participants are less interested in pursuing a Biology or science-related career compared with their peers in rural schools. The

percentages of both rural and urban participants interested in a biological related career were 72% and 39% respectively. Of those who were not interested in pursuing a career in Biology, 61% were located in urban schools and 28% were based in rural schools.

It is possible that these findings stem from the different kinds of career role models in urban and rural areas. Rural students have fewer career role models to learn from than their peers in the cities, and outside of family members, most of the potential role models in rural areas are nurses and doctors who are highly respected in rural communities. Urban students have a wider range of career role models to learn from and this could be a contributing factor as well. They may see themselves as having more choices available to them. Generally speaking, however, rural students appeared to be more interested in Biology-related science careers than students in urban schools.

The participants who expressed an interest in pursuing a Biology-related science occupation referred to several different types of careers including doctors, nurses, counsellors, Biology teachers, veterinarians, agriculturists and pharmacists. One participant in an urban focus group commented:

I am interested in training to be a community counsellor because I have already done this sort of work as a volunteer in one of the international NGOs that deals with creating community awareness about malaria and HIV issues. (Male participant, urban private school)

There were a few urban participants who believed that they might use the biological knowledge that they learned at school in their future careers. One participant in an urban focus group commented: "I want to be a journalist. As a journalist I will sometimes need biological knowledge to report on biological or health-related issues" (female participant, urban private school). In addition, another urban participant commented that he hopes to be a lawyer but he expects that he will sometimes use biological knowledge in his legal activities. This shows

that a small number of students recognised that a knowledge of Biology can be of value in careers that are not directly related to the biological sciences.

Those participants who did not show interest in pursuing a career in health or Biology gave various explanations for this. Most of them said that they had lost interest in the subject because of the shortage of qualified Biology teachers. As one participant said: “I lost interest in Biology last year [2011]. If I come across challenges that require a knowledge of Biology that is beyond my ability to solve, I will ask for assistance from experts” (urban male participant, government school). Another student added:

I lost interest in Biology a long time ago. I’m not sure if I would be able to use what I learn at school in my life. The ongoing problem of not having Biology teachers in our school has caused me to lose interest. (Urban male participant, government school)

And another student said:

I will only pursue a Biology-related career if I have teachers who will teach me the subject up until the end of my studies. When we go for long periods without qualified Biology teachers I will surely not want to continue with a Biology career when I leave school. (Female participant, urban government school)

Similarly, Mabula (2012) found that most Tanzanian students are not generally interested in taking Biology when they enter higher education. He argues that this situation is exacerbated by the shortage of qualified teachers, the kinds of teaching methods that are used in secondary school Biology classrooms and the lack of teaching materials, resources and equipment.

Members of all eight focus groups agreed that the biological knowledge and skills they acquire in school could be useful in dealing with health problems and challenges to some extent. One participant said: “A lot of what we encounter in our lives has some element of Biology, so there is no way out. We can’t avoid using Biology”

(female participant, urban government school). Another participant from the same group added, “Madam, I think there is Biology for the classroom and Biology for use in the society. Even if I don’t take Biology in my future studies I will use it in my life in some way” (male participant from urban government school). These findings show that despite a general lack of interest in pursuing health or Biology-related careers, the participants recognised their importance in their daily lives.

5.5 Chapter summary

This chapter has addressed the first and second research questions for this study. The first research question asks about the extent to which students consider the school Biology curriculum facilitates the development of their biological literacy. According to Miller (2011), biological literacy is needed for personal decision-making and to enable people to participate in civic and cultural affairs as well as economic productivity. The findings in this chapter show that the Tanzanian Biology curriculum is meeting neither the students’ priorities nor society’s needs in relation to the development of biological literacy. There are various factors mentioned in this chapter that the students believe hinder such development; these include curriculum content, teaching method and assessment techniques.

The second research question in this study asks about the impact of rural and urban schoolings’ context as it relates to students’ development of biological literacy. My findings indicate that students in both urban and rural secondary schools note the severe lack of resources in their schools and see this as a material disadvantage to their learning. However, the students were aware that rural schools are even more poorly resourced than urban schools and these realities directly contradict the Tanzanian government’s official goal of delivering secondary education equally, regardless of location (URT, 2010a).

In summary, this chapter shows that the participants perceived school Biology education to be useful to a limited extent in helping them to develop biological literacy. In the first section of this chapter, demographic data were presented that

show that the majority of urban students do not wish to continue science subjects when they enter higher education and they expressed little interest in pursuing Biology-related careers when they left school. This was in striking contrast to the majority of rural students who indicated a desire to pursue a Biology-related career in the future.

In this chapter, the students also talked about their perceptions of the school Biology curriculum in terms of the content that was taught, the kinds of teaching methods that were used, the high value that teachers place on assessment and exam scores, problems with English as the language of instruction at secondary school, and, the lack of resources. These findings show that most of the participants were not happy about the way the Biology school curriculum was implemented.

The findings show that despite the fact that the participants recognised that a knowledge of Biology could be important, they did not think that most of what they learned at school was immediately relevant to their lives. Also, the majority of students had not been given the opportunity to share their prior learning at school and I contend that this denies them the opportunity to connect what they learn outside of school with the formal Biology curriculum. On the other hand, extracurricular club activities were enjoyed by many of the students and they said that these activities raised their awareness about health and Biology-related issues and they considered that much of this knowledge was transferable to their daily lives.

Despite the students' concerns about the lack of support and the constraints of the Biology curriculum and its implementation, they recognised that they would need to address a range of health and Biology-related challenges in their lives and for that reason they believed that it was important to know about Biology. The next chapter explores some of those challenges and the students' perceptions in more detail.

CHAPTER SIX

YOUNG PEOPLE'S PERCEPTIONS ABOUT HEALTH ISSUES IN TANZANIA

6.0 Introduction

Young people need health education at school as well as in the community because things like teenage pregnancy are challenging for all girls whether they are enrolled at school or not. We need school health programmes and community health programmes because a lot of young people don't have a secondary education so they don't get to learn about health issues at school.
(Female student, urban government school)

Access to reliable health education is a priority for many Tanzanian young people. Ideally, all young people should receive this information at school and Biology classes should certainly have a role in learning about the relationship between human Biology and health. However, as the participant points out in the quote above, not all young people in Tanzania have access to secondary schooling, so community health programmes and initiatives are very important.

In the previous chapter I discussed the findings about my participants' (students') perspectives about the junior secondary school Biology curriculum. In this chapter, I extend the examination of my participants' (students') views about whether the Tanzanian Biology curriculum supports or constrains students' acquisition of knowledge and skills that could guide them to make informed decisions about health issues in their daily lives. The main focus of this chapter is students' views and beliefs about the health challenges they face in their daily lives and their understandings about the socio-cultural contexts that have an impact on their physical and emotional wellbeing. I consider this to be an important component of my analysis because the way that people think about the relationships between the biological, social and cultural dimensions of wellbeing give insights into how biological literacy is shaped, interpreted and enacted within Tanzanian society.

It is often taken for granted that people within a society share common understandings and awareness of health matters and biological issues but, in fact, the way that people perceive these matters is often filtered through diverse social and cultural lenses. This is certainly the case in Tanzania where the ways that people think and talk about health problems and human Biology are embedded within a range of socio-cultural discourses (Burr, 1995). One of the assumptions of social constructionism is that different kinds of knowledge are historically and culturally embedded in the way that people engage with the world around them (Allen, 2005). These discourses also shape the way that people respond to health challenges (Jha, 2012). In light of this, I argue here that young people in Tanzania actively interpret, negotiate and construct their understandings of health and biological issues and that this can be seen in the way they explain and talk about their wellbeing (Gergen, 2009). In this regard, the use of ideas from social constructivism and social constructionism provides a framework for analysing some of the individual and social negotiations that take place about human health and the role of biological knowledge in dealing with health-related events.

As noted previously, in each of the site schools that I visited, questionnaires were administered in the first instance to elicit students' perceptions about their biological literacy. Focus group discussions were then conducted to gain more detailed insights into the health issues that were identified in the questionnaire. In this chapter, however, only data from the focus group discussions are presented because these afford a more nuanced and detailed picture of the participants' views than the questionnaire data.

One of the limitations of the focus group approach was that I noticed that apart from a few exceptions, the rural students were less forthcoming than urban students. They needed encouragement to speak, whereas, the students in the urban schools were generally more talkative and sometimes had to be refocused on the interview questions. These differences may be due to the greater exposure that urban youth have to a wide range of multicultural interactions compared with their

peers in rural schools, most of whom share a common language and cultural understandings. Accordingly, urban students are more familiar with situations that require cross-cultural or cross-tribal knowledge and this allows them to communicate more readily with people, such as myself, who are from different communities. It could also be the case that, as discussed in Chapter Four, as a cultural outsider, I had encountered a cultural silence and as a result the participants may have felt reluctant to discuss certain issues with me. For this reason, this chapter contains more quotes from urban students than from rural students, although the views that are expressed are common to both groups (unless otherwise indicated).

In Tanzania, it is common for urban and rural people to talk openly about their views about each other because there is a constant flow of interaction between urban and rural communities as people move back and forth between villages and the cities for work and family reasons. Often, these movements involve the migration of the whole family with their young ones. It is therefore not uncommon for young people in Tanzania to have experienced life in both urban and rural areas. In addition, news, electronic media and schools provide a lot of information about rural and urban lives. The responses that the mainly urban young people provided in this part of the study show that they have a strong sense of familiarity with both urban and rural contexts.

Several themes emerged from the data including: a lack of knowledge about reproductive health issues; adolescence and sexuality; awareness of diseases such as cholera, malaria, sexually transmitted diseases (STDs), HIV/AIDS; risky cultural practices, for example, FGM and the practice of widow inheritance (where a widow is inherited by a close relative in polygamous contexts, thereby increasing the likelihood of HIV infection in some communities). Some of the students also talked about the way that social and cultural beliefs influence perceptions about health. For example, several participants told stories about pregnant women who do not eat eggs for fear of having babies without hair because they believe that this could

negatively affect the health of their babies. The students also discussed how FGM can increase the risk of HIV. Other topics of discussion included: community attitudes towards sex and sexuality education for young people; the socio-economic impact of poverty in exacerbating health problems; peer pressure; poor diet; and, biotechnology. In this section of the focus group discussions, the students spoke mostly about health problems and diseases although some raised issues that were not directly related to health but which had a more indirect impact on their health and wellbeing such as community attitude towards young people. These challenges are discussed further in the coming sections.

6.1 Knowledge of reproductive health issues

Inadequate education about reproductive health was seen as a challenge by members of all the eight focus groups that I conducted in both rural and urban schools. The participants believed that a lack of knowledge about these matters has negative consequences for them. They also discussed a range of problems that relate to a lack of reliable information and education about reproductive health, such as teenage pregnancies, unsafe abortion practices, early exposure to risky sexual practices, poor family planning and unprotected sex. In discussing these matters, one rural participant said:

When young people have unprotected sex, they can end up with unexpected pregnancies and some go on to have abortions that pose a danger to their health [...]. People really need education. (Female student, rural private school)

The students' responses showed that they had a level of understanding about health and wellbeing and they were comfortable about raising issues that concerned them, although as noted earlier, the urban participants were more forthcoming. Many Tanzanian schools strictly enforce the rule that if a girl is found pregnant, she will be expelled. For some girls, this may be another factor in deciding to seek an abortion. Abortion is illegal in Tanzania unless there are extenuating

circumstances such as medical reasons. For this reason, many girls seek illegal and unsafe abortions which places their lives at risk.

In one urban school focus group, a couple of participants (2/6) suggested that their peers in rural areas are more likely to be given reliable reproductive health education when they reach puberty. For example, one participant said, “Young people in rural areas are more privileged than we are. They have many elders, such as grandparents, around them to help during puberty” (urban female participant, government school). Students (2/6) in this focus group talked about how grandparents in rural areas take an active role in informally educating and advising their grandchildren about puberty as well as sexual matters. In rural Tanzania, grandparents tend to have closer emotional bonds with their grandchildren than parents. Frequently, there is a special relationship where grandparents joke and play with their grandchildren. This relaxed relationship between grandchildren and grandparents means that conversations about matters such as puberty can take place more openly. In contrast, parents often have a more formal relationship with their children where they communicate expectations, rules and warnings for the children to follow. My urban participants felt that because of this, their peers in rural areas have more access to informal education about puberty than they have themselves.

However, in two focus groups, one in an urban school and the other in a rural area, some participants (4/12) argued that family planning is more challenging for rural people. One focus group member explained:

I think rural people tend to have more children than urban people. They do not even think about their poor economic conditions. Urban people are more educated and they are more likely to think about their financial position when planning their families. (Female student, urban government school)

Two groups (one each from an urban and rural school) stated that family planning methods are not always very reliable or helpful and that people are often left with many unanswered questions about the impact of particular reproductive practices or the side effects of contraceptives. One student said:

Some family planning techniques, I think, lead to temporary sterility. Many people are afraid to use these methods of contraception because they are frightened that they might become permanently infertile. Most doctors don't give factual information about effective and reliable family planning methods. (Female student, urban government school)

My findings indicate that many students felt they did not have adequate and reliable information about contraception and that is partly the reason they believe that reproductive health education needs to be a priority for young people to face the health challenges they encounter, especially in relation to sexual maturity, unexpected pregnancies and family planning.

6.2 Life skills to manage adolescent sexuality

Participants in six of the eight focus groups talked about sex and sexual activity. This included discussions around exposure to sexually explicit material such as adult movies that are available on the internet or accessible on cell phones. For example, one participant said:

Things that cause sexual emotions are watching pornographic films on the internet or listening to music that is sexually oriented. I think this eventually leads young people to engage in risky sexual activities such as HIV, STDs and unwanted pregnancies. (Female student, urban government school)

This comment suggests that there is a perception amongst some of the young people that sexual activity is linked to moral considerations. They associated factors, such as watching sexually explicit materials, as a trigger for young people to engage in risky sexual behaviour. Some participants noted that they thought the government should block internet access to sexually explicit materials. My data suggest that most participants did not see it as their own responsibility to keep

themselves safe and were asking society in general and the government in particular to help them get through adolescence and maintain their sexual health.

In their discussions about adolescent sexual relationships, members of one urban focus group discussed the differences between boys and girls. The students in this focus group believed that girls are more affected by sexual issues and carry those emotions for a long time in ways that might affect their academic performance. In the participants' view, girls and boys face many challenges during adolescence that need to be handled in different ways. In line with this, one of the participants said that they would like their teachers to provide them with guidance and information that would help them to better understand sex and sexuality, including how to cope with the emotional aspects of sexual relationships. These participants believed that their Biology classes at school do not adequately prepare them to understand the biological basis of the area they perceived as being most relevant to them, namely sex and sexuality. These findings show that these young people want to be informed about how to be responsible in their sexual lives despite the many pressures and challenges they face.

6.3 Diseases

The findings in the previous section show that Biology education that students were particularly interested in relates to health, human reproduction and sexuality education. In this section I discuss the students' concerns about particular diseases that affect many people in Tanzania, how they are contracted, and what can be done to educate young people and communities as a whole.

Members of all eight focus groups were aware that diseases such as HIV/AIDS, STDs (including gonorrhoea and syphilis), malaria, cholera, schistosomiasis (also known as bilharzia) and typhoid are among the most common health challenges that young people face in Tanzania. Participants (10/24) in four groups (two each from rural and urban schools) said that many people lack education about how to treat and

prevent diseases. Participants in all eight focus groups argued that there is a societal need for Tanzanian youth to have reliable knowledge about the mode of transmission, symptoms and treatment of these illnesses. One participant elaborated:

It is easy for a person to contract the disease like syphilis if he is not knowledgeable about how he can be infected. When I say a person is knowledgeable I mean they have at least primary school education. But actually, a primary school graduate may not have much knowledge since we are given most of this kind of knowledge in our secondary education. (Urban male participant, private school)

Further, a participant spoke about HIV/AIDS saying that, "I think we need more education about HIV/AIDS prevention. For instance, knowing that the use of condoms prevents STDs and unexpected pregnancies" (male participant, rural private school). The participants understood the need to be knowledgeable about preventing STDs, such as HIV infections, as well as preventing unwanted pregnancies. However, they were also concerned about young people who have only received a primary school education and are therefore unable to access this knowledge which, when it is given at all, is more often found in the secondary school curriculum.

Participants in all eight groups were aware that HIV/AIDS is an epidemic amongst young people in Tanzania. They spoke about social attitudes towards people with HIV/AIDS that include widespread prejudice against people who have contracted the disease and who are often stigmatised as a result. One of the participants said, "I am wondering why, despite all the education people receive about HIV/AIDS, discrimination still exists" (urban male participant, private school). Another participant added:

There's a lot of discrimination against people with HIV/AIDS in Tanzania. In spite of having knowledge about HIV/AIDS, many people still refuse to help HIV-infected people. I think religion could have a great influence in teaching

people to love and care for people who have HIV/AIDS. (Urban male participant, private school)

It is noteworthy that members of three of the urban focus groups suggested that the reason that many people do not disclose their HIV status is because they fear prejudice and discrimination. The prevalence of HIV infections continues to rise in Tanzania and my participants suggested that this situation is not simply a matter of teaching facts about HIV but rather, they argued, that it was important to teach people about caring and love.

In addition, some participants (2/6) in one urban group told stories about how pharmaceutical drugs are misused because of a lack of biological literacy about taking medication. For example, some patients continue to take drugs after the expiry date on the label. One participant related the following story:

I have heard a story that a man used expired ARV (Anti retrovirus) medicines that caused his breasts to increase in size. I think education should be given to people to know both advantages and disadvantages of using expired medicines. (Female participant, urban government school)

Although there is no evidence to suggest that this may be true, misconceptions like these may influence whether or not people take such medication. A similar incident was published in a Tanzanian magazine called *Mwananchi* that reported that some pharmaceuticals officials in Dar-es-salaam had been prosecuted for distributing fake ARV (Ally, 2014). News stories like this cause widespread confusion and people lose trust in the kinds of medication they are given. My participants argued that education is needed to inform people about the dangers of taking fake medication or medicines that have expired.

Another factor that has increased the spread of disease in Tanzanian communities is a lack of knowledge about proper waste disposal. Students from one urban government school group talked about how poor waste disposal practices from nearby factories had contaminated the drinking water in their area and this had

resulted in illnesses amongst people in the area, many of them suffering from diarrhoea, fungal infections and cholera as a result. The students also talked about the rubbish in the streets that could cause many diseases, as one participant said:

Over-population in urban areas and bad rubbish disposal practices can cause water sewage pipes to block and that can cause an overflow of dirty water during the rainy season. The dirty water flows into the neighbour's house or on to the street. And that can cause diseases like fungal infections and cholera. (Female participant, government urban school)

The students argued that Tanzanian people in general need more education about waste disposal management and keeping their environment clean in order to reduce the spread of disease.

In summary, in this section, I have discussed the participants' views about disease and the effect on health. Education about the transmission and symptoms of various diseases was emphasised by the participants as a priority.

6.4 Cultural practices

My participants described a range of cultural practices as being unhealthy for young people, especially in relation to the spread of HIV/AIDS. This section explores students' views about cultural practices and the extent to which education is needed to ensure they acquire the skills and knowledge they need to make informed decisions.

Early marriages

All students in seven focus groups said that early marriage (i.e., marriage under the age of 18 years) was a significant cultural challenge for many young girls in Tanzania. One participant argued:

Cultural initiations like 'jando and unyago' (i.e., Swahili terms for cultural initiation ceremonies for youth) in some tribes encourage early sex and marriages. (Urban male participant, government school)

In Tanzania, some tribes, such as the Makonde and Zaramo tribes, conduct cultural initiations for both boys and girls when they reach puberty. These ceremonies, centred on adolescent sexuality, are called '*Jando*' (for boys) and '*Unyago*' (for girls). Initiations take place when young people reach adolescence; girls are initiated when they have their first menstruation while boys are initiated when they start to experience wet dreams. During these initiations, young people are taught cultural norms and beliefs about gender roles, family life, and sexuality. As part of the '*Unyago*' ceremony, a girl is trained about marital sexual relations including how to satisfy a male partner (Mbeba et al., 2012). After the cultural initiation has taken place, girls are seen as potential candidates for marriage. My participants believed such practices pose a risk to their health and wellbeing and agreed that early marriage and subsequent teenage pregnancies can cause health problems for girls because their bodies are not yet fully developed. One participant commented:

Many people think that formal education is not useful for girls, and that they are just supposed to be married. This situation creates a lack of confidence and a feeling of inferiority amongst girls. They end up believing that they are not as important as men especially when they are forced into early marriages and pregnancies without their consent. (Urban male participant, government school)

This comment shows that both girls and boys have concerns about the social positioning and wellbeing of girls and women in Tanzanian society. My participants were concerned that forced marriages that led to the termination of girls' education were one of the causes of early pregnancies and subsequently, increased health risks for young girls. According to Mtengeti, et al. (2008), girls between 10 and 15 years of age have increased health risks if they become pregnant before their pelvic bones are ready for childbearing. There is also an increased risk of conditions like obstetric fistula (Mtengeti et al., 2008) amongst girls who bear children at an early age. In Tanzania, around 2,500 to 3,000 new cases of obstetric fistula occur each

year (Siddle, Vieren, & Fiander, 2014), and over a quarter of these cases occur amongst girls younger than 20 years of age (Siddle et al., 2014), so it is certainly a recognised problem.

Female genital mutilation (FGM)

Participants in all eight focus groups said that FGM continues to be practiced in some Tanzanian communities despite the efforts of various organisations to educate people about its effects. My participants connected the lack of education about hygiene and human health among FGM practitioners as a potential factor for spreading HIV. Focus group participants (7/18) from one urban and two rural areas talked about how the use of the same knife during FGM ceremonies indicated a lack of education within the communities about HIV transmission. Students (5/18) in three other groups commented that FGM is usually performed in secret, so community members often do not know very much about what is involved in the practice, and consequently they do not necessarily have enough information to speak against it. One participant said:

When a girl undergoes FGM, the society sees her as a potential candidate for marriage. Most of these girls are teenagers. This has a huge impact on their health in terms of pregnancies and HIV infections. I think that in rural areas there is less education and girls in the villages do not have a place of refuge. Many elders in the villages still want to maintain their traditional ways of life and that might include practices such as FGM. In urban areas, there are many health centres and non-governmental organisations (NGOs) for girls to turn to, to get help with these sorts of issues and the health problems they have as a result of these practices. (Male participant, urban government school)

FGM is one of the cultural initiations conducted in some tribes in Tanzania during the initiation ceremony for girls (Unyago) when they enter puberty. Several of my participants saw this as a potential risk to teenagers' health because FGM can cause complications when women give birth and may also put girls who have been

circumcised in danger of being infected with HIV. My participants noted that girls in rural areas, where the practice is more widespread, are more vulnerable to the situation than girls in urban areas. This shows that the urban young people in this study are concerned about the situation of their rural peers, many of whom are relatives, and they talked passionately about the need for education.

Widow inheritance

Widow inheritance was considered by some participants (4/12) in two focus groups (one group was located in an urban private school and the other in a rural private school) as a custom that carries risks to girls' health and wellbeing in some Tanzanian communities. Widow inheritance is a cultural practice that persists in some Tanzanian villages. It involves a widow being 'inherited' as a wife by a close relative of the late husband. One participant said, "Widow inheritance increases the risk of HIV transmission because it encourages polygamy and that can cause HIV infections to spread among family members" (Male participant, urban private school). They agreed that this was an issue affecting young people because some of the widows are themselves very young.

Witchcraft rituals

Participants in two focus groups, one in an urban private school and the other in a rural government school, associated certain witchcraft practices with the transmission of HIV/AIDS. One participant argued:

Local witchcraft beliefs can cause some patients to die because of the lack of proper treatment of specific diseases. Sometimes witch doctors use the same blade to make incisions in more than one person and that can increase the risk of HIV infections. (Urban female participant, private school)

This shows that these students were aware of the impact of religious beliefs and cultural practices in Tanzanian society. The focus group participants commented that education initiatives are needed to put an end to risky practices associated with these rituals. Mubyazi et al. (2013), in their research in Tanzanian

communities, also found that people often rely on traditional medicines for modern day diseases rather than seek medical advice. Unfortunately, in many cases, this increases the prevalence and transmission of disease.

6.5 Community attitudes towards young people

Poor parent-child relationships were cited as a cause for young people's health problems by some groups (5/8). One student argued:

Parents should forget the idea that telling children about sex will encourage them to become sexually active. For example, telling children about the use of condoms does not mean that they will go and have sex straight away.
(Rural male participant from private school)

My findings show that young people did not associate the use of condoms with prostitution, a link that many adults appear to make. They did, however, suggest that there was a mismatch in the views held by parents and young people. The students said that their parents think they are too young to understand matters relating to sex and sexuality but the young people themselves want to be better informed about these issues.

In two focus groups, some students (4/12) said that it is the parents' responsibility to inform their children about issues of puberty and menstruation. One participant said:

When a girl begins menstruation, often her parents do not talk about anything more than telling her to wear sanitary pads. They do not talk about other issues like protection against unwanted pregnancies after they become sexually mature. (Rural female participant from government school)

This finding shows that even though the participants would like their parents to be their primary source of information about puberty, parents often fail to meet these expectations.

Getting reliable advice from qualified professionals was also challenging. In two rural focus groups and one urban focus group, some participants (6/18) noted that young people are not comfortable about consulting health officers about sexual health issues. One participant said:

[...] sometimes-young people are afraid to tell the health officers that they are suffering from a sexually transmitted disease, like syphilis. This is because the health officers will treat them as if they are prostitutes. (Rural female participant from private school)

Another participant added:

I stopped going to the hospital for health check-ups because the nurses treat us so harshly. Actually, in our community, if young people go to the hospital and ask questions about reproductive health issues, they are sometimes seen as prostitutes. (Urban male participant from government school)

Further, one participant recommended that, "I think health counsellors, nurses and doctors need to be trained about how to treat people respectfully regardless of their age" (urban male participant from government school). This evidence shows that it is difficult for young people to get information and advice from health centres about sexual matters. Many Tanzanians have the socially and culturally constructed belief that young people should not be given too much information about issues relating to sex and sexuality and should wait until marriage before finding out about these matters.

Teachers' reluctance to discuss sexual matters was also discussed by the participants. For example, one student said, "Some teachers are very shy about teaching and explaining about things that are related to sex education" (rural male participant from private school). Furthermore, members of two focus groups (one each from an urban and rural school) argued that young people are discouraged from expressing their views about what they know about sexual health matters in community forums. One student said, "Young people are not given the opportunity to express their views during community meetings or even during family

conversations. It's because they think that we are too young to make useful suggestions" (rural male participant from private school). Another participant added:

The problem with Tanzanian society is that there is a lot of ignorance and contempt for young people. When we try to give advice to younger people they say to us 'you are just a young child yourself, what are you going to say to us!' They think that we do not have anything useful to say. Youth are not given opportunities to share what they learn at school with others. (Urban male participant from government school)

From the students' point of view, the lack of education of some of their elders deprives them of opportunities to discuss the things that matter to them. Several participants expressed frustration that family, tribal and community elders are frequently unwilling to engage with them or listen to their views because they perceive them as being too young to understand sexual issues.

6.6 Poverty as a contributing factor to young people's poor health and wellbeing

In this study, participants in all eight focus groups argued that poverty contributes directly to various problems faced by young people. One participant commented:

Prostitution is a problem among young people, especially girls. A lot of young people from poor families end up selling their bodies to earn money. Sometimes some girls become prostitutes so they can earn money not only for themselves but also for their families. Some parents agree to their children doing this because it means there is more money for the family. (Urban male participant from government school)

Hellandendu (2012) also comments that the economic recession that has hit sub-Saharan countries has led many young women and girls into prostitution in order to survive. The participants were very aware of how poverty creates problems for families and how this affects girls and young women in particular.

Participants in two focus groups (one each from an urban and rural private school) argued that poverty is also a contributing factor to early marriages and some spoke about how in some families, parents force their daughters to forsake their education and marry when they are very young. They also believed that sometimes parents force their children to get married without checking the HIV status of the person they are marrying. One participant said:

Most of the time parents insist on early marriages for their daughters for the sake of obtaining bride price money offered by rich people. Girls are often forced into marriage to much older men who will provide for financial needs of the family. But a lot of parents do that without thinking about the possibility that their daughter might contract HIV as a result of that liaison.
(Rural male participant from private school)

These comments suggest that the participants do not simply view the issue of early marriage as a cultural practice but also as a significant socio-economic problem. The practice of early marriage continues because of the financial incentives of the bride price payment. Originally, bride price was not intended to be a form of financial gain; rather, it was a way of showing that a woman was highly valued and had become a part of the husband's family. However, in modern times, families who are struggling sometimes see it as a way of bettering their financial position. In this regard, poverty has become a factor in the continuation of this cultural practice where girls are used as a source of wealth, often at the cost of their health and wellbeing.

The participants were eager to talk about family issues, and some of them wanted to talk about parents' role in their children's education. One participant said:

Some parents do not support their children to get an education, especially in the villages. They tell their children to take care of cattle or fetch water or cultivate the fields instead of going to school. I think that in the cities, parents are more likely to encourage their children to go to school. (Rural female participant from government school)

In contrast, another participant argued:

Parents in both rural families and urban families depend on small businesses like 'mama ntilie' (*Swahili term for a woman who sells food as part of a small business venture*) so when students come home after school they help their parents with the business. This means students do not have enough time to do their homework. (Rural male participant from government school)

These findings show that students in both urban and rural schools feel that there is inadequate support from their parents for education in general and for learning about health issues in particular.

6.7 Peer influence

Socio-economic status was also seen by some participants as being one of the factors that contributes to negative forms of peer pressure. One participant said:

Some young people come from poor families. Sometimes they want to have things they can't afford and they get pressured by their friends to get money by having sex with people and they end up with unwanted pregnancies and STDs. (Male participant, urban government school)

Another participant commented:

Peer pressure is worse in urban areas, especially for girls. Some girls want more than they can afford and they end up falling into the temptation of getting those things by having sex for money or other favours. (Urban male participant, private school)

Participants (3/6) in one rural government school focus group commented that young people need to learn about different ways of earning money other than through prostitution which carries a significant risk of HIV infection.

In some groups (4/8), students suggested that peer pressure and a lack of education can lead to drug use. Students in four focus groups (two each from urban and rural schools) commented that illegal drugs is a youth problem in Tanzania. One

participant said, “Young people see drugs as a way of reducing stress but in reality drugs are not good for the human health and they increase the likelihood of rape and violence” (rural male participant, private school). Another participant added, “I think young people lack education about the effects of drugs” (rural male participant, government school). Some of the participants suggested that drug education for young people might be a way of dealing with the problem. They also commented that public education campaigns could be conducted through the media, for example, on radio, in print media or television, or through community meetings.

6.8 Poor diet

Members of each of the eight focus groups mentioned that there was little education given to them at school about the importance of a balanced diet and problems related to malnutrition-related conditions such as kwashiorkor (i.e., a severe lack of protein) which are acutely experienced by people in certain areas of Tanzania, such as Zanzibar. Students in two urban focus groups in government and private schools claimed that some Tanzanians do not have enough education regarding eating a balanced diet. One individual gave the following example:

We sometimes tell our parents what we learn at school about eating healthy balanced diets such as ‘dona’ (*Swahili word for food made from maize flour*) and vegetables but sometimes it is very hard for them to accept our ideas.
(Urban male participant, government school)

The students also talked about how families on very low incomes often struggle to feed themselves. One participant said, “In the farming areas, there is plenty of food, so people are able to eat a well-balanced diet” (urban male participant, private school). In contrast, another participant told a different story, saying that, “I think in urban areas we have a better chance of having a good diet and being able to attend classes every day, while our fellows in the rural areas, sometimes they do not know what they will eat” (male participant, urban private school). It is likely that

these contradictory explanations about rural and urban diets are related to the fact that the urban participants in this study came from villages in different parts of Tanzania so their experiences of rural diets vary considerably. In some rural areas, favourable climate conditions provide a suitable environment for growing crops, while people in other areas face food shortages. On the other hand, although food shortages are not a problem in urban areas where supplies come in from a variety of sources, having a balanced diet is highly dependent on families' economic status in urban areas as well as the availability of a good climate to produce food in rural areas.

Having an understanding of diet and nutrition is very important in Tanzania because inequities in child and adolescent nutrition affect large sections of the population including in some agricultural areas where food production levels are high, such as Iringa, Mbeya and Rukwa (UNICEF, n.d). This is an issue where the Biology curriculum could provide students with additional information and awareness about the relationship between human Biology, food scarcity, and social and economic factors.

These findings reveal that while young people are aware of the importance of having a good diet and some had a level of awareness about the range of social, economic, and cultural factors that contribute to poor nutrition, they were not able to make clear causal links between these different factors. At best they were only able to suggest that a better education might help people earn more money so they could have a better diet. They were unaware of the structural and political implications of national and global food scarcity and had only limited awareness about the effects of a poor diet on human health despite high levels of stunting and other symptoms of malnourishment in different parts of Tanzania.

6.9 Understandings about biotechnology

As mentioned in the previous chapter, few of my participants were familiar with biotechnology. The majority of students did not really understand what it is and how it might affect them. One participant, who struggled to define biotechnology, gave the following example: “I think biotechnology is when you use one organism to improve another organism. So when an organism dies, it decays and later it produces oil that human beings can use in different ways” (urban male participant, government school).

A few participants (3/6) in one private school urban group did, however, attempt to comment on the health effects of genetically engineered food. One student said, “I think that when a person eats food that has genes implanted in it, you can get health problems” (urban female participant, private school). Another participant gave this example: “I think medicines like contraceptives are made from biotechnological techniques that create particular hormones. I think these medicines sometimes have a bad effect on women’s bodies” (female participant, urban government school). These students did not have a clear understanding about how biotechnology may be used in the development of contraceptives, and drew on a more general public perception that some medicines can be bad for a woman’s health.

6.10 Chapter summary

In summary, this chapter is intended to answer my first research question about the degree to which the school Biology curriculum supports or constrains the development of biological literacy. My findings, as elaborated in this chapter, indicate that young people feel that they are confronted by many very serious challenges to their health and wellbeing and that they look toward their schools to help them to find ways of dealing with these problems in their everyday lives. Unfortunately, they do not feel that what they learn at school, particularly in their Biology classes, helps as much as they would like. As noted earlier in Chapter Two

(section 2.1), Miller (2011) argues that biological literacy relates to the acquisition of knowledge and skills that allow people to participate in biological debates, problem solving and decision-making in their everyday lives. My findings show, however, that much needs to be done to achieve this level of biological literacy in the Tanzanian context.

In this chapter, the findings show that there are many health challenges that young people face in Tanzania and in some respects, they feel that their voices are not heard as a result and they are uncertain about what is being done to help them meet these challenges. In line with this aspect of the focus group sessions, they discussed a range of problems including: a lack of knowledge about reproductive health; a lack of life experience in managing adolescent sexuality and few adults willing to talk honestly with them; endemic diseases; the impact of various cultural practices on human health; unhelpful community attitudes about young people and their concerns; poverty; peer pressure; poor diet; and a lack of biotechnological knowledge about health issues. Overall, however, a major concern for the participants was the lack of information and discussion about reproductive health. Young people really wanted knowledge that would keep them safe in their sexual relationships. These findings indicate that the socio-cultural perspectives that young people hold about the health problems that exist in Tanzanian society do not invalidate medical and scientific perspectives but rather provide ways that allow them to deal with the challenges in a more informed way. Therefore, the constructivist and constructionist approaches taken in this study provide a useful framework for understanding how individuals and members of the social collective perceive those challenges.

In this study, the participants argued that there was a need for more education to protect themselves against sexually transmitted diseases including HIV/AIDS. They also want their parents to be well informed and open to discussing matters of sexual health and sexuality with them. The participants believed that the government needs to invest in young people's health and wellbeing whether they

are enrolled in schools or out in the community with little or no access to secondary education. One student said, “Young people are the foundation of the nation so the government needs to be responsible for their wellbeing” (urban male participant, government school). In the next chapter, I discuss teachers’ views about the secondary school curriculum and the extent to which it influences students’ understanding of health and Biology.

CHAPTER SEVEN

TEACHERS' PERCEPTIONS ABOUT BIOLOGICAL LITERACY AND PEDAGOGICAL PRACTICE

7.0 Introduction

The Biology curriculum outlines the topics and learning activities that we are supposed to put in place but the reality is very different from those curriculum statements. (Gilbert, male teacher, urban private school)

This quote encapsulates the frustration that most of the participating teachers experienced about the mismatch between official curriculum documents and their teaching practices. In this chapter I look at how the Biology teachers involved in this study thought about their teaching practice and their views about their students' learning. In particular, I focus on whether the teachers believe that the Biology curriculum adequately prepares students to apply what they learn at school to the complex real life situations that they encounter outside of school. In this regard, this chapter elaborates my first and second research questions for this study. The first research question asks whether the Biology curriculum supports or constrains students' acquisition of knowledge and skills that will allow them to make informed decisions in their everyday lives. The second research question asks about the contextual differences between urban and rural locations in relation to the Biology curriculum and students' learning in the Biology classroom.

I draw on social constructivist and social constructionist theories to explain teachers' perceptions of the curriculum and of students' learning. These theoretical lenses help to show how teachers' perceptions about the development of biological literacy are socially constructed in their interactions with their students (Hruby, 2001).

The data sources for this chapter are the semi-structured interviews that I had with teachers and the classroom observations that I conducted. The data do not represent the perceptions of each participant in relation to his/her practices in the classroom; rather, I have analysed data across the schools and classrooms that I visited. As noted previously, I conducted classroom observations in eight secondary schools - four urban and four rural schools. I interviewed each of the participating teachers and observed them in the classroom in both the science and the non-science streams. Subsequently, the data obtained have been subject to a constant comparisons analysis where similarities and differences were taken into account. To maintain the participants' confidentiality I have used pseudonyms. The urban schoolteachers' pseudonyms are Gilbert, Macky, Shedafa and Asha. The rural schoolteachers' pseudonyms are Huruma, Sihaba, Abel and Rose.

This chapter is divided into four major sections. Each section is related to the teachers' beliefs about the way their students develop biological literacy and includes analyses of:

- Teachers' educational background and related demographic data.
- The implementation of the Biology curriculum and:
 - Biological knowledge and content
 - Biology teaching methods
 - Assessment techniques
 - The language of instruction
 - Disparities between urban and rural schools
 - Gender
 - Streaming.
- Extracurricular activities: This section draws on the interviews I conducted with teachers who were involved with club activities in the site schools. The pseudonyms for the club teachers are Ayubu and Kicheko who were both based in an urban school, and Ally, Shema and Zulfa who were located in three different rural schools.
- The influence of informal and community education.

7.1 Teachers' educational background

The participating teachers' backgrounds are discussed in this section.

Table 7.1 Teacher qualifications and gender in rural and urban schools

		Urban schools			Rural schools			Total
Qualification		Diploma in Ed	Degree in Ed	Other diploma/degree	Diploma in Ed	Degree in Ed	Other diploma/degree	
Gender	Male	01	-	01	01	02	-	05
	Female	01	01	-	01	-	-	03
Total		02	01	01	02	02	-	08

All the participants except one are formally qualified teachers. Macky, Abel and Sihaba have degrees in Education, and Huruma and Rose have a Diploma in Education. Asha and Gilbert have Diplomas in Education but they also have professional training in food science and nutrition, and accountancy respectively. Shedafa is a medical assistant who is also a part-time teacher. Most of the participants regarded teacher training as an important part of their profession in preparing them for working in classrooms.

Two participants who have additional professional training other than a teaching qualification have different stories to tell from those of their peers. Asha explained how she became a Biology teacher:

I applied for a degree in Education as my first choice and a degree in Food Science and Nutrition as my second choice. I was selected to join a Food Science and Nutrition course. I think the reason I wasn't selected to enrol in Education is because of my poor performance in Biology when I was at secondary school. Fortunately, I am still working as a Biology teacher using my teaching skills and knowledge that I gained from my diploma studies. (Female teacher, urban government school)

Gilbert said:

I studied for a diploma in accountancy because I wanted to leave teaching and get an accountancy-related job. The reason I want to quit teaching is because it's so poorly paid. I joined the teaching profession because I didn't really have any other choices [...]. When I finished my secondary advanced education, I didn't have enough qualifications to get into join university so I enrolled in a Diploma of Education.

He added:

When I am in a Biology class, I do my best to teach well because of external factors, like pleasing my employer [...]. My boss expects me to teach well so that the students will pass their exams. I pretend to be happy in class because I don't want the students to get bored with the way I teach. (Male teacher, urban private school)

These stories show that some teachers join the teaching profession willingly while others feel they do not have any other choice. An important factor for one of the participants who did not feel motivated about the profession is the poor remuneration offered to teachers. This situation is not uncommon in Tanzanian schools and in Biology it may well compromise students' acquisition of biological literacy when teachers have a low level of commitment to their work.

One participant was an untrained teacher who did not have a teaching qualification but had a Diploma in Medicine. This participant, whom I have called Shedafa, was working as a part-time Biology teacher in one of the site schools. He explains his background:

I enrolled in a Diploma in Medicine so I could work in my father's dispensary. I worked in my father's dispensary for a short time but unfortunately it closed down. [...], I got part-time work as a teacher but I also continued my work as a medical assistant. The truth is that the teaching profession is poorly paid compared with medical work. It's because of this that I'm at a

crossroad while I decide whether or not to study Education in the future.
(Male teacher, urban government school)

These extracts highlight a common problem in science classrooms where the shortage of Biology teachers in secondary schools has led some head teachers to employ unqualified teachers to fill the gaps.

7.2 Teachers' perceptions about the implementation of the Biology curriculum

A lot of people might think that Year Four is a very low level of education to cater to a student's needs in life, but it is not true. I think the main issue is that what is taught in educational environments often doesn't reflect real life situations. (Macky, female teacher, urban private school)

Macky's explanation suggests that the school curriculum does not equip students with particularly useful knowledge and skills that they can apply in their everyday lives. This comment also raises questions about the relevance of the curriculum to students. These ideas are explored further in this section of the chapter. The section provides an overview of teaching and learning in the Biology classroom, issues relating to Biology curriculum content, teaching methods, assessment techniques, the language of instruction, teaching resources, gender, and streaming.

7.2.1 Biology curriculum content

Despite the social, cultural and economic differences between urban and rural communities, all the teachers believed that the current idea of having one national Biology curriculum for the whole country is appropriate. One interviewee commented:

We only need one Biology syllabus for the whole country because there's a lot of fluidity in Tanzanian society. It's not hard to find someone living and working in a community that's different from the one he/she grew up in. And for that reason, students need biological knowledge and skills that will

help them to be able to work and live in any community in Tanzania or beyond. (Huruma, male teacher, rural private school)

This comment highlights a belief commonly held by my participants that a national curriculum would serve the needs of a highly mobile population.

All eight teachers agreed that the current Biology curriculum provides them with useful content in teaching about socio-scientific issues, although they also noted that it has some shortcomings. They identified various topics in the curriculum that they considered to be useful such as reproduction, reproductive health, health and immunity and diseases like malaria, typhoid, cholera, diarrhoea and STDs. While the participants identified Biology content in the curriculum that they considered useful, they all agreed that the syllabus is overcrowded and that there is not enough time to cover all the topics in depth. One rural schoolteacher said:

[...] Student-centred teaching methods are too demanding with respect to the time needed to cover the syllabus content. The bottom line is that students need to pass their examinations. If you don't get them through their exams, you are counted as a failure. I mean, if you are not teaching your students how to answer questions in examinations, you are seen as a failure. (Huruma, male teacher, rural private school)

These comments show that the teachers struggled to cover the entire Biology syllabus in the time available. The use of student-centred methods was also seen by several teachers as being too demanding and time-consuming given the pressures they were under to get through the syllabus.

A further concern was the heavy pressure teachers are under to get as many students as possible through national examinations. Abel and Huruma, both from rural schools, further commented on this issue. Abel elaborated:

Our education policy requires students to take so many subjects at secondary school and this is a barrier to good teaching and learning. Teachers can't teach effectively when they don't have enough time to teach

and when there's just so much content that needs to be covered in a short period of time. The problem is that the students can't concentrate when all the other subjects are over-crowded as well. (Male teacher, private rural school)

Reproductive health and cultural issues

My findings reveal strong dissatisfaction among the participating teachers about reproductive health education in schools. For instance, Macky commented:

I think topics like reproductive health aren't really given much attention. It's been introduced in the education system without much consideration for the fact that students and teachers need to know more than what has been outlined in the syllabus. Students come to school with a lot of misconceptions about reproductive health issues that really need to be addressed in class. (Female teacher, urban private school)

This comment highlighted what I saw in one urban school where I observed students asking many questions about reproduction. For example, one student asked "Is it possible to have sex with an HIV-infected person and not get infected?" Fortunately, the teacher had a medical background, so he took time to answer carefully and fully, giving a detailed explanation about the chances of getting an HIV infection. According to most of the participants, they themselves wanted a better understanding about issues relating to reproductive health so that they would be able to facilitate their students' learning more effectively.

I asked the participants to explain how and to what extent they integrate cultural issues such as FGM and early marriage (marriage before 18 years) in their Biology lessons. They all said that they try to teach about the influence of cultural beliefs on matters relating to health. Gilbert commented that, "FGM is not a big challenge for youth in urban areas but they do need knowledge because they have many interactions with Tanzanians who don't have this awareness" (male teacher, urban private school). Sihaba added that, "I teach FGM and talk about issues such as early

pregnancy and HIV/AIDS. This cultural practice [FGM] is not common in our community but it still needs to be included in the syllabus” (male teacher, rural government school). The participants believed that it was important to teach about cultural practices such as FGM regardless of whether it is practiced in their own communities or not because young people living or marrying into other communities may need that knowledge at some point in their lives.

In discussing how he teaches about HIV/AIDS, Huruma said, “I usually integrate cultural issues like widow inheritance into my teaching. Actually, widow inheritance is a common practice in this community” (male teacher, rural private school). Huruma believes that it is important to check for HIV/AIDS status before inheriting a widow and he talks about this in his classes. This view was also evident in one of the posters (see figure 8.1 below) that I saw in one of the areas in the village I visited. It was written in Sambaa, which is a tribal language. In translation from Sambaa, the words on the poster below mean “If a man inherits a widow or if a widow wishes to be inherited, they should first check each other’s HIV status”. This is one of the ways that the community is informed about the health risks of cultural practices such as widow inheritance.



Figure 7.1 HIV awareness poster on show in a site community

Climate change, biotechnology and health issues

Five out of the eight teachers explained how they incorporate ideas about climate change into their teaching about diseases but said that they only do this occasionally. They mentioned topics like environment and diseases which involve discussions about illnesses like cancer or malaria. Macky said, "I talk about climate change when I'm teaching about human health and when I teach about diseases like cholera. I usually explain to my students about the effect of environmental change on the spread of disease" (female teacher, urban private school). Abel, a rural schoolteacher, added that he shows students how the rainy season increases the number of breeding sites for mosquitoes and talks about how this in turn increases the risk of malaria. The participants viewed climate change as an important concept that needed to be integrated into health topics in Biology classes. However, the teachers had little knowledge about climate change and were unable to incorporate these understandings in their teaching to any great degree.

On the issue of biotechnology, seven out of the eight teachers asserted that they only very rarely discuss biotechnological issues in their teachings. Macky commented:

I usually talk about biotechnology in topics like genetics but there is not much of this in the syllabus. At teachers' college, I didn't really learn very much about biotechnology so I don't have much confidence about teaching those issues to my students. (Female teacher, urban private school)

Further, Gilbert said that students found it difficult to understand biotechnological content. He explained:

I think students need to understand biotechnological issues especially when they're linked to health issues. Actually, I think there's a need to have different teaching methods from the ones we currently use. We need methods like observing the real environment through things like field trips. In field trips, students have the opportunity to observe and discover which

we can then follow up in classroom discussion. This would be useful in facilitating learning about biotechnological issues. (Male teacher, urban private school)

This teacher suggested that field trips for observing real life situations would be helpful, believing that students need to see the issues in real life rather than as just facts given out in the classroom. However, most biotechnological issues are not observable in field trips as many of the applications of biotechnology take place at a microscopic level. This suggests that perhaps Gilbert did not have an extensive understanding of biotechnology.

7.2.2 Teaching methods

The section explains about the teaching methods used in Tanzanian Biology classes.

Social constructivism pedagogy and its implementation

All eight teachers believed that while the syllabus proposes the use of social constructivist teaching methods, there are many challenges involved in implementing it in their classrooms. Sihaba commented that, “The constructivist teaching methods proposed in the syllabus are not supportive; they don’t fit with the actual environment of the classroom. I usually end up using the lecture method which is teacher-centred rather than student-centred methods” (male teacher, rural government school). During my classroom observations, in all eight schools the predominant method used in teaching was lecturing with occasional pauses for questions.

All the teachers mentioned that they would like to use different teaching methods such as diagrams, illustrations, small group discussions, whole class discussions, question-answer techniques, and laboratory work. During my observations, however, I noted that when teachers occasionally used whole classroom discussion approaches, there were many challenges. They appeared to lack confidence in

managing class discussions. In one urban school during the class discussion, some students were very attentive and were copying notes from the blackboard while others were off task or seemed bored and disengaged. Also, during my classroom observations I did not see much evidence of teachers making an effort to ascertain students' prior knowledge which is a key element of constructivist pedagogy.

Four of the eight participants agreed that students come into their classrooms with many misconceptions. In my classroom observations, in a few rare cases, teachers were able to clear up students' misconceptions. For example, in one urban classroom, a student said that she had heard that the chemicals inside condoms can cause cancer. In the same class, another student asked whether or not HIV is carried by sperm. The teacher was able to respond to both questions and the students seemed to be satisfied with the explanations. But, in all cases during my observations, the teachers did not actively elicit students' ideas or attempt to clarify misconceptions to enable students to make links between prior knowledge and new ideas. Misconceptions were cleared up almost by accident and in an *ad hoc* manner.

All the participating Biology teachers agreed that heavy teaching loads and large class sizes were obstacles for implementing social constructivist learning approaches. One participant gave the following example: "In 2012, I taught Biology to all classes from Year One through to Year Four. This year (2013) I am expecting another teacher to join me soon" (Sihaba, male teacher, rural government school). During classroom observations, the reality of high teaching loads and very large class sizes became clear to me. It was also apparent that these problems affected teachers in both rural and urban areas. In rural areas, teachers often teach relatively small classes (between 35 and 50 students) but because of the shortage of teachers in these areas, they usually have many more classes to teach compared with their peers in urban schools. In contrast, urban teachers face the problem of extremely large classes, for example there can be 50 to 80 students in a single class.

In two of the site schools, some elements of cooperative learning were observed. In these two schools, the teachers gave the students a task to do in small groups, but, in one of those schools, most of the students were not able to present their ideas even when they were directly reading what they wrote. They also found it difficult to pronounce some English words. To gain an insight I asked a teacher (out of class) why they thought students could not express their ideas. She explained:

Students in Year Four in this school are not very advanced because of the nature of selection when they started Year One. This group of students was selected in the third or fourth round of selections after they finished their Standard Seven national examinations so that is why they are so slow in their understanding. (Rose, female teacher, rural government school)

In Tanzania, at the end of primary school there is a national examination and this is used to decide which students will progress to secondary education in government schools. Sometimes the selection process involves a second or third round of selection. This happens after the first round of selection if it turns out that the school has vacancies and can accommodate more students. Those students who are selected in the second or third rounds are drawn from those who did not perform at the top levels of the national examination. This is why my participant, Rose, referred to these students from the second and third rounds as *slow*.

The influence of cultural attitudes in teaching activities

Cultural beliefs and practices were seen by some of the teachers as being a hindrance to students' learning in Biology. Macky explained:

In Tanzania, there are cultural protocols that prevent us from talking openly about certain issues related to reproductive health. For example, once I had to teach about HIV/AIDS issues. But when I talked about using condoms to prevent infection it was considered culturally inappropriate to teach this. Culturally speaking, people believe that it's better to teach about disease prevention by advising students to abstain. Culturally, a lot of people think it's wrong to talk about condoms because students have not yet started

having sex so it is inappropriate to tell them. There are things in our culture that our mind does not want to hear. (Female teacher, urban private school)

The quote indicates that schools' HIV/AIDS intervention about HIV/AIDS needs more than just an understanding about how the disease spreads; it also needs to include consideration of the influence of a community's cultural attitudes.

Sihaba gave the following example:

There's a cultural barrier, especially when you teach female students. For example, sometimes it's difficult to talk about sexual matters in front of girls or to ask them to explain some of the issues which seem to be culturally sensitive. They usually start to look down, they feel shy and they get very uncomfortable. The problem is that this reduces girls' confidence because they cannot contribute to such discussion. (Male teacher, rural government school)

Abel added:

In some tribes it is taboo to mention the sex organs. I was teaching about sexual reproduction and the students went to the Head of school to complain about it. The Head of school looked at the syllabus and explained to the students that it was part of the national curriculum and they had to learn about it. I think that when you're teaching about these issues you have to observe cultural morals and try not to provoke or stigmatise the differences between males and females. (Male teacher, rural private school)

The arguments made by both Sihaba and Abel indicate that they find it difficult to talk about sexual matters in classes, especially in coeducational environments.

Use of real life examples in teaching

The interviewees said that teaching socio-scientific issues by connecting with real life examples was important. During my classroom observations, Abel taught about

albinism in genetics, and he used an example of albinism witchcraft beliefs, as follows:

Knowing about genetics helps us to support and care about people with albinism and not to discriminate against them. For example in other places, albinos have been hidden for fear of being abused on account of people's beliefs about witchcraft. In this past month, an albino child died and was buried inside the house because the parents were frightened that other people might dig up the grave and take the corpse for ritualistic purposes. We should support people with genetic disorders and not discriminate against them. (Male teacher, rural private school)

Gilbert (an urban schoolteacher) and Huruma (a rural schoolteacher) commented that urban and rural environments provide teachers with different kinds of learning opportunities. Gilbert commented that, "In rural areas many schools have farms where chickens and cattle are kept so it is easy to use the farm for students' learning. Most of the urban students learn these things theoretically, using books" (male teacher, urban private school). Huruma stated:

Urban students benefit when teaching about air pollution and its impacts on human health. It's easy for urban students to understand because they have real experiences of air pollution. In rural schools, it is easier for students to understand when you teach about the relationship between plants and animals because those things are right in front of them. (Male teacher, rural private school)

7.2.3 Assessment techniques

All the participating teachers noted that the Biology curriculum is competency-based and requires the application of knowledge. Five participants (based in both urban and rural schools) said that they incorporate questions aimed at assessing students' ability to use knowledge and skills in their everyday lives. Three out of four teachers (Gilbert, Shedafa, & Asha) said that they assess students' ability to

make decisions in life through questioning them verbally and also through written tests, quizzes and examinations. For instance, Asha asserted that she usually includes different kinds of questions ranging from ones based on memory recall ones those that require students to apply their learning to a real life situation. Shedafa added that if the students asked him questions in class, this suggests to him that they have understood and engaged with the subject matter. For most of the participants, the most common method of measuring students' ability to make decisions involving what they had learned in class was through questions that required students to apply their knowledge to real life contexts.

In addition, three out of four rural school participants said that they rely on their own observations of students as they apply what they have learned in real life contexts around the school as a determinant of students' ability to use biological knowledge and skills in their daily life. Huruma asserted:

I always give my students opportunities to practice what they have learnt around the school environment. For example, if one of their fellows faints, I usually observe the way the others take care of the fainting victim. (Male teacher, rural private school)

All the participants agreed that the national examinations in Biology are not a good predictor of students' ability to apply biological knowledge and make informed decisions. Macky, an urban schoolteacher claimed that despite the curriculum insistence on applying school Biology knowledge to everyday situations, the reality is that this does not reflect the needs of society. She further commented that the Tanzanian education system is oriented towards passing national examinations and she argued that this is why the graduates are not able to make informed decisions about socio-scientific issues. Huruma further explained:

A student can get a high score in the Biology national examination and still not be able to use biological knowledge in their everyday life. That's because most of our students are interested in getting the highest scores they can

and they're not as interested in applying their knowledge to life situations. So they usually just regurgitate Biology concepts for the sake of the examination. After the exam, the students never remember any of material.
(Male teacher, rural private school)

This comment supports Kellaghan's (2004) findings that national examinations in Tanzania do not usually include questions that require students to apply their knowledge to real life situations. The situation where students learn for the sake of examinations and then forget what they have learned jeopardises the development of useful skills and knowledge.

Some of the teachers were very concerned about the practical examinations. Students are able to do a paper which is known as 'the alternative to the practical'. In alternative to the practical examinations, students focus on doing biological practical work in terms of theory. This examination was introduced in secondary schools during the 1980s and focuses on doing practical knowledge in a theoretical manner. Huruma, a rural schoolteacher said:

The 'alternative to the practical' exam is hopeless for student learning because it's not linked to their lives. For instance, when students learn about starch in the laboratory they see the real thing and its application. (Huruma, male teacher, rural private school)

He further argued that learning through practical work is better for students than focusing mainly on theory. Millar (2004) argues that the reduction of practical work limits students' opportunities to gain hands-on experience which is contrary to the notion of being able to manipulate objects and ideas to develop conceptual understanding.

7.2.4 Language of instruction

The language of instruction in secondary schools is English and this is a serious problem because students spend seven years in primary schools

studying and speaking Swahili. This is a real stumbling block for many students. (Abel, rural schoolteacher, private school)

This quote exemplifies the concerns of several participants about the language of instruction in secondary schools in Tanzania. All eight teachers argued that having English as the medium of instruction is a barrier to understanding. Macky explained:

Most of us are more comfortable speaking in Swahili than we are speaking English. We use Swahili in primary education but the switch to English at secondary education is a major challenge. We don't have a good foundation in English language. (Female urban schoolteacher, private school)

The participants noted that mixing Swahili and English and switching back and forth between languages was the only way of getting students to understand their lessons. This was also evident to me during classroom observations where in most cases teachers regularly switched between English and Swahili. Huruma commented:

I remember my students being taught Biology by one European teacher. It was very difficult for them to understand so I repeated everything in Swahili after that European teacher left. Teachers are forced to use English but if we were to do that all the time in our teaching practice, our students would fail. It is necessary to mix English and Swahili though it is not actually allowed. (Huruma, male teacher, rural private school)

Abel, a rural schoolteacher, added that most of students are fluent in their tribal languages and Swahili but less fluent in English. He said that the situation has a significant impact on students' performance in Biology. Sometimes teachers translate issues from the students' tribal language into Swahili and then translate again into English. But English is not very popular with many students. In one rural school, I saw that students had written a message in their tribal language on the classroom ceiling. It read: "*English ya nyokwe*" (*English is the language of your*

mother'). This is not easy to translate but it is intended to be a derogatory comment about the English language.

7.2.5 Teaching and learning resources

All the participants said that there was a severe shortage of teaching and learning resources such as books, laboratory rooms, equipment and indeed, of Biology teachers themselves. However, the participants were unanimous in their assertion that there are more teaching resources available in urban schools than there are in rural schools. Rose added that the lack of resources such as books in rural schools limits learning opportunities for students, so they largely depend on teachers' notes. Gilbert further commented:

Many rural schools have few teaching resources because of the state of the rural economy which is not very good. Actually, I think it is true that the economic potential of urban families is much greater than that of rural families. So urban parents are able to support their children's education in terms of resources such as books. (Male teacher, urban private school)

Some of the participants (2/8) indicated that many rural parents are not educated so they are less able to support their own children in their learning at school. This suggests that the socio-economic and education status of urban parents may provide greater opportunities for them to support their children's education than parents in rural areas.

During the interview, Abel and Rose, both from rural schools, remarked on the lack of opportunities to use technology such as video cassettes. They said that this has an effect on teaching and learning. Abel added that, "Students in urban areas have access to the internet and television which gives them opportunities to learn about biological issues. Rural students often have no access to electricity or the internet" (male teacher, private school). Abel further commented that he teaches using his own initiatives, like drawing diagrams. However, according to the rural

schoolteachers, it was clear that they had limited access to technology that would help them in the classroom.

Each of the eight participating teachers noted that they are occasionally given teaching and learning resources by their school administration. For example, they might be given materials such as chalks, flip charts, marker pens, syllabus, and very rarely, chemicals, laboratory equipment and books. Huruma said:

I usually depend on the school administration to support field trips but sometimes it's hard to get that support because of the financial situation of the school. That's because most of time it's difficult to get support from parents in rural areas because of their poor financial status. (Male teacher, rural private school)

In this regard, Head of schools cater to teachers' basic needs when possible but not to their subject specific curriculum requirements. The participants commented that teachers generally prefer to stay in urban areas because of the availability of social services like hospitals, transport, and electricity. Consequently, they said, in many rural areas there are severe teacher shortages. Rose, a rural schoolteacher, talked about being the only teacher who teaches Biology classes in Years Two, Three and Four. She noted that rural teachers face the challenge of very heavy teaching loads compared with their urban peers.

7.2.6 Gender and Biology education

All eight teachers agreed that there are differences between girls' and boys' achievement in Biology. Four out of eight participants noted that boys tend to perform better than girls in Biology. Gilbert said:

At the start of Year One, girls and boys perform equally well. But by the time they reach Year Two, the girls' achievement starts to drop. The reason behind this is that girls have many challenges compared to boys. (Male teacher, urban private school)

Gilbert and Shedafa, both from urban schools, added that as a rule, girls have many household and domestic chores such as cleaning, cooking and washing dishes. The participants noted that this affects the amount of time they have to study.

Sihaba and Rose, both from rural day schools, asserted that girls often feel inferior to boys. Sihaba said:

Some girls are afraid without reason. One day I heard a boy tell one of the girls that she wanted to be intelligent like men. The boy provoked the girl by calling her '*dume-jike*' (*English translation is a female who tries to appear masculine or lacking in femininity*). These put-downs of girls' intellectual abilities really affect their self-confidence. (Male teacher, rural government school)

The cultural conditioning of girls to feel inferior to their male counterparts is constructed by a society that believes that women's primary social, cultural and economic roles are domestic and subservient. Two other teachers, both from private boarding schools, contributed their views on girls' performance in Biology. Huruma commented:

Girls perform better because to them Biology really touches their lives directly. For example, girls usually know that it is their responsibility to appear clean and to keep the domestic environment clean. Girls are responsible for preparing food at home so they have to learn how to prepare a balanced diet. We can teach them this in Biology classes. Also, girls need to learn Biology because it is seen as a social and cultural duty to be pregnant and take care of young ones. (Male teacher, rural private school)

Abel added:

In day schools, girls have to do a lot of household chores like cooking, fetching water, washing, looking after their young sisters and brothers when they come home from school. But, because girls in boarding schools live away from home, they have ample time for their studies. (Male teacher, private school)

In this respect, the participants agreed that if girls are given a favourable environment for learning they can perform well.

7.2.7. Streaming

All the participants agreed that there are differences in the way science and non-science students learn Biology. They also agreed that science students are more interested and understand Biology better than non-science students. Six out of the eight teachers argued that the major cause of these differences is the nature of selection when students finish Year Two and enter Year Three. They argued that teachers usually encourage students with high academic performance to go into science streams. Huruma added that, "In very rare situations, a high performing student can decide to study a non-science subject" (male teacher, rural private school).

During my classroom observations I noticed significant differences in student participation and engagement in science stream and non-science stream classroom discussions. In two schools, the science students were able to give detailed explanations compared with non-science students. Also, science stream students demonstrated more curiosity during class and they asked a lot of questions compared with their peers in the non-science streams. This observation endorses Macky's concern that teaching the non-science stream is sometimes frustrating because students are not always interested in Biology. I also observed gender differences between the science and non-science streams. For example, in one urban school, I noticed a difference in the way that girls in the science and non-science stream participated in class. The science stream girls tended to be more active participants in classroom discussions compared with girls in the non-science stream. Outside class, the teacher explained the situation saying that the nature of student selection during Year Three favours more capable girls who are channelled into the science streams. Macky and Huruma commented that non-science stream students rarely saw a link between school Biology and their future careers.

7.3 Extracurricular activities

My study shows that extracurricular activities at school can play an important role in students' development of biological literacy. School club activities were popular extracurricular activities in most participating schools. I discuss this further below.

7.3.1 School clubs

School clubs provide extracurricular support for learning about environmental and health-related issues. During my investigation, I was able to attend five school-based health and environment clubs and have included the insights gained from these data in this section. The health and environment clubs in urban schools were named AMREF (African Medical and Research Foundation) and TAYOA (Tanzania Youth Alliance) clubs. In rural schools, I saw various clubs such as PASHA (Prevention and Awareness in Schools of HIV/AIDS, established by the Ministry of Education and Vocational Training), FEMA (a programme offered by Femina Health Information Project (HIP) aimed at promoting healthy lifestyles to young people) and Malihai (Swahili word meaning *living well*) clubs. Most clubs are named after organisations that deal with health and, in particular, reproductive health. The Malihai club is an environmental club that deals with aspects of human health, especially environmental health. These organisations provide schools with information and training about health issues. I had an opportunity to interview a total of five club patrons (here, I use the word 'patron' as a term for a male who performs school matron duties) and matrons in both rural and urban secondary schools. In my site schools in the urban area, I interviewed two health club patrons from one school. I also interviewed two club patrons and one matron from three different rural schools. The other site schools did not have club activities relating to health or Biology. In the schools where I interviewed club patrons and matrons, we discussed the goals and activities of these health clubs and I asked them about their thoughts about how these clubs might help students to develop biological literacy.

All the clubs except one (Malihai) dealt with reproductive health issues such as HIV/AIDS. Malihai is an environmental club but sometimes dealt with human health issues. Ayubu, the patron of the AMREF club, explained:

Our club disseminates information about health matters such as HIV/AIDS. As patrons, we have tried to establish a friendly atmosphere between local health centres and our students. This has helped to create an environment where students can express their needs more openly. (Urban patron, government school)

Another participant, Shema, who is a patron of the Malihai club, added:

Our club activities have a small component of human health. For example, we often discuss the importance of keeping water sources clean to reduce water-borne diseases. We sometimes discuss HIV/AIDS issues in relation to cultural issues like widow inheritance. We also advise our students about financial matters. This has a direct impact on health. For example if girls are able to earn a living once they leave school, they are less likely to become prostitutes or rely on sex to earn money. (Male patron, rural private school)

These club activities show how teachers involved themselves in students' development of biological literacy as it relates to health matters. Also, Shema, the patron of the Malihai club, indicated how it is possible to connect different kinds of knowledge to come up with authentic learning. This implies students need to be equipped with the ability to connect a range of biological concepts to other kinds of knowledge in order to be able to make informed socio-scientific decisions related to their lives. In other words, biological knowledge does not occur in isolation from other kinds of knowledge (Haight & Gonzalez-Espada, 2009). For instance, knowledge about climate change helps people to protect themselves from being affected by health challenges created by climate change.

The participants explained that they are given training from the organisations responsible for establishing a particular club at their school. Ayubu commented:

We usually get training from AMREF through seminars and workshops. Also, they train some of our students to be peer educators. Actually, my role as patron is to facilitate and coordinate club activities but not to train. Peer educators are responsible for training and to organise their fellows. (Male patron, urban government school)

The modes of operation in most of these clubs were discussions, meetings, songs, poems, drama, peer education, festivals and celebrations. Zulfa, the FEMA matron, remarked:

Our club is still new [...] we have plans to organise conferences, dramas, poems and songs related to HIV/AIDS drugs. It's all about creating awareness amongst our students. (Rural government school)

Most of the participants said that students acquire useful knowledge and skills through club activities. Ayubu, stated:

The club activities help our students to some extent, but the nature of the environment students come from, these can be a hindrance. For example, some students' homes are close to places that encourage bad habits. The place like '*dangulo*' (Swahili word which means brothel house or bordello in English). (Male patron, urban government school)

Ally, a PASHA patron, further commented:

We've seen evidence of how useful the students find the PASHA club activities. For example, teenage pregnancies in our school have dropped compared with previous years. (Ally, club patron, rural government school)

Also, Kicheko believed that his students gain useful decision-making skills and knowledge because they are able to express themselves with confidence in front of

people. From the patrons' and matrons' perspectives, club activities played an important role in helping students acquire biological knowledge and skills that are immediately relevant to their lives.

The participants made suggestions for improving club activities. Some recommended increasing the amount of time students spent on club activities. Kicheko argued that students do not get enough time for club activities. He added that meeting once a week is not enough and what they got from Biology is not enough either. Kicheko recommended that the government should include a topic on reproductive health in the curriculum because most of the students are affected directly or indirectly by issues like HIV/AIDS.

7.3.2 Other activities outside the class

The participants commented that students get information about health and wellbeing from a range of sources. But it was important that public health information was given in a way that was relevant and accessible for young people. For example, Shedafa, an urban schoolteacher, drew attention to the public health posters that are placed in schools and around the community that describe various health issues such as HIV/AIDS. He said that these provide useful information to the students, but he said that those posters could be better designed so that students can learn from them.

The patrons and matrons also pointed out a range of extracurricular activities that have flow-on benefits for students in their everyday lives outside of school. For example, Gilbert and Shedafa, both urban schoolteachers, argued that sports and physical exercise can improve students' health and fitness. They believe that it is important for young people to be fit and if they get regular exercise at school, there are obvious benefits for their health outside of school. This implies students can be able to learn biological matters efficiently if they have health bodies.

Asha, Huruma and Abel (located in urban and rural schools) argued that in normal school activities hygiene is emphasised but other activities, such as planting trees, can teach students valuable knowledge and skills. They further commented that they use the clubs to provide students with information about disease prevention. They remarked that some diseases that students are familiar with are associated with poor environmental cleanliness such as cholera, dysentery and schistosomiasis. In this respect, students need environmental knowledge and skills in order to confront biological challenges they experience in their everyday lives.

7.4 Biological education outside school

All eight participants agreed that students acquire a great deal of relevant knowledge and life skills outside of the school environment. For example, they mentioned places such as hospitals, dispensaries, community meetings, religious groups, and NGOs like '*Damu salama*' which deals with youth in society. The participants also said that students get useful information from their parents, public health information sources (e.g., pamphlets), and the media including radio and television programmes (e.g., FEMA and Sema talk shows which deal with promoting healthy lifestyles to youth).

The participants agreed, however, that there is little difference between the health knowledge obtained from schools and that which is acquired outside school. Gilbert said:

Some religious groups have different teachings from what we teach at school. For example, on the issue of protection against STIs some religious groups insist that young people should protect themselves through sexual abstinence until they are married. They also emphasise marital fidelity for married couples. They don't encourage the use of condoms outside the marriage. This is contrary to the knowledge students acquire from school which sometimes does encourage young people to use condoms. (Male teacher, urban private school)

7.5 Chapter summary

This chapter has explored teachers' perceptions about students' acquisition of biological knowledge and life skills for making informed decisions in their daily lives. First, the chapter explained the teachers' professional background and how it influences students' learning. Second, the chapter discussed curriculum matters in terms of content, teaching methods, assessment techniques, language of instruction, and availability of teaching and learning resources, and issues of gender and streaming. These curriculum matters were explained in relation to how and to what extent the curriculum contributed to students' development of biological literacy. Third, this chapter has elaborated on the contribution that extracurricular activities make to students' development of biological literacy. Lastly, this chapter explained the influence of knowledge received outside of schools on students' development of biological literacy.

Overall, the findings reveal some of the influences that shape students' development of biological literacy as teachers perceive this. However, the findings show there are many shortcomings in the implementation of the curriculum and this can jeopardise the effective development of biological literacy among students. Following on with this idea, the next chapter summarises the issues raised in this chapter, and links these to the previous two chapters of the findings.

CHAPTER EIGHT

BIOLOGICAL LITERACY IN CONTEXT: A DISCUSSION ABOUT THE KEY THEMES

8.0 Introduction

The previous three chapters of this thesis focused on the findings from this study. In this chapter, I synthesise the main themes that emerged from the findings and locate them within the wider academic and theoretical literature in the field. My intention in this chapter is to address my two main research questions:

- Does the Tanzanian Biology curriculum support or constrain the development of biological literacy?
- What is the impact of the institutional context (school environment and availability of resources) as it relates to urban and rural secondary school environments in Tanzania, and, how does this affect the development of biological literacy and the acquisition of socio-scientific decision-making skills that could potentially be applied to everyday situations in these contexts?

In particular, I will discuss how the Biology curriculum is implemented in Tanzanian schools and its usefulness in facilitating students' acquisition of knowledge and skills through the social constructivist pedagogical approaches that are favoured by Tanzanian education authorities. As noted previously, however, my findings show that social constructivist approaches are rarely practiced in Tanzanian classrooms despite official recognition of this kind of pedagogical framework. In this chapter, I shall apply both social constructivist and constructionist ideas to contextualise these issues. The chapter has three main sections as follows:

1. A discussion about how the Tanzanian Biology curriculum both facilitates and constrains students' acquisition of decision-making knowledge and skills in their daily lives.

2. A discussion about the varying levels of inequality between urban and rural communities and the influence of these inequalities on students' Biology learning.
3. Identification of a range of other factors that influence the development of biological literacy amongst secondary school students in Tanzania.

8.1 School curriculum and the development of biological literacy amongst students

This section discusses the Biology curriculum in terms of content, teaching methods, assessment techniques, English as the medium of instruction, availability of resources and the role extracurricular activities play in students' development of biological literacy.

8.1.1 Biology content

Students' acquisition of biological knowledge depends on creating well-integrated resources about socio-scientific issues in the curriculum (Chamany et al., 2008). A URT (2009b) government document for the teacher education curriculum also recommends that the Biology curriculum content should be responsive to students' needs, that it should address the kinds of societal challenges they face, and recognise global demands such as the use of biotechnological products. My findings show that teachers and students consider that there is a certain level of relevance in the Tanzanian secondary school Biology curriculum. There are also a number of areas, however, that have not caught up with the needs of young Tanzanians in the twenty-first century. In commenting on the Biology curriculum, both teachers and students identified the topics that they believed were most relevant to students' lives. These topics included: reproduction, reproductive health, diseases, health, and immunity to diseases through vaccination. Students talked about a range of content areas that they considered to be immediately relevant and important to them, including awareness about the symptoms of particular diseases within their communities, disease prevention, first aid techniques, good nutrition, and, the

effects of illegal drug use. They also considered that environmental knowledge was useful to them. Although these topics are generally taught in schools, my findings show that teachers and young people feel they need more applied and detailed understandings of these matters which they have a direct impact on their health and wellbeing. Many participants argued that the curriculum needs to be reviewed to better address their needs. For instance, my findings about reproductive health reveal that despite the topic being taught in schools, students felt it did not provide them with the skills they needed to manage the sexuality and sexual health issues they faced in their daily lives. Constructivists emphasise the use of educative content which is in line with the contemporary challenges and needs of learners (Dewey, 1947). To this end, I argue here that Biology curriculum content needs to be further integrated into students' daily experiences and that this can be achieved when they have learning experiences that are meaningful and relevant to them.

My findings also reveal that teachers believe that there is not enough time allocated to Biology in the school day to properly cover the content. Hakielimu (2012) found that Tanzanian teachers perceive the curriculum development process as a top-down one with very little teacher involvement. As a result, teachers struggle to see the relevance of the curriculum. This sense of powerlessness may also affect their teaching since many teachers are more focused on delivering the syllabus rather than increasing students' understanding of the topic. I argue here that curriculum developers need to take into consideration the needs of students as grassroots stakeholders when developing curricula.

8.1.1.1 Reproductive health content

My findings about the perceptions of both students and teachers show that they are concerned about the relevance of the reproductive health education that students receive at school. Generally speaking, the teachers did not feel confident about teaching about reproductive health matters, nor did they feel sufficiently knowledgeable about discussing the specific challenges that students face in this

area. Some teachers attributed this to a lack of knowledge on their part. One teacher participant argued that classroom-based learning cannot in itself change students' behaviour outside of school nor adequately clear up all their misconceptions about reproductive health issues. On the other hand, it can be argued from a constructivist point of view that it is the teacher's role to uncover students' misconceptions and tailor their teaching to address these misconceptions (Morrison & Lederman, 2003). If students are not given the opportunity to share their experiences then it is highly unlikely that teachers will find out what misconceptions they have. I argue here that the teachers' concerns about not being able to address students' misconceptions might be because they are not cognisant of their role in student learning or have accepted that they are powerless to create meaningful change. Perhaps this is because of the culture of following syllabus instructions very closely and not looking beyond this. For instance, teachers may be given instructions about the content to be covered and the methods they are expected to use in the classroom, but because they are not given specific ideas or encouragement to explore students' misconceptions, they do not incorporate this in their practice.

Issues relating to sex and sexuality were, however, a focal point of several focus group discussions. For example, several of the students wanted to talk about the sorts of conditions that give rise to what may be termed 'sexual feelings'. They mentioned factors such as watching sexually explicit material on the internet or in cinemas; boredom, and peer pressure. The students also suggested that boys and girls respond to sexually explicit material in different ways. Owens, Behun, Manning, and Reid (2012) argue that adolescents who watch sexually explicit materials are more likely to engage in sexual behaviours, some of which are risky and problematic and are sometimes associated with drug and alcohol use, emotional disturbances, and multiple sexual partners. Flood (2009) further argues that exposure to sexually explicit materials encourages young men's participation in sexual abuse. The issue here is not about placing restrictions and rules on what young people do, but to teach them the skills to be able to decide what is best for

their health and wellbeing and I argue here that the Biology curriculum is a good place for these messages to be given.

In addition, my participants suggested that parents should be responsible for supervising their children at home and protecting them from accessing sexually explicit websites on the internet. The students also proposed that the government should closely monitor internet cafes by restricting them from watching pornography. Mbeba, et al. (2012) content that community bylaws about pornographic video watching are poorly enforced in Tanzania. This supports my argument that laws alone are not enough to change the situation. Young people need to be educated so that they can make informed decisions about their lives. Amongst other things, young people need to have knowledge and skills to be able to choose whether or not to involve themselves in activities which lead to high-risk behaviour. Such education will help to build a younger generation where individuals are confident about taking responsibility for their health and wellbeing rather than depending on externally imposed rules and regulations.

8.1.1.2 Diseases

Kwesigabo et al. (2012) argue that illiteracy contributes to ill health in Tanzanian communities. My findings show that students learn about common diseases in schools. But, from my participants' point of view, education about disease prevention still needs to be improved. Communicable diseases, non-communicable diseases, STDs and HIV/AIDS are the cause of ill health amongst young people in Tanzania so the stakes are very high. My participants noted that a major cause of the prevalence of diseases is a lack of education about prevention, symptoms, and the treatment of particular illnesses. The participants said that because some young people do not have access to secondary school education, disease prevention education needs to begin in primary schools. This finding concurs with Mwambete and Mtaturu's (2006) study which shows that there are varying levels of awareness and understanding about diseases such as STDs among young people in Tanzanian

society. Kisinza, et al. (2002) argue that there is much discrimination against people with HIV/AIDS among Tanzanians and this deters many people from disclosing their HIV positive status to their friends, relatives and partners. My findings show that further education about HIV/AIDS transmission is needed if prejudice against people with HIV/AIDS is to be eliminated. Discrimination was regarded by my participants as a major reason why HIV positive people do not disclose their status. Despite having education about how HIV is transmitted, many people continue to fear getting HIV infection through casual, non-sexual contact (Maman, et al., 2009).

8.1.1.3 Cultural practices and health

The findings from students and teachers show that students learn about cultural issues and health at school and that some of this material has relevance to their everyday lives. Cultural issues, including the consequences of FGM, widow inheritance, early marriage, witchcraft practices, unhygienic male circumcision ceremonial practices, and food taboos were mentioned by both teachers and students. The students associated most of these practices with negative health consequences, especially the spread of HIV infection, and they were also able to explain, through examples, how these practices spread HIV infection. Hellandendu (2012) argues that culturally prescribed acts, such as ritual circumcision, play a role in the spread of HIV. Gausset (2001) argues that because cultural practices are so entrenched in many communities, widespread condemnation of African cultural practices is not a useful strategy for preventing the spread of HIV/AIDS. In Gausset's opinion, more lives can be saved if more hygienic options are promoted that make traditional practices safer. With this in mind, I contend that students need to be taught the pros and cons of cultural practices that take place within their communities and be given the tools of critical thinking to make informed decisions about those cultural practices, rather than merely learning a series of facts about cultural issues and health.

While students in both urban and rural areas were interested in learning about cultural practices and health, most rural students were not satisfied with what they were currently learning. For instance, rural young people who participated in the focus groups told me that girls in rural areas do not have a voice in protecting themselves against sexual violence compared with their peers in urban areas. Agrawal's (2014) study about educational inequalities amongst urban and rural areas in India also found that rural girls need to contend with traditional practices, such as teenage marriages and have little or no say in the matter. Kaptan and Timurlenk (2012) assert that education can help young people to confront these cultural and social challenges and that biological knowledge can provide them with an understanding about how they might protect themselves from the spread of disease even in situations where they have few choices. This follows the argument that education is needed to empower girls and to give them a voice to take a stand against widespread sexual abuse at all levels of society. While this proposition would not change the structural and material conditions of young women's lives, it does suggest that education about preventing sexual violence against girls and women is needed for all students, not just girls.

Despite rural students not being satisfied with their education in relation to health matters, students from both urban and rural areas believed they acquire a great deal of relevant knowledge outside of school. During the focus group interviews, the participants considered that television programmes and community projects such as those related to increase awareness about HIV/AIDS were very useful. Some students said that they had the opportunity to listen or to be involved in these programmes that raised awareness. For example, one student mentioned being a volunteer in an international NGO on community issues. Mubyazi et al. (2013) contend that many Tanzanian people have deep-rooted cultural beliefs and some of the practices associated with those beliefs increase the spread of disease such as HIV/AIDS. It is therefore important to educate society as a whole, both formally and informally, about risky cultural practices, the reasons why people are at risk and how they can keep themselves healthy and safe.

Another finding from this study relates to the culture of silence between young people and elders, such as parents, health officers and teachers about sexual matters. Shemsanga (2013) argues that these silences affect students' ability to access information about sex and sexuality. There are cultural taboos in many Tanzanian communities about sexual practices and parents and other older people rarely speak openly with children and young people. Students in this study claimed that cultural attitudes affected their access to reliable information about puberty and sexuality. At the same time, both students and teachers bring their cultural attitudes into the classroom and this can influence and limit the extent of Biology teaching and learning activities that are offered (Kaptan & Timurlenk, 2012). On the other hand, Gergen (2009) notes that taboos around matters of sexuality are beginning to change in some areas and this has led to the beginnings of an awareness of the need to review and replace old meanings about sexual issues, but there is a long way yet to go. Clearly, a major issue for education policy and curriculum development is to identify ways of breaking these silences in the Biology classroom, a subject area that should ideally provide opportunities for these issues to be talked about.

8.1.1.4 Education about nutrition

Good eating habits are essential for health and wellbeing. The participating students told me that they were interested in learning more than they are currently taught at school about a balanced diet and making healthy food choices. My participants (the students) said that some people are not educated about this and so do not realise the importance of it. Education about a balanced diet is therefore needed in schools and also needs to be extended into the community. Community nutrition programmes that are culturally oriented, however, play a significant role in disseminating information about eating a balanced diet. Onuorah and Ayo (2003) argue that the use of magazines, radio, television, and books such as those used in wealthy nations can also produce meaningful results in developing countries. I contend, however, that it is better to use methods of dissemination that are grounded within our cultural context, for example, through using cultural

celebrations such as dance, songs, drama, or meetings chaired by respected community elders to disseminate information about a balanced diet. However, if this is to be effective, these elders would, themselves, need to be trained in nutrition and healthy eating options. I argue that while it is important to use a range of methods, after conducting my research I have come to the conclusion that people respond more immediately to strategies that are culturally familiar to them and which mobilise traditional learning approaches.

Onuorah and Ayo (2003) argue that beliefs about food are deeply rooted in the culture of society. Sometimes, taboos occur even when there is plenty of food and these can have a significant effect on the nutrition of particular individuals and groups (Onuorah & Ayo, 2003). In my study, for instance, the food taboo practices mentioned by both teachers and students indicated that education about the importance of eating a balanced diet is needed in some communities. For example, participants mentioned food taboos such as pregnant women who do not eat nutritious food like eggs for fear of delivering babies without hair. In their study of Nigerian communities, Onuorah and Ayo found that most food taboos are constructed around women and children. This is because most food taboos are perpetuated by adult men who are considered to be head of families. This situation can prevent women and babies from getting sufficient nutrients (Onuorah & Ayo, 2003). However, my findings show that these kinds of cultural taboos were held by students in only a few communities, mainly in rural areas. Nonetheless, I argue that it is still important to teach about how these taboos might prevent good nutrition practices. This would help to address deep-seated food taboos that are, in the main, perpetuated through elders in rural communities. Educating elders within community contexts as well as younger people in schools may help people to make more informed choices about their diet.

My study also revealed that a family's economic status was a major factor in whether a family has a well-balanced diet. There are many reasons why some people cannot afford to eat a balanced diet. Onuorah and Ayo (2003) cite

conditions such as war, poverty and climate change that make it difficult for people to grow their own food and in these situations people need external help to survive. Westengen and Brysting (2014) argue that through strategic thinking and education, people living in semi-arid areas in Tanzania can be trained to grow drought-tolerant crop species, such as sorghum. In this case, education is an important part of the strategy.

8.1.1.5 Climate change and health

Climate change has already posed many challenges to people's health in Tanzania. According to CIGI (2009), climate change has already increased incidence of droughts in eastern Africa. This threatens agricultural activities and increases food insecurity which in turn has resulted in malnutrition. Specifically, CIGI reports that climate change threatens human health in Africa because extreme climatic conditions cause natural disasters leading to a scarcity of safe drinking water and the spread of water-borne communicable illnesses, such as cholera and diarrhoeal diseases. Awareness of these issues was also discussed by my participants. The students told me that they were particularly interested in learning about health relating to climate change. I believe that raising awareness of the need for conserving the environment and taking appropriate action in order to reduce or respond to factors that contribute to extreme climate changes needs to be a priority of secondary school Biology education.

While the student participants in urban areas had learnt about climate change and health both in and outside school, rural students had more opportunities to learn about climate change in school. This might be due to the current secondary Biology syllabus having few topics which relate climate content to health issues (URT, 2005). To affect change and increase student knowledge about the impact of climate change, perhaps teachers need to take personal initiatives to integrate these issues when they teach about health. However, as noted previously, many Tanzanian teachers depend on the syllabus for direction about what to do in the classroom; so

if the syllabus is silent about climate change and health, it is unlikely that teachers will talk about those issues. In this respect, many students, especially those in rural agricultural areas who see the direct effects of climate change, depend on other sources of information outside the school environment for information. Currently, many Tanzanians learn about climate change and its effects through the media (BBC World Service Trust Report, 2010). There is clearly a need for students to learn about climate-related health issues at school. In light of this, initiatives need to be taken for the school curriculum to put more emphasis on climate change and health. Teachers need education and professional development to enable them to integrate climate change issues into their teaching of health in order for the students to be well informed and apply this knowledge in their daily lives.

My study reveals that both students and teachers have some awareness of the effect of climate change on human health. The students were aware of some of the health effects caused by climate change including conditions such as drought which causes a lack of food and increases the occurrence of kwashiorkor and marasmus. They also knew that environmental conditions caused by climate change increases the risk of diseases like malaria, cancer, asthma, respiratory allergies, cholera, and bilharziasis. These findings are in line with Niringiye and Douglason (2010) who comment that climate change increases the spread of diseases such as malaria due to environmental modifications like deforestation. For these sorts of reasons, the teachers who participated in this study commented on the importance of teaching about climate change and its impact on human health. While both rural and urban students had some knowledge about climate change and health in schools, it can still be argued that the Biology syllabus does not adequately cover these issues.

8.1.1.6 Biotechnological issues and health

The increasing use of biotechnology in various sectors such as food production and health has created a need for people to become biologically literate about issues relating to biotechnology and health. Usak, et al. (2008) argue that this area

therefore needs to be an important component of formal education. Schools are charged with the task of preparing future citizens and can play a crucial role in helping young people to acquire biotechnological knowledge. My findings indicate that students know very little about biotechnology and it appears that this does not feature in the junior secondary school Biology curriculum. Most of the information about biotechnology that students had acquired had come from out of school (for example, through the media). However, my findings show that most students are interested in knowing more about biotechnological issues. Biotechnology is used in disease prevention, for example, in vaccines and the treatment of diseases, such as the use of insulin in treating diabetes, and for improving crops, for example, through the genetic modification of grain crops and the control of pests and diseases. From students' perspectives, it follows that an understanding of biotechnological practices, such as genetic modification, modern ways of preventing and fighting diseases, population control through contraception and reproductive technologies, ought to be an important aspect of Biology education in our schools. In light of this, I argue that Biology curriculum developers need to consider incorporating material about biotechnological issues and health into the curriculum.

The teachers in this study talked about how they also needed to increase their knowledge and understanding about health and biotechnology. Furthermore, in the absence of well-equipped laboratories, my participants (teachers) regarded fieldtrips to industries that produce biotechnological products to be the best method of teaching these issues. In more wealthy countries with laboratories, for example in Australian schools, teaching biotechnology in the classroom is relatively easy (Schibeci, 2000). Incekara and Tuna (2011) comment that people's attitudes towards biotechnological education depends on national and socio-economic conditions. G. Kidman (2009) suggests that teachers need to be prepared with subject matter knowledge so that they can teach biotechnology.

8.1.2 Teaching methods

Lenz and Willcox (2012) argue that teachers need strategies to link socio-scientific issues and biological content. My findings suggest that teacher-centred approaches such as lecturing were prevalent in the participating schools and student-centred teaching methods, for example, demonstrations and fieldwork, are rarely used. Students have little sense of 'ownership' in their learning and perhaps this explains why they are unable to see the relevance of what they learn in Biology to their lives outside school. Lenz and Willcox emphasise the need to contextualise class activities and to connect students' prior knowledge and experiences with classroom content to make personal sense of their learning experiences. Several teachers said that they try to integrate real life examples into their teaching; for example, they tend to 'narrate' scenarios in their lecture format. However, my classroom observations showed that much of the content is presented in a very abstract form and students struggle to link what they learn with real life situations. As teaching activities play a significant role in students' development of skills, knowledge, and the ability to apply what is learnt, Lenz and Willcox argue that it is important for teachers to develop problem-solving activities and case study scenarios that will trigger critical thinking. It follows, that teacher education programmes in Tanzania need to include guidance on how teachers can integrate socio-scientific issues into their teaching and when designing learning activities that directly connect with real life scenarios.

Constructivist learning is underpinned by the belief that learners acquire new knowledge that can be placed alongside existing knowledge so that new understandings emerge. Zeilder et al. (2005) contend that through social constructivist learning approaches teachers can elicit students' prior knowledge and provide them with opportunities to share their socio-biological experiences with their peers. The findings from my study, however, indicate that in Tanzania, students have few opportunities to share their everyday life experiences in school.

Furthermore, Morrison and Lederman (2003) argue that it is important for teachers to develop a variety of techniques to uncover students' experiences and address their misconceptions. My findings show that even though teachers knew that their students held many misconceptions about biological processes, they rarely explored these misconceptions or sought to correct them. When teachers introduced new topics or concepts they usually did so by asking questions which only required students to recall answers. The opportunity to find out what the students know about the topic to be taught was largely lost. My findings mirror Kaptan and Timurlenk's (2012) argument that Biology teachers sometimes fail to recognise the influence of students' life experiences in their learning.

Students said that copying notes from the blackboard was a very common practice in their classes and this reflects Qorro's (2006) argument that most Tanzanian students copy notes from the blackboard that are later learnt by rote. Rote learning is contrary to social constructivist pedagogical approaches where students are encouraged to exchange ideas during classroom interactions (Lunenburg, 2011; Sumra & Rajani, 2006). While it is easy to criticise teachers, the problem is larger than the practices of individuals. Even though the Biology syllabus focuses on student-centred teaching approaches, teachers neither have the opportunity to develop such approaches nor do schools provide adequate resources including sufficient time and reasonable class sizes. My findings are in agreement with Mabula (2012) who notes that teachers are discouraged from taking more student-centred approaches by the inadequacy of teaching materials and the environment of many schools. The participating teachers also talked about other problems including having to cover too much content in the time available, a lack of teaching materials and resources, and heavy teaching loads which inhibited them from adopting learner-centred pedagogical approaches. Indeed, these teachers are seriously overworked and subsequently lacked the motivation to improve their practice because they felt disillusioned with their working conditions. As a result, curriculum delivery and teaching practice favoured rote learning.

In terms of pedagogical approaches in Biology more generally, the students who participated in my study wanted more teaching activities that included practical work and fieldtrips. They also suggested a greater use of real life examples, diagrams, technology, peer educators, debates and demonstrations. Some teachers acknowledged that the use of student-centred methods provides students with better learning opportunities compared with teacher-centred learning but felt uncertain about how to shift their practices.

Despite the many shortcomings of Tanzanian schools in not using social constructivist teaching and learning methods, it is important to contextualise the reasons for it. According to Vavrus (2009), context plays a significant role and because there are differences in the cultural and material conditions of classrooms, there can be no valid single standard of measuring social constructivist learning. Vavrus further argues that it is unfair to argue generally for school reform without considering the forces that directly affect teaching. Therefore, adopting these ideas in the Tanzanian context will require curriculum developers to carefully research how to accommodate social constructivist ideas in the Tanzanian situation with its scarcity of teaching and learning materials, large classes and poor facilities, and different cultural practices from those of the Western contexts.

8.1.3 Assessment techniques

The Tanzanian secondary school Biology curriculum is a competency-based curriculum where assessment is an integral part of curriculum implementation (Hakielimu, 2012). This approach is in agreement with the social constructivist thinking that includes assessment in the learning process (Duit, 1996). My findings show that teachers are aware that the Biology curriculum is intended to develop students' life skills and competencies and some of the teachers said that they sometimes ask questions aimed at measuring students' competency. The teachers also saw how students' behaviour changed after being taught about Biology-related socio-scientific issues in the classroom. Most teachers said, however, that the

national examinations are focused on assessing content knowledge rather than on measuring students' understanding or ability to apply what they have learnt.

Some teachers said that they were not sure whether continuous assessments were included in the final results as at times the results did not reflect the students' performance in on-going assessments. Teachers in Hakielimu's (2012) study similarly argued that if continuous assessments were included, the failure rate in the results of national examinations would be lower and that students' continuous assessments are expected to contribute to their national examination results. But, Hakielimu notes, interviewees from the National Examinations Council of Tanzania claimed that continuous assessments contribute to half of the final results of the students' performance, which is contrary to teachers' views in my study. On a related assessment issue, social constructivists give priority to formative assessments during the learning process (Duit, 1996). The purpose of formative assessment is to support learning. If teachers believe that the final results do not include student performance in continuous assessment, then they are likely to put effort into preparing students for the final examination. Careful thought is required to find the balance between assessment *for* learning (formative and ongoing), and assessment *of* learning (summative, final examination). Therefore, I argue that final assessments need to include student performance on assessments that take place during the year.

The students who participated in my study believe that the primary purpose of school assessment is to prepare them for the national examinations rather than for gaining knowledge and skills that can be applied in their daily lives. This finding is similar to Qorro's (2013) remark that students memorise their notes for recall during assessment and forget them soon after examinations. Teachers complained that if the students did not pass their examinations, then teachers are viewed as failures. The teachers, therefore, teach students so they can pass examinations and this is not conducive to learning for understanding and application.

In Tanzania, some schools choose to conduct “alternative to practical” national examinations as mentioned earlier in Chapter 7, section 7.2.3. Semali and Mehta (2012) argue that as a consequence, students memorise experiments to answer questions in the alternative to practical national examination. My findings indicate that the alternative to practical examinations is the main reason why some teachers do not use practical work in their everyday teaching. The purpose of science education in general, and Biology education in particular, ought to be to prepare scientifically literate students with knowledge and skills to make informed decisions about socio-scientific issues in their everyday lives (Hodson, 2014). I argue that it is important that, despite the shortage of laboratories, laboratory equipment, curriculum developers consider what practical work in schools will contribute to students’ development of biological literacy.

8.1.4 English as the medium of instruction

My findings show that both teachers and students consider that maintaining English language as the medium of instruction is a major hindrance to students’ learning. The participants’ major concern was the switch from the Swahili language as the medium of instruction in primary schools to English in secondary schools. Qorro (2006) argues that language issues in Tanzanian schools have not been considered seriously although they have a significant effect on the quality of learning. Further to this, Swilla (2009) contends that while students need to be competent in both English and Swahili, there is a need for a clearer policy about the languages of instruction in Tanzanian schools. While I agree with Swilla that students need to be competent in both languages, the major issue is to think about how students can become fluent in both languages. Improving their competency in English enhances future employment prospects both locally and globally, and this is an important consideration.

In many Tanzanian classrooms, it is common practice to borrow Swahili words in order to express meaning in English. Most participants acknowledged that they frequently switch between English and Swahili but some teachers discouraged

students' use of Swahili in class. The rural students who participated in this study found it more challenging to express themselves fluently in English while the urban students had fewer difficulties. This could be because most rural students speak their own tribal languages as well as Swahili, so English is their third (or even fourth) language. On the other hand, Swahili is the lingua franca of the cities, so English is often a second language. However, code switching between English and Swahili appears to be common amongst both urban and rural students. Mwinsheikke (2003) argues that this creates problems for students' learning and assessment. For example, although students understand when teachers switch languages, teachers set tests and exams in English (Mwinsheikke, 2003). So while students may well be able to answer the questions in Swahili, they may struggle to provide the same answers in English and if they answer questions in Swahili, they will fail the examination (Mwinsheikke, 2003). This creates many tensions around the language of instruction in educational settings.

The participating students felt strongly that there needs to be one language of instruction from primary through to university education whether it is English or Swahili. Currently in Tanzania, parents, teachers, academics, policy-makers and students have different views about the language of instruction. Telli (2014) found that policy-makers in Tanzania prefer English because it is an international language and argues that students need to become fluent in it through their schooling. Qorro (2006) argues that there are good reasons for "teaching English" but not "teaching in English" (p. 4), suggesting that students can become proficient speakers by learning English as a school subject. Qorro (2006) believes that Swahili needs to be the main language of instruction for all levels of education, arguing that it is widely used in trade, offices and throughout the country.

8.1.5 Availability of resources

My participants told me that the scarcity of teaching and learning resources, such as books, laboratories, classrooms, technologies and libraries, are major challenges in

their schools. Certain challenges, like access to electricity, transport and technologies are more severe in rural areas than in urban areas. Semali and Mehta (2012) also found that Tanzanian schools lack science-teaching facilities. However, Tanzanian education data show that recently there has been an increase in the construction of schools and classrooms but it is not clear whether these will include laboratories (Sumra & Rajan, 2006). The issue here is not the number of schools that are built, but that schools need to be well equipped with resources and teachers. The Tanzanian government therefore needs to consider how it can improve the resourcing of existing schools, because this affects the quality of education.

My findings also show that there is a severe shortage of qualified Biology teachers and this problem is worse in rural areas. The lack of basic facilities, such as suitable accommodation, electricity, access to hospitals and reliable transport are the main reasons that fewer Biology teachers opt to teach in rural schools. This finding corroborates comments made by IIEP (2006) that teachers hesitate to work in rural areas because there are fewer health and leisure facilities. The shortage of Biology teachers makes the job very demanding for the small number of qualified Biology teachers already working in schools (Semali & Mehta, 2012).

8.1.6 Extracurricular activities

The secondary school curriculum in Tanzania includes a range of extracurricular activities such as sports, school clubs, and athletics which are promoted by each school (Osaki, 2000). These activities differ from school to school depending on the interest of the school management and staff (Osaki, 2000). In Tanzania, extracurricular activities in secondary schools carry no academic credits towards graduation. These activities, however, have the potential to facilitate students' development of skills and knowledge (URT, 2007).

My findings show that school clubs are a major source of extracurricular activity. The intention of these club activities is to familiarise students with emerging socio-scientific issues such as environment, gender, life skills and HIV/AIDS issues (URT, 2007). In most cases, schools collaborate with NGOs or other projects to establish these clubs in schools. School clubs are expected to be supervised by one or more teachers as patrons/matrons (URT, 2007). One of the findings in this study is the influence of school club activities on students' development of biological literacy. I had the opportunity to spend time visiting people involved with five clubs: these were AMREF, TAYOA, PASHA, FEMA and Malihai. The main intention of most of these clubs was to promote reproductive health among young people, especially on issues related to HIV/AIDS. One club, Malihai, emphasises issues of reducing water-borne diseases. I argue in this thesis that these clubs directly facilitate students' levels of biological literacy.

The school clubs each operate in different ways and their activities include a range of initiatives such as basic training in hygiene or health, regular meetings and group discussions, conferences, environmental programmes, poetry, drama, and singing. During festivals and school celebrations, several activities are developed with the aim of disseminating information about reproductive health. Mgimwa and Thulstrup (2011) comment that one of the activities of the FEMA clubs in schools is to facilitate discussions amongst students about their health challenges. In most of these clubs, the preferred method of disseminating information was through peer education where few students are trained to educate their fellow students even though teachers are patrons/matrons of the clubs. Peer education is a common means of promoting young people's reproductive health and well-trained and highly motivated young people facilitate educational and skill-building activities with their peers (Family Health International, 2010). Kessler and Agert (2012) also found that peer education can encourage students to discuss sensitive issues more openly, especially about sexual matters, in a mixed gender environment. However, currently in Tanzania, peer education is underutilised as a teaching method and is only practiced in a few club activities. In my view, these different club activities

appear to make a contribution towards students' development of biological literacy, and mainstream curriculum activities need to consider using peer education as a preferred pedagogical approach.

In my study the majority of questionnaire respondents claimed what they learnt during club activities was relevant and useful to them. Mgidwa and Thulstrup (2011) argue that the main purpose of the FEMA clubs is to help young people gain knowledge about healthy lifestyles. In addition, Massoni (2011) notes that students' participation in extracurricular activities can reduce their involvement in drug use, alcohol abuse, and criminal activities. However, in the participating schools club activities take place either weekly or monthly, and attendance is voluntary. Consequently, the opportunity for students to develop biological literacy is limited and some students miss out as attendance is not compulsory.

Extracurricular activities provide opportunities for students to integrate knowledge from different disciplines (Lunenburg, 2010) and so create new knowledge. For example, the Malihai Club is an environmental club where issues of human health are actively linked to the care of the environment. Haight and Gonzalez-Espada (2009) contend that biological knowledge does not occur in isolation from other kinds of knowledge. It follows then that being able to apply knowledge from different disciplinary areas allows students to enhance biological life skills. After all, making decisions about different issues in life does not rely on knowledge from only one source. In this regard, school activities which are aimed at developing students' ability to make informed decisions in their lives, biological or otherwise, should emphasise the integration of knowledge from different disciplines in order to make holistic decisions.

Also, images are powerful communication sources. One of the findings (from teachers' interviews) from my study is that having posters displayed around the school helps students to acquire useful knowledge which is in agreement with

Chanda, Mchombu, and Nengomasha's (2008) finding that images on posters can contribute to raising awareness of socio-scientific issues. For example, a poster showing a weak HIV-infected person can make a strong impression. In this respect, well-designed posters can have a lasting impact on students in communicating health and wellbeing messages.

An objective of the Tanzanian secondary school curriculum is to encourage students to participate in sports and physical exercise (URT, 2007). Ajay (2011) maintains that participating in sports and physical exercise promotes fitness in young people and reduces health problems. In this study, too, sports and physical exercise were found to promote health and fitness among students, and that students take these skills to their lives outside the schools. Students who experience sporting activities in school may be better able to make informed choices about health matters.

In sum, my findings reveal many barriers to young people's ability to apply what they learn at school to situations in their everyday lives. First, most young people in Tanzania have only primary school education and this level of schooling offers very little biological content. Second, most secondary school students study Biology with a focus on passing exams rather than extending their science education beyond school. For this reason, many students graduate with only very limited awareness or knowledge about biological health and wellbeing. Some of my participants said that students are able to use what they learn at school to some extent. However, the majority of students said that they do not get enough support from the community to be able apply school knowledge. There is clearly a need to develop closer school-community partnerships in this area.

8.2 Inequalities between urban and rural education

Disparities between urban and rural education in developing countries are widespread (IIEP, 2006; Taylor & Mulhall, 2001). My findings also highlight significant educational inequalities between urban and rural communities. The

students in my study suggested that the parents of the urban participants had higher levels of income and education than their rural counterparts and these geographical inequalities reinforce social class divisions in Tanzanian society. The former leader of Tanzania, Julius Nyerere, argued that "education is not a way to escape poverty, it is a way of fighting it" (cited by Tilak, 2006, p. 6). But the circular nature of this kind of inequality ensures that some people will not be able to use education as a tool to fight poverty.

Despite these inequalities, the participating teachers in my study believed that it is important to have a national curriculum rather than a series of locally constructed curricula. Whilst social constructionism recognises historical and cultural diversity in the construction of knowledge (Burr, 1995), the Tanzanian nation is built from many different cultural and linguistic traditions emanating from various tribes (URT, 2007). Diversity is not an abstract aim; it is a daily reality and people who speak different languages need to communicate with each other. The Swahili language facilitates a level of communication amongst linguistically diverse Tanzanians, providing a lingua franca that allows people to communicate in one language all over the country (URT, 2007). Having Swahili as a common language allows people to be more mobile; for example, they can seek work away from their tribal communities if they need to (URT, 2007). Some teachers in my study commented on the need for a national Biology curriculum to be implemented across Tanzania. They argued that there is a lot of interaction among Tanzanian communities and people need to know the biological challenges of different communities so that they can interact, understand, and work on common issues. They contend that a national curriculum would provide a vehicle for these kinds of conversations.

8.3 Other factors influencing students' development of biological literacy

This section explores the influence of other factors related to school context as well as society as a whole in the development of biological literacy among young people. These factors include students' career choices in relation to Biology-related jobs,

teachers' professional backgrounds, gender, and streaming. The section also discusses the hindrances contributed by community attitudes about health education amongst young people as well as education to cope with peer pressure and the economic situation. In addition, the contribution of non-formal education is also noted.

8.3.1 Career choices

My findings from focus group interviews show a significant difference between urban and rural students' intentions to continue with Biology-related careers. Rural students showed considerably more interest in pursuing careers as doctors and nurses compared with their urban peers. Uitto (2014) argues that occupational role models and socio-cultural contexts are important influences on students' thinking about their future careers. I concur with Uitto's ideas with respect to the Tanzanian situation. The rural students in my study also considered teaching to be a good job but ranked it last on their list of career preferences, perhaps due to the poor remuneration offered to teachers compared with other professions. This is in contrast to urban areas where students see role models who prosper in many other non-Biology professions. Another reason for students considering non-Biology careers may be that for extended periods of their secondary school education they did not have Biology teachers in their schools due to teacher shortages.

8.3.2 Biology teachers' backgrounds

Mkumbo (2012) contends that a good teaching qualification is important for providing quality education. Similarly, Osaki (2007) argues that having knowledge of a subject does not in itself mean that an individual can teach that subject in a school environment. In Osaki's view, teaching requires not only subject matter knowledge but also pedagogical knowledge. In my study, all the participating teachers except one were qualified to teach Biology. However, because of the widespread shortage of Biology teachers in Tanzania, head of schools often employ untrained teachers

believing it is better to have somebody in front of the class even if they do not know the subject.

Bennell and Mukyanuzi (2005) contend that teachers play a crucial role in the development of the society and Mkumbo (2012) maintains that teachers need to feel motivated and enthusiastic if they wish to make progress in their career. Currently in Tanzania, however, there is a growing concern about the large number of unmotivated and unhappy teachers (Bennell & Mukyanuzi, 2005). My findings show that all the teacher participants except one felt excited about becoming a teacher early in their careers. However, one teacher chose this career because he felt he had no other choice and he does not enjoy his job. Similarly, Mkumbo (2012) found that some teachers in Tanzania enter teaching because they do not have sufficient qualifications for their first choice of profession. Mkumbo adds that sometimes-negative experiences as teachers demotivates and frustrates them. Another participant, an untrained teacher, was unsure about staying in the teaching profession because of the low pay. These examples suggest that teaching might be an interesting profession for many people but the issue of lower salaries is a deciding factor for some.

8.3.3 Gender

In the government day schools where I collected data, most teachers said that boys perform better in Biology than girls. The major reason they gave for this was that they believed that girls had extensive and sometimes quite gruelling domestic duties that took them away from their studies but there was also a perception that boys are simply better. Machimu and Minde (2010) contend that in many Tanzanian homes, girls' domestic duties do not leave much time for study. This finding reflects historical and cultural constructions of gender roles in Tanzanian society. Often, women who try to compete for 'men's' jobs, especially in science-related careers, are frequently perceived as being less feminine (Nyamba & Mwajombe, 2012). Most science teachers in Tanzanian schools are male and in Nyamba and Mwajombe's

(2012) view, this discourages female students from taking up science studies. Perhaps having few female role models in science-related jobs is an added deterrent.

My teacher participants in the day schools, however, thought girls perform poorly in Biology compared with girls who study in boarding schools, and that the latter in some cases outperform boys. Their reasoning was that boarding school girls have more time for studying and are perceived by teachers as being interested in Biology because they see its relevance to their lives, for example, bearing children. Meena's (1996) study had also found that if girls are given a favourable environment they perform better. Perhaps it is important for the government to review different initiatives that have been put in place for improving girls' education in the sciences.

8.3.4 Streaming

The teachers who participated in my study believed that students in the science stream seemed to be more interested in learning Biology than students in non-science streams. They said that non-science students often find Biology difficult but do not have the option to drop it because it is compulsory. Some of the participating teachers found this frustrating when teaching non-science classes. They attributed poor attitude of many non-science students towards Biology to student perceptions that Biology is difficult and meant for science majors because they are expected to specialise in it. Kihwele (2014) found that many students came to secondary school with a preconceived notion that Biology is difficult so they lost confidence in studying the subject. This situation deprives them of the opportunity to acquire useful knowledge and life skills. Since most students in Tanzania are expected to study Biology in junior secondary school, it is important to develop strategies to encourage them to take an interest and continue their Biology studies.

8.3.5 Community education

The findings also show that my participants believe that young people generally have little awareness or knowledge about reproductive health issues. The students cited as examples, the prevalence of teenage pregnancies, abortion, unprotected sex, and poor family planning in their communities. URT (2001) contends that Tanzanian adolescents often do not have the information and skills they need to make informed decisions about sex. In my study, the young people commented that within their communities they did not have opportunities to express their views about their health challenges including those associated with sexuality. In this respect, my data concur with Coll and Taylor (2008) who argue that in developing countries many initiatives take a top-down approach rather than a grassroots approach that begins with the needs and priorities of diverse communities.

Baram-Tsabari, Sethi, Bry, and Yarden (2010) maintain that adolescents tend to become interested in human Biology when they enter puberty as their bodies start to change. My findings from the participating students show that they were concerned about the lack of information about puberty and felt that their parents needed to give them more information. The urban students in my study, many of whom were living away from their rural tribal communities and kinship networks, believed that their peers in rural areas were more informed about matters of puberty because they were more likely to have grandparents nearby who could provide this information. This finding concurs with Wamoyi, Fenwick, Urassa, Zaba, and Stones' (2010) study which found that in many African cultures grandparents are the main providers of reliable information about sex and reproduction to their grandchildren. In contrast, Leshabari and Kaaya (1997) argue that most Tanzanian adolescents depend on their peers for information about puberty issues, and further that this is not an ideal situation as it may lead to young people misinforming each other because they have not received proper education about puberty and sexuality. In this regard, both young people and adults need to be well informed about issues of puberty and sexuality, so young people can help each

other in appropriate ways as well as adults such as grandparents providing appropriate information to their young ones.

Students in this study argued that older relatives, such as their parents, consider them too young to be told about safe sexual practices and family planning. The young people in this study believed that they required further education about family planning. A similar situation was observed in Uganda by Mitchell, Nakamanya, Kamali, and Whitworth (2001) who noted that many parents worry that if they tell their children about condoms, they would be encouraged to enter into sexual relationships. My findings show that the problem is more severe in rural areas than in urban areas. Mbeba, et al.'s (2012) study shows that many young people in Tanzania, especially girls, become sexually active from the ages of 9 to 12, so it is unrealistic for parents to deny them information about family planning. Clearly, this situation threatens young people's health as early pregnancy can affect girls' physical and emotional wellbeing (Mtengeti et al., 2008).

In addition, my participants (students) were concerned about the reliability of the family planning advice given to them because they had heard many stories about the negative effects of contraceptives. Similarly, Mosha, Ruben and Kakoko (2013) found that young people were concerned about the side effects of family planning techniques. For example, many feared becoming infertile. Mosha et al. (2013) argue that most of the concerns about the side effects of contraception were based on myths rather than facts.

The participating students also commented that they wanted more information in their science classes about how to care for the environment. Their concerns related to disease prevention, particularly cholera, which is common in sub-Saharan African countries. The major sources of these kinds of diseases are unsafe water, poor sanitation and unhygienic physical environments (Schaetti et al., 2013). However, Schaetti, et al. (2013) argue that some people, especially in rural areas, still

associate cholera with witchcraft. Based on my findings it appears that education is still needed about hygiene and disease prevention.

The use of anti-retroviral medication (ARVs) has increased in Tanzania because of the prevalence of HIV infections. My participants commented on the need for people to be reliably informed about the dangers of taking fake ARV medicines beyond the expiry dates. Atuyambe, et al.'s (2008) study in Uganda also found that people were concerned about the quality of ARVs in terms of counterfeit and drugs being sold past the expiry date. My study also shows that many people did not trust some of the information they were given about ARVs. Better biological literacy is needed for students to not engage in drug abuse as well as to critically evaluate the medication that is helpful and useful to them.

8.3.6 Education to cope with peer pressure and economic hardship

The students who participated in my study talked about the importance of dealing with peer pressure. Leshabari and Kaaya (1997) found that young people receive a great deal of misinformation from their peers on a range of health-related issues and argue that trained personnel such as counsellors are needed to guide young people in making informed decisions. In most Tanzanian secondary schools, guidance and counselling responsibilities are left with teachers who are not adequately trained to deal with the range of issues that young people face (Mghweno, Mghweno, & Baguma, 2014).

My participants talked about ways of standing up to peer pressure. They suggested, for example, that young people need advice about employment and budgeting and ways of earning money in order to avoid peer pressure to make money through prostitution. The cultural contexts of gender relations in Tanzania make it difficult for women to negotiate safe sex with older male partners (Hellandendu, 2012). Therefore, female students need to be empowered with knowledge and skills in

order to make informed decisions to protect themselves and to be able to earn money safely rather than depending on prostitution or risky sex practices.

My findings suggest that young people living in poverty are more likely to risk their health through prostitution or early marriages to provide for themselves and their families. This situation creates a potential threat to girls for HIV infections and other diseases (Mbeba et al., 2012). Mbeba, et al. (2012) argue that education about sexual and reproductive health is needed in schools as well as within the community at large. I would add here that education on sexual reproductive health is needed, but at the same time, inequalities that create poverty among young people also need to be addressed. This is because even when someone knows all the consequences of unprotected sex, poverty can lead to compromises. Therefore, it is imperative for the government of any developing country to ensure it facilitates and regulates the economy and supports the health and wellbeing of young people. This can be achieved by establishing teacher education programmes that help them to be equipped with the necessary knowledge and skills to help disadvantaged groups such as young people to reduce poverty in order to overcome financial pressures that lead to ill health.

Other findings suggest that peer pressure can lead to the use of illegal drugs among young people. URT (2001) comments that for some young people, adolescence is a period of anxiety and low self-esteem, and they respond to the situation by using illegal drugs such as marijuana. This concurs with my participants' perception that young people use illegal drugs because they think it will reduce stress. The participants proposed education, the establishment of drug rehabilitation centres and appropriate legislation to prevent the use and sale of illegal drugs. Despite the students' recommendations, I argue that school education needs to be strengthened to empower students with knowledge to make informed decisions against the use of illegal drugs. Mbonile and Kayombo (2008) argue that the methods initiated by young people themselves also need to be identified and used

to train them. They suggest methods such as drama, seminars, workshops, and music for this.

My participants (students) commented harshly on parents in both urban and rural areas who involved their children in economic activities such as small businesses, fetching water, or taking care of cattle, while forsaking their education. I argue, on the other hand, that these are Tanzanian cultural ways of raising children that provide them with an understanding of how to look after themselves as future citizens. My participants also viewed urban parents as taking a greater role in their children's education than rural parents. Taylor and Mulhall (2011) found parents in rural areas are less educated and have lower incomes. In contrast, I believe that the poor economic conditions of rural parents may lead them to find a means of getting out of poverty by involving their families. For this reason, I consider education to be an important part of the equation in developing coping strategies for marginalised rural communities and families.

The study has also shown that sometimes parents force their children to enter into early marriages for the sake of earning money through bride price. Similar results were observed by Machimu and Minde (2010); many Tanzanian girls drop out of school because of early marriages. P.S.D. Mushi (1996) argues that parents in some regions of Tanzania take their girls out of school for the sake of getting a dowry through marriage. The situation can compromise girls' health in terms of HIV infections and early pregnancies. Early pregnancy increases the chances of conditions such as obstetric fistula among girls because their bodies are not physically ready to handle pregnancies (Mtengeti et al., 2008). In addition, my participants indicated that most of the men who marry these young girls are well off compared to the girls' families, so sometimes parents do not take the precaution of checking the HIV status of the man who wants to marry their daughter, and this can be seen as a serious consequence of poverty. Therefore, the major issue is to address how to overcome poverty first in order for education about the consequences of early marriages to be meaningful. This can be achieved by proper

integration of biological knowledge and skills in teacher education programmes. Well-prepared teachers can empower girls through appropriate Biology education to make informed decisions.

8.3.7 Biology education acquired outside school

Teachers in my study commented that their students acquire useful knowledge and skills about health outside the school environment, for example, in NGOs such as Damu Salama. Teachers also mentioned that information is disseminated in a range of community contexts including religious organisations, hospitals, community health centres, and community festivals. Media such as the internet, television programmes like the FEMA talk show, radio, and magazines are another source of useful information about health issues for young people. According to Mwambete and Mtaturu (2006), television and radio do not provide detailed information about health issues often because of cultural and religious reasons. The participating teachers also acknowledged some differences between schools and religious groups; for example, many religious groups do not condone the use of condoms out of wedlock. Mwambete and Mtaturu also argue that learning about health from sources such as magazines and the internet can be counter-productive since there may be no guidance for young people while reading the articles. A few students also noted that parents and friends are a source of biological information. However, Mwambete and Mtaturu found that none of their participants mentioned parents as a source of information for health issues. This indicates my participants viewed that few parents discuss health issues with their children. One student mentioned learning from observing bad consequences for other people in society. These sources of information are useful for young people's learning, but there remains a need for them to be guided by well-informed people.

8.4 Chapter summary

Issues relating to the development of Tanzanian secondary school students' biological literacy have been discussed in this chapter. First, the discussion reveals

that the school curriculum does not, in the main, support the development of biological literacy. There are also several aspects of the curriculum that hinder the acquisition of knowledge and skills. For example, in terms of content, much needs to be done to make it relevant to students' social needs and challenges. Second, in order to facilitate students' acquisition of biological knowledge and life skills, teaching methods and assessment techniques need to be more aligned with social constructivist approaches to teaching. Currently, the lack of teaching resources, combined with teacher-centred methods of instruction, encourage rote learning. Third, the use of English as the medium of instruction is seen as an obstacle to students' engagement with Biology since many of them are not fluent in English. Fourth, extracurricular activities such as school clubs potentially play an influential role in students' development of biological literacy; however, only a few schools offer this opportunity. I argue schools need to make club activities compulsory rather than optional. Finally, the findings reveal discrepancies between urban and rural institutional contexts in terms of resources and the environment with urban schools being better resourced than rural schools.

In addition, many other factors that hinder the students' development of biological literacy were also identified. Some of these originate from societal and cultural attitudes towards health while other factors emerge directly from the school context. In schools, many students were frustrated about their Biology education. Teachers' professional backgrounds influence students' Biology learning; teachers need to be well trained to facilitate students' learning. Moreover, issues related to gender and streaming need to be addressed. In addition, knowledge obtained out of the school environment seemed to contribute to students' development of biological literacy in some instances. Furthermore, a lack of education on reproductive health and skills and knowledge to cope with peer pressure were considered to be barriers for the development of Biological literacy among young people.

Overall, my findings reveal that the junior secondary school students in Tanzania who participated in this study did not experience the conditions they needed to facilitate biological literacy. A number of barriers exist in this situation. Although the curriculum required teaching of Biology which has the potential to develop some biological literacy, the practice of teaching is constrained by the large amount of content to be covered, the pedagogical approaches, and the requirements of assessment. In terms of the curriculum, students expressed that the content did not address their needs to learn about real life examples in relation to reproductive Biology and health.

The next chapter presents the conclusions and considers their implications, acknowledges the limitations of this research, and makes recommendations for further research.

CHAPTER NINE

CONCLUSION AND RECOMMENDATIONS

Smooth seas do not make skilful sailors. African proverb

9.0 Introduction

In this study I have explored the development of biological literacy amongst students in urban and rural junior secondary schools in Tanzania. I began by investigating the Biology curriculum and how it supports and constrains biological literacy. Then I examined the institutional and pedagogical contexts in which school Biology is taught. To that end, I looked at urban and rural secondary school environments and the availability of resources. Overall, my findings show that the school curriculum does not provide comprehensive support for the development of biological literacy. The situation is more challenging in rural schools than in the cities.

I used qualitative methodologies in this study and designed and organised data as an ethnographic case study. The methods of data collection included teacher interviews, classroom observations, student questionnaires, and student focus groups. Biology teachers were interviewed and their thoughts about the Biology curriculum and the challenges of teaching and learning Biology in Tanzanian secondary schools were elicited. I also conducted observations of Biology lessons in urban and rural schools and witnessed how a range of pedagogical and curricular tensions played out in the classroom. Young people also participated in this study, first, through a questionnaire that I administered to find out their views about a range of socio-scientific issues, and then I ran focus groups so that these issues could be discussed in greater depth.

This chapter provides a summary of my key findings. It reviews the implications of the findings for the Tanzanian education system context as well as worldwide. I also make recommendations for education policy, the Biology curriculum, and

community education programmes. Finally, the limitations of the research are discussed and proposals are made for future research priorities.

9.1 Summary of the key findings

My findings reveal that to a large extent, the Tanzanian Biology curriculum does not support the development of biological literacy. The findings also show that there are considerable inequalities between urban and rural schools. While students in both urban and rural areas experience many challenges in their learning and understanding of school Biology, my participants (both teachers and students) were aware that rural schools face more severe constraints, both in terms of resources and also in a difficult pedagogical environment where large classes and few resources are the norm.

While the students involved with this study agreed that the Biology curriculum content offers some level of awareness about how they might make informed choices in their everyday lives, they also wanted a broader range of topics included in the Biology curriculum that were specifically tailored to help them make decisions about the health and environmental problems that affect their communities. These additional topics include reproductive health, human reproduction, sexuality and adolescence, disease, and nutrition. The students were particularly concerned about being informed about the symptoms, prevention, and treatment of diseases such as HIV/AIDS which is widespread in many Tanzanian communities. Teachers also expressed concern about the large number of students in their classes who held many misconceptions about important matters such as reproductive health issues, but many of the teacher participants said that they lacked the knowledge to address these issues. This supports the students' claims that there is no exploration of their prior knowledge in Biology classes and that misconceptions or lack of knowledge about these matters is not addressed at school other than in a very general sense.

I also asked the student participants about their views on a wide range of cultural practices and in response they talked about how many traditional practices, such as FGM, widow inheritance, early marriages, and witchcraft practices, are implicated in the spread of HIV/AIDS. Rural students in particular indicated that they wanted more information about these matters. In many cases, young people get information from sources outside of school. For example, both rural and urban school students talked about how out-of-school forums, such as the media, play an important role in providing them with information about cultural practices and health.

The students also talked about the impact of climate change on their lives and it was clear that very little teaching takes place on these issues, although again, agencies outside of school, such as the media, were a key source of information, especially in rural areas. Climate change was of particular interest to the rural participants many of whom were from agricultural communities where the effects of climate change were directly experienced. However, both urban and rural students were interested in knowing more about these issues.

Findings from the students and the teachers show that teacher-centred teaching methods predominate in secondary schools despite government advocacy of student-centred approaches. Moreover, this study reveals that students are not given the opportunity to share their everyday knowledge, nor are they given the opportunity to build on it in their classrooms. Even though teachers are aware that their students have many misconceptions about socio-scientific matters, few attempt to address these directly or tailor their lessons to the specific needs or interests of the students in their classes. In addition, the teaching of more abstract theoretical material takes precedence over practical learning in Tanzanian Biology classes. In these classes students mainly listen to lectures and copy notes from the blackboard. The teachers in this study were aware that this is not an ideal way of teaching Biology but there are many obstacles that prevent them from practising student-centred pedagogies. For example, they said that the Biology syllabus is

already over-crowded and they struggle to cover the content. In addition, there is a lack of basic teaching materials. In some schools there are not even enough desks or chairs let alone texts. Classes are typically very large; teachers are poorly paid and carry heavy teaching loads compared with teachers in many western nations. They are aware that their teaching practices encourage rote learning but many of them feel unable to change the situation.

The Tanzanian Biology curriculum policy states that teachers shall use competency-based assessment techniques and this resonates with social constructivist arguments about assessment. However, the teachers involved with this study said that because they are required to prepare students for the national examinations, they do not prioritise skills and knowledge that are not included in examinations but which may be important in helping students to make informed decisions about their health and wellbeing. They also said that the assessment techniques used in schools encourage rote learning and this does not inspire students to develop a deep understanding of the topic. The alternative to practical national examination seemed to be an obstacle for the teachers to use applied teaching approaches or engage in more practical applications of the subject. For this reason, many teachers end up teaching students how to answer the alternative to practical examination. These responses indicate that in Tanzanian schools, teachers are mainly focused on preparing students to answer national examinations rather than teaching Biology as an inspirational and interesting domain of knowledge.

In the course of this study it became apparent that the use of English as the language of instruction in secondary schools is perceived as an obstacle to students' Biology learning because they are generally more fluent in Swahili than English. Many students struggle with switching from Swahili as the medium of instruction in primary schools to speaking English when they reach secondary school. They said that they would prefer to code-switch between both English and Swahili at secondary school. However, this would pose problems because in the end students must answer examination questions in English. Many of the participants said that at

the national level, a choice should be made between the two languages, and only one language should be the medium of instruction throughout from primary level through to university level. While most students preferred Swahili, some commented that being fluent in English was important for global communication. In this respect, English and Swahili languages are both important to students; the major issue is to find out the best way of using them within the education system.

The results of this study also show that there is a serious lack of resources in both urban and rural schools, although rural schools are more severely affected. My participants mentioned acute shortages of books, laboratory rooms, classrooms, libraries, and technology in their schools. In addition, there is a chronic shortage of science teachers in both urban and rural schools, although rural schools fare worse than urban schools in this regard. Teachers often refuse to work in rural schools because life is hard in those areas; it is difficult to find suitable accommodation, often there is no electricity, access to hospitals, or reliable transport. This situation places a burden on rural teachers who have to teach long hours in large classes with limited resources. Teachers subsequently feel less motivated to do their jobs well and often do not have the resources to do so.

In this study, extracurricular school activities such as club activities were shown as providing many students with knowledge about biological matters, like reproductive health, that they do not get in their Biology classes. However, these club activities are voluntary and were only offered in a few schools that I visited. Club activities focus on actively involving students in various projects rather than just giving them information, and this allows students to apply what they learn to real life situations. Club matrons and patrons suggested that this has a positive impact on their motivation to learn. Evidence of extracurricular activities could be seen in the posters displayed around the schools, as well as in sports activities, and physical exercise. Generally speaking, in schools where clubs were offered, the participants saw these activities as important in supporting and enhancing their learning

experiences and they were able to make at least some connections between these activities and what they learnt in their Biology classes.

This study has identified many factors that hinder the development of biological literacy; however, teachers' professional background and motivation to join the teaching profession plays a significant role in students' learning. Other factors that prevent students from engaging with school science in general and Biology in particular include the practice of streaming in Tanzanian secondary schools and economic hardship. In addition, girls – especially those in day schools – face many challenges in science classrooms. Social attitudes towards girls and the fact that science streams are dominated by male students prevents many girls from achieving well in school Biology.

9.2 Implications of the research

The findings of this study challenge some of the fundamental assumptions that underpin the Tanzanian Biology curriculum. In particular, they show that the content of the curriculum does not adequately address young people's interests, needs or priorities. For instance, within the topic of reproductive health students want to understand not only the biological aspects of the material, but also they want to know how to apply that knowledge to situations that confront them in their everyday lives outside of school. They want to understand sexuality and have a greater awareness about issues relating to sexual and reproductive health. In addition, work has yet to be done to improve pedagogical practices and assessment techniques so that they dovetail with the needs and priorities of young people growing up in Tanzania today. Issues such as teenage pregnancy and HIV infection among young people, for example, clearly need to be covered in the Biology school curriculum.

The study also found that many teachers lack both content knowledge and the pedagogical skill to facilitate the development of biological literacy. For instance,

some of the teachers in this study do not have the skills to identify and address students' misconceptions about biological matters. In relation to this, it is clear that changes to science education teacher training are needed.

Controversy surrounding the language of instruction in Tanzanian schools is ongoing and to date no solution has been found. In this study, the findings show that switching from Swahili as the main language of primary school instruction to English in secondary schools has a negative effect on student learning. This problem has an impact across the entire curriculum but it also plays a role in the Biology classroom. In the early years of secondary school, students who are not fluent in English struggle to understand teachers' explanations in class and have difficulty expressing their lack of understanding or asking questions, especially when there are classroom rules about speaking grammatically correct English.

Many extracurricular activities provide students with opportunities to extend their knowledge of science and Biology but many schools do not have the resources to offer clubs. The interactive forms of engagement used to disseminate information in these clubs facilitate students' learning. Most of the schools that are able to offer club activities do not have a clear timetable, and if they do run activities, it is only for a few hours per month. I argue here that policy-makers should note the value of school clubs and extracurricular opportunities for students in enhancing their learning particularly in the area of science and Biology.

A major area of concern in this study is the huge educational inequalities between urban and rural communities. Rural schools in general are poorly resourced and are located in communities where poverty and disease are widespread. This situation requires visionary and capable leaders who understand life within these communities and who have the ability to speak and be heard at the highest levels of government.

9.3 Recommendations

The recommendations from this study focus on the Biology curriculum, teacher training, the language of instruction, teaching and learning resources, and the role of community education programmes.

9.3.1 Biology Curriculum

The findings of this study show that changes to education policies relating to the Biology curriculum are needed. The recommendations are as follows:

- Curriculum developers need to direct their energies towards improving a curriculum that helps students to acquire biological literacy at the junior secondary school level. The majority of students do not specialise in Biology after the early stage of secondary schooling so they need to be equipped with knowledge and skills they can apply to situations they confront in their everyday lives.
- Curriculum developers should reconsider how they can contextualise the use of social constructivist ideas in Tanzania teaching and learning activities; particularly in science and Biology.
- Curriculum developers need to revise the content of the Biology curriculum so that it is achievable in the time given to finish the curriculum.
- Extracurricular activities need to be more widely available to a greater range of students.
- To this end, Michie (2014) argues that indigenous students need to learn how to cross intellectual and cultural boundaries between western science and indigenous science if they are to become effective and culturally astute learners. In these environments, teachers may assume the role of “culture brokers” whereby they facilitate students’ movement between traditional knowledge and western science systems. In these contexts, social constructivist pedagogical approaches can be used to integrate indigenous science and western perspectives in Tanzanian schools (Michie, 2014).

However, this approach would require teachers to have knowledge of both western and indigenous sciences and the skills to contextualise western science in their teaching (Carter & Walker, 2010). As was found in this research as well as other studies, there are serious science teacher shortages in Tanzania and untrained teachers are frequently employed simply to ensure that there is an adult in front of the class. In this study I show that the current Tanzania science curriculum does not address this issue of integration of indigenous science into school curriculum (Semali, 2014). If blended approaches to western and indigenous science are to be incorporated into the curriculum, this idea first needs to be addressed by the government at the national policy level. Unless this change is signalled in curriculum policy documents and then translated into the syllabus, it is unlikely that anything will change. In addition, professional development is needed to ensure that teachers understand the philosophy that underpins such a change and how this would look in the classroom.

9.3.2 Teacher training

It is recommended that the teacher-training curriculum and in-service professional development programmes focus on equipping teachers with knowledge and skills to facilitate their teaching of socio-scientific issues. In particular, teachers need to be trained to use social constructivist pedagogies in their specific classroom contexts such as in large classes and few resources. The teachers' training programmes can include the following:

- Focusing on how to develop and implement social constructivist pedagogies which help students to develop decision-making knowledge and life skills.
- Student teachers being taught how to promote peer learning by encouraging cooperative learning in classes. In cooperative learning, students in small

groups need to take responsibility for coaching each other and helping their peers to solve problems that have been assigned to their group.

- Student teachers being trained to teach for understanding rather than for the sake of national examinations. This can be achieved by emphasising or developing thinking skills through engaging students with tasks that provoke their thinking ability.

9.3.3 Language of instruction

In light of the findings of this study, public debates need to be reflected in education policy about the language of instruction, not only for Biology learning, but for the whole secondary school curriculum.

9.3.4 Teaching and learning resources

The scarcity of teaching and learning resources prevents the widespread development of biological literacy in Tanzania. Because the situation is more serious in rural schools, these schools need to be given priority. In relation to issues of resourcing it is recommended that:

- Given the serious shortages of texts and resources, In-service training for Biology teachers needs to be developed that educates them about using resources that are locally available in both urban and rural environments.
- Biology programmes or courses need to be developed in teachers' colleges and universities that focus on effective teaching about the particular socio-scientific issues that confront people in Tanzania, acknowledging that many teachers will be working with a scarcity of resources.
- The Tanzanian government needs to prioritise the training of Biology educators and teachers as resourceful people in helping young people to develop biological literacy. This can be achieved by improving teaching and

learning activities in the early years of secondary school so that more students aspire to enter science-related careers including science education.

9.3.5 Community programmes

Schools are part of the wider community and the links between community and school are important. For that reason, communities need to be involved in developing biological literacy. The following are my suggestions about programmes that need to be established:

- Programmes aimed at strengthening parent-child relationships would help young people to take advice from older family members who have knowledge and experience about the sorts of decisions that need to be made around matters relating to health and wellbeing.
- Community meetings that involve young people in social decision-making would provide forums for young people to speak about the issues that concern them.
- Schools need to work alongside their local communities to establish programmes that allow teachers and students to talk about issues relating to sex and sexuality in ways that appropriately question the culture of silence surrounding public discussions about sex.

9.4 Research limitations

While this study provides insights about the development of biological literacy among Tanzanian students, there are a number of limitations associated with it:

- This study focuses only on students' and teachers' perceptions about Biology in secondary schools in Tanzania. It did not measure their ability to make decisions about socio-scientific issues. Future studies are needed that focus

on measuring students' ability to make informed and biologically literate decisions in their daily lives.

- The sample size of this study comprised a few urban and rural junior secondary schools in Tanzania. These are the schools that allowed me access, but there are many other schools in Tanzania and the situation may well be different elsewhere. For this reason, the findings of this study cannot be generalised across all Tanzanian schools. The findings do, however, provide baseline data about the priorities and experiences of teachers and students in rural and urban areas and this can be built on in the future.
- This study is intended to establish a general picture about students' development of biological literacy and does not delve into close detail about specific topics within the Biology curriculum. A closer look at the different elements of the Biology curriculum may serve as a focus for future studies.
- The study did not explore the training teachers receive at teacher's colleges to facilitate students' learning of socio-scientific issues and this is an important area for further study.
- Issues such as the culture of silence surrounding adolescent sexuality and health, gender inequalities, streaming, teachers' professional backgrounds, peer pressure, and economic hardship emerged as important considerations in this study. However, a detailed investigation of how these factors influence students' acquisition of biological knowledge and life skills was not carried out. These matters provide the basis for further investigation.

9.5 Future research

As the first study of its kind investigating the Tanzanian context, this study has revealed a number of possibilities for further research. In order to develop Tanzanian students' biological literacy, the following areas of research are worth consideration:

- Measuring students' ability to make informed decisions about socio-scientific issues within the Tanzanian context. Together with the results from this study, such research could inform the establishment of authentic programmes to improve the situation of students' learning as they develop their levels of biological literacy.
- Effective teacher education programmes which focus on equipping teachers with the knowledge and skills to help students to develop biological literacy.
- Research investigating the influence of cultural beliefs and practices in social constructivist learning could provide insight on how social constructivism can be effectively integrated into Tanzanian classrooms.
- Finally, because the majority of Tanzanians, especially in rural areas, do not have the resources or the means to continue with their secondary school education, research is needed to find out the extent to which primary school leavers have opportunities to gain scientific literacy knowledge and skills for their lives.

9.6 Concluding remarks

The findings from this study show that biological literacy among Tanzanian students remains low. This is due to various challenges relating to the implementation of the Biology curriculum as well as other factors that are outside the reach of schools. As a result, it seems that very little is happening concerning the development of biological literacy amongst Tanzania's young people many of whom urgently need reliable and accurate information to make decisions that will affect their lives and their wellbeing. There is a Swahili saying, "*Usipoziba ufa utajenga ukuta*", which means that if you do not fill up a crack, you will have to build a wall. It is time for government officials, curriculum developers, and other education stakeholders to begin building new walls that stand solid against the lack of knowledge that many young Tanzanians hold about biological matters. These partial truths, misconceptions and misunderstandings about Biology affect their own lives and those of their families. It is surely easier to educate young people with the knowledge and skills that they need to use both now and in the future than it is to

deal with the terrible human and environmental consequences of biological illiteracy. This study is intended to contribute to this improvement.

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APPENDICES

Appendix A: Letter to Head of School

Head of school,

..... Secondary School,

.....

RE: Permission to conduct research

Dear Sir/Madam

I am a doctoral student at Te Kura Maori, Faculty of Education, Victoria University of Wellington in New Zealand. As part of this degree, I am required to conduct a research project leading to a thesis. I am writing to ask for your permission in order to conduct my research in your school. I would like to invite year four Biology teachers and students in your school to participate in my study.

My research intention is to explore how the development of biological literacy amongst Tanzanian junior secondary school students' helps them to make informed socio-scientific decisions in their everyday lives. In order to carry out this research I am asking for your permission to:

1. Invite Biology teachers and their students in your school to participate in this research
2. Observe Biology lessons for one class throughout one week
3. Conduct one focus group interview with a small group of 4-6 students in the participating teacher's Biology class
4. Interview the participating teacher before and after the lesson observations
5. For the students in the participating teacher's class to complete a brief questionnaire [Approximately 20-30 minutes].

Prior to conducting the research, I will provide a research information sheet and ask for informed consent from the participating teachers and students. This implies participation is entirely voluntary. In addition, if any participants wish to withdraw from the project for any reason, they may do so without question at any time

before the data is analysed (a month after collecting data in your school). Just let me know at the time.

This research is approved by Victoria University Faculty of Education Ethics Committee Application Number 2012/KURA/59, New Zealand. The school, teachers and students will not be identified in this study in any way. No information obtained in the study will be discussed with anyone else except for me and my supervisors and the participants without their written permission. All information will be strictly confidential and will be stored in a locked facility and electronic files will be protected password protected. All data will be destroyed three years after the completion of the research project.

Should you have any further queries please contact me or my supervisors.

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I would be very grateful if you would be willing to consider my request to conduct my study in your school.

Thank you so much in advance,

Yours sincerely,

Zawadi Richard Juma.

Note: “If you have any ethical concerns please contact the Chair of the Victoria University of Wellington Human Ethics Committee, Dr Allison Kirkman (Allison.Kirkman@vuw.ac.nz)”.

Appendix B: Teachers' Semi-structured interview schedule

Gender: Qualification:

Thank you for agreeing to the interview. There are no right or wrong answers. I am really interested in your views about the questions I am going to ask.

1) Why have you decided to become a Biology teacher? Do you find teaching Biology interesting? Why or why not?

- Ni kwanini ulifikia maamuzi ya kufundisha baiolojia au kuwa mwalimu wa baiolojia? Je, unafurahia kazi yako? Kama ndiyo au sio ni sababu zipi?

2) How do you teach Biology in order to confront the health challenges in society? What are the challenges do you face in your teaching? What do you think should be done to improve the situation?

- Ni njia vipi na kwa namna gani unafundisha ilikuweza kuwasaidia wanafunzi kupambana na changamoto wanazokutana nazo za kiafya katika maisha yao ya kila siku?

- Je ni changamoto zipi unazokutana nazo katika namna hii ya ufundishaji?

- Unafikiri ni nini kifanyike kuboresha hali ya ufundishaji ilikuwawezesha wanafunzi kupambana na changamoto wanazokutana nazo katika maisha ya kila siku?

3) What do you understand by the term biological literacy?

- Umeshawahi kusikia kuhusu hili neno? Unafikiri ni nini maana yake?

- Naomba uniambie unafikiri nini kuhusu kiwango wanafunzi wako cha kufuta ujinga juu ya mambo ya kibaiolojia katika jamii, ukizingatia maarifa na stadi wanazozipata toka shule.

- Unafikiri kuna sehemu nyingine zaidi ya shuleni ambayo wanapata maarifa na stadi za kufanya maamuzi ya kibaiolojia katika maisha yao ya kila siku? Kama zipi naomba unitajie mifano? Tofauti yake na yale wanayoyapata shule? Na unafikiri kwa kiwango kipi inawasaidia wanafunzi katika maamuzi yao ya kila siku?

- Nielezee kwa kiviipi unafikiri wanafunzi wa kike na wa kiume wanatofautiana katika kusoma na matumizi yao maarifa na stadi wanazozipata shuleni katika kufanya maamuzi ya kila siku ya maisha yao yanayohitaji elimu ya baiolojia?
- Pia naomba unieleze kwa mifano kwa kiwango kipi wanafunzi wanaochukua sayansi, sanaa na biashara wanatofautiana katika kupata maarifa na stadi za namna ya kufanya maamuzi ya kila siku yanayohitaji elimu ya baiolojia.

4) How do you teach about health issues in the class taking into account the cultural, biotechnological and environmental issues? In what ways, if any, do you relate them with other subjects?

- Unafikiri kwa kiwango gani mtaala wa baiolojia umeweka mada zinazohusu afya kwenye jamii? Naomba nipe mifano ya mada na kwa kiviipi ni msaada? Unafikiri kuna mada zaidi zinahitajika kuwekwa ili kuboresha zaidi utoaji wa elimu ya afya kwa wanafunzi? Je, mbinu za kufundishia elimu hiyo zinajitosheleza? Naomba unielezee kwa kiwango gani?
- Je unafikiri utoaji wa elimu ya afya kwa wanafunzi unahusisha mambo ya utamaduni, baioteknolojia na mazingira kwa kiwango gani?
- Je, unafikiri ni rahisi kwa waalimu wa biolojia kufundisha elimu ya afya wakihusisha utamaduni, baioteknolojia na mazingira? Pia kuweza kuhusisha elimu ya masomo mengine? Unafikiri mtaala unakusaidia katika kufanya hili? Kwa kiwango gani? Naomba unipe mfano angalau mmoja? Pia naomba uniambie ni changamoto zipi unazokutana nazo katika kufundisha hili?
- Pamoja na changamoto zote za kufundisha baiolojia, unafikiri kwa kiwango kipi na kiviipi wanafunzi wanaweza kutumia elimu na mbinu wanazozipata wakati wa kufundishwa elimu ya afya kupitia baiolojia wanaweza kufanya maamuzi ya kiafya yanayohusiana na utamaduni, baioteknolojia na mazingira? Unaweza kutoa mifano pia.

5) How do you think the Biology curriculum/syllabus supports or constrains students' ability to make informed Biology related socio-scientific decisions about their everyday lives?

(Prompts will include content, pedagogy, assessment and language of instruction)

- unaweza kunipa maelezo kwa kivipi mtaala wa baiolojia ukizingatia mbinu za kufundishia , maudhui na assessment zinasaidia katika kuwasaidia wanafunzi kupata maarifa na stadi za kufanya maamuzi katika maisha yao ya kila siku.
- Naomba unielezea kwa kiwango gani lugha ya kiingereza inasaidia/inarudisha nyuma maendeleo ya wanafunzi katika kupata maarifa na stadi zitakazowasaidia katika kufanya maamuzi ya kila siku yanayohitaji elimu ya baiolojia.
- Unafikiri tunapotumia neno 'informed Biology related socio-scientific decisions' tunamaanisha nini hasa?
- Nielezee ni changamoto zipi unakutana nazo katika kufundisha baiolojia kwa ajili ya kuwasaidia wanafunzi kupata maarifa na stadi za kufanya maamuzi ya kila siku katika maisha.
- Unafikiri nini kifanyike katika elimu ya baiolojia ili kuboresha utoaji wa elimu kwa wanafunzi kwa ajili kuboresha uwezo wao wa kufanya maamuzi ya kila siku yanayohitaji elimu ya baiolojia.

6) How do you find out that your students have gained skills and knowledge useful for their life in the class?

- Ni njia zipi unazotumia darasani kufanikisha au kufahamu kuwa wanafunzi wako wameweza kupata stadi na ufahamu wa kutosha wakati wa kuwafundisha?

7) How do your students incorporate Biology in their everyday life? If nothing/little happening why? What do you should be done to improve the situation?

- Unafikiri wanafunzi wako kwa vipi huwa wanatumia elimu ya baiolojia wanayoipata darasani? Kama unafikiri hakuna chochote wanchofaidia na elimu wanayoipata katika maisha yao nini kifanyike kuboresha?
- 8) In what ways, if any, do you use extracurricular activities in school to contribute to the development of Biology literacy among students?
- Unaweza kunipa mifano ya shughuli zinazofanyika nje ya darasa ambazo zinamsaidia mwanafunzi kuweza kujenga uwezo wake wa kuondoa ujinga juu ya mambo ya jamii yanayohitaji elimu ya baiolojia? Naomba pia unieleze kwa ufupi kwa kiwango kipi na kivipi inasaidia? Pia itakuwa vizuri ukinipa mifano ya elimu ya afya ukihusisha utamaduni, mazingira na baioteknolojia inayosaidia mwanafunzi kujenga uwezo wa kufanya maamuzi.
- 9) What support do you get from the school administration/Ministry of Education in helping you in teaching Biology to students which is useful for them to make daily decisions?
- Niambie ni msaada upi na changamoto zipi unazokutana nazo kutoka kwa uongozi wa shule na wizara kwa ujumla.
 - Unafikiri ni kinahitajika zaidi kutoka kwa uongozi wa shule/wizara ili kusaidia usomaji wa wanafunzi katika somo la baiolojia na ili kuwawezesha kujenga uwezo wa kufanya maamuzi ya kila siku katika jamii hasa yanahusu afya.
- 10) What is your experience of teaching Biology in rural/urban area?
- Niambie kwa kivipi mazingira yako haya ya mjini/kijijini yanakusaidiaje au yanazuiaje katika ufundishaji wako wa baiolojia hasa katika kuwasaidia wanafunzi kupata maarifa na stadi za kufanya maamuzi ya kila siku katika maisha? Naomba unipe faida na hasara kama zipo? (zako kama mwalimu, wanafunzi na shule kwa ujumla).

Appendix C: Club-teachers' Semi-structure interview schedule

1) What are the goals for student learning in your club? Why are they important in your particular region? What issues do they cover that affect students everyday lives?

- Nini ni malengo ya klabu yenu? Mnakutana mara ngapi kwa wiki/mwezi na wakati gani? Mko waalimu wangapi? Mmepata wapi elimu ya kuendesha hii klabu? Unafikiri vigezo vipi zilitumika kukupa wewe ulezi wa klabu?
- Unaweza kunitajia shughuli mnazozifanya kwenye klabu yenu hasa kwenye mambo ya afya?

2) How do you teach about health issues in your club and how do the students respond? Why are these issues important in your region?

- Je, kwa kiwango kipi na kivipi mnahusisha mambo ya kuwafundisha afya ya jamii mkihusisha utamaduni, mazingira na baioteknolojia?

Note: Keeping in mind that English language competency may influence teacher responses prompts and explanations will be used in Kiswahili (explained in coloured words in each question).

Appendix D: Running record template

Teacher's gender: Qualifications:

Class stream:

Number of students:

Date of observation:

Stage	Teacher's activities	Students' activities
Introduction		
Presentation		
Reinforcement		
Evaluation		

Appendix E: Student questionnaire

Student's number:

Gender: (1) Male (2) Female

Stream: (1) Commercial (2) Arts (3) Science (4) any other,
specify.....

A. Student's perspectives about learning Biology

Please rate how much you agree or disagree with each of the following statements by placing a check (X) mark in the appropriate box. If you don't know, place a check (X) in the final column.

Statement		Strongly disagree	Disagree	Agree	Strongly agree	Don't know
1.	Biology knowledge and skills are useful in my everyday life.					
2.	Studying Biology at school is useful in my everyday life.					
3.	I find studying Biology at school interesting.					
4.	In our Biology class, we are often asked to share our everyday life experiences.					
5.	School activities which are not in the class curriculum, such as HIV/AIDS club, help me to make decisions about how I will look after my health.					
6.	I learn about interesting biological issues outside of school which are useful in life.					

B. Teaching methods used in Biology classes

Please show how often you have experienced each of the following teaching methods in your Biology class. Place a check (X) mark in the appropriate box.

Method	Frequency		
	Rarely	Sometimes	Very often
Lecturing			
Whole class discussion			
Small group discussion			
Questions asked by the teacher			
Questions asked by students			
Demonstration by the teacher			
Laboratory work			
Making observations during field trips			
Using technology (software, CD, video) to teach Biology			
Doing Biology projects			

C. Student's perceptions on their learning about health issues

For the rest of the questions please rate your level of agreement with each of the following statements by placing a check (X) mark in the appropriate box. If you don't know, place a check (X) in the final column.

I. Culture and human health

	Statement	Strongly disagree	Disagree	Agree	Strongly agree	Don't know
1.	I am interested in learning about health issues that are related to cultural issues.					
2.	In school my understanding of health issues that are related to culture has improved.					
3.	Outside of school I have learned interesting things about health issues that are related to culture.					
4.	What I have learned in school about health issues has little to do with my everyday cultural life.					
5.	What I have learned in Biology classes helps me understand and make informed decisions about 'Female genital mutilation' (FGM) issues (ukeketwaji-swahili word).					
6.	What I have learned in Biology classes helps me make decisions about HIV/AIDS issues in my everyday life.					
7.	Cultural beliefs and explanations about sexuality and diseases influence positively people's understanding of HIV/AIDS issues.					
8.	I believe that a woman who experiences FGM is vulnerable to HIV infection.					
9.	Someone who is HIV positive should be willing to share this information with others.					

10.	Giving care and support to a person who is HIV infected helps him/her think positively about their life.					
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II. Climate changes and human health

Statement		Strongly disagree	Disagree	Agree	Strongly agree	Don't know
1.	I am interested in learning about health issues that are related to climate change.					
2.	In school my understanding of health issues that are related to climate changes has improved.					
3.	Outside of school I have learned interesting things about health issues that are related to climate changes.					
4.	What I have learned in school about health issues in relation to climate change is useful for making decisions in my everyday life.					
5.	I believe that climate changes pose risks to human health.					
6.	I believe that the effects of global warming such as flooding causes an increase in some diseases like malaria.					
7.	I believe that climate change causes an increase in asthma, respiratory allergies and airway diseases.					

III. Biotechnology and human health

Note: Biotechnology refers to the use of living systems and organisms to develop or make useful products, and it is usually seen in agriculture, food production and medicine production.

Statement		Strongly disagree	Disagree	Agree	Strongly agree	Don't know
1.	I am interested in learning about health issues that are related to the use of biotechnology.					
2.	In school my understanding of health issues that are related to the use of biotechnology has improved.					
3.	Outside of school I have learned interesting things about health issues that are related to the use of biotechnology.					
4.	What I have learned in school about health issues in relation to the use of biotechnology is helpful for making decisions in my everyday life.					
5.	In school, I have learned that biotechnology can be used to manufacture food and medicine.					
6.	Eating food from plants or animals that has been manufactured using biotechnology creates risks for my health.					
7.	The nutritional value of food for people is increased if the food is obtained from plants or animals that have been treated with biotechnology.					

Appendix F: Questionnaire: Swahili version

Dodoso la wanafunzi

Nambari ya mwanafunzi:

Jinsia: (1) Me (2) Ke

Mchepuo: (1) Biashara (2) Sanaa/ sayansi ya jamii (3) Sayansi

(4) mwingineo, taja.....

A. Mtazamo wa jumla wa wanafunzi kwenye kujifunza baiolojia

Tafadhari chagua ni kwa kiwango gani unakubaliana sana au hukubaliani kwa kila sentensi/kauli zifuatazo kwa kuweka alama ya vema kwenye kisanduku husika.

Kama huji chochote weka (X) kwenye kisanduku cha mwisho.

	Sentensi	Sikubaliani kabisa	Sikubaliani	Nakubaliana	Nakubaliana kabisa	Sijui lolote kuhusu swali
1	Maarifa na stadi za baiolojia zinaumuhimu katika maisha ya kila siku.					
2	Ujifunzaji wa baiolojia shuleni ni muhimu kwa maisha yangu ya kila siku.					
3	Ujifunzaji baiolojia shuleni husaidia kukuza udadisi					
4	Tuna fursa ya kushirikishana uzoefu binafsi darasani					
5	Shughuli za nje ya mtaala zinazohusiana na afya kama vile klabu za HIV/UKIMWI shuleni kwangu hunisaidia kufanya maamuzi katika maisha yangu					

6	Ninajifunza mambo mazuri yanahusiana na baiolojia nje ya mazingira ya shule					
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B. Njia za kufundishia zinazotumika kwenye madarasa ya bailojia

Tafadhali, onesha utumiaji wa njia za kufundishia zifuatazo katika madarasa ya baiolojia kwa kuweka alama ya vema katika kisanduku husika.

Njia	Kiwango cha kufundishwa		
	Mara chache	Saa nyingine	Mara nyingi
Mhadhara			
Majadiliano darasani zima			
Majadiliano ya vikundi vidogo			
Maswali yanayoulizwa na mwalimu			
Maswali yanalyizwa na wanafunzi			
Mwalimu kuonyesha kwa vitendo kwa niaba ya darasa zima na wanafunzi kuangalia toka kwa mwalimu			
Kazi za maabara			
Ziara-uchunguzi			
Utumiaji wa teknolojia (CD, Video) kufundishia baiolojia			
Kufanya kazi mradi			

C. Mtazamo wa wanafunzi juu ya elimu ya afya

Tafadhari chagua ni kwa kiwango gani unakubaliana sana au hukubaliani kwa kila sentensi/kauli zifuatazo kwa kuweka alama ya vema kwenye kisanduku husika.

Kama huji chochote weka (X) kwenye kisanduku cha mwisho.

I. Utamaduni na afya ya binadamu

	Sentensi	Sikubaliani kabisa	Sikubaliani	Nakubaliana na	Nakubaliana kabisa	Sijui lolote kuhusu swali
1.	Ninafurahia kusoma elimu ya afya inayohusisha mambo ya tamaduni					
2.	Shuleni ni sehemu huwa ambayo napata mara kwa mara elimu juu ya madhara ya baadhi ya tamaduni kwa afya ya binadamu					
3.	Ninapata mambo muhimu yanayohusu mahusiano ya elimu ya afya na utamaduni nje ya mazingira ya shule					
4.	Ninachosoma shuleni juu ya elimu ya afya na mahusiano yake na utamaduni haina mahusiano kabisa na maisha yangu ya kila siku.					
5.	Ninachosoma katika darasa la baiolojia kinasaidia katika maamuzi yanayohusu ukeketwaji katika maisha.					
6.	Ninachosoma katika darasa la baiolojia kinanisaidia kufanya maamuzi yanayohusu mambo ya ukimwi katika maisha					

7.	Naamini tamaduni za kwenye jamii kuhusu mambo ya sexuality na magonjwa yanahitajika katika elimu juu ya Ukimwi.					
8.	Naamini kuwa mwanamke aliyefanyiwa ukeketwaji ana uwezekano mkubwa wa kupata maambukizi ya Ukimwi.					
9.	Naamini kuwa kuwaambia watu kuwa ni muathirika wa Ukimwi kunasaidia kiafya.					
10.	Siamini kwamba 'kujali na kumsaidia' muadhirika wa ukimwi kuna faida kiafya.					

I. Mabadiliko ya hali ya hewa na afya ya binadamu

	Sentensi	Sikubaliani kabisa	Sikubaliani	Nakubaliana	Nakubaliana kabisa	Sijui lolote kuhusu swali
1.	Ninafurahia kusoma elimu ya afya inayohusisha mambo ya mabadiliko ya hali ya hewa.					
2.	Shuleni ni sehemu huwa ambayo napata mara kwa mara elimu juu ya madhara ya mabadiliko ya hali ya hewa kwa afya ya binadamu.					
3.	Ninapata mambo muhimu yanayohusu mahusiano ya elimu ya afya na mabadiliko ya hali ya hewa nje ya mazingira ya shule.					
4.	Ninachosoma juu ya mahusiano kati ya elimu ya afya na mabadiliko ya hali ya hewa havinisaidii katika kufanya maamuzi ya kila siku katika maisha.					
5.	Naamini kuwa mabadiliko ya hali ya hewa yanaweza sababisha matatizo ya afya.					
6.	Naamini athari za mabadiliko ya hali ya hewa huleta mafuriko ambayo yanasababisha magonjwa kama malaria.					
8.	Naamini mabadiliko ya hali ya hewa yanasababisha maongezeko ya magonjwa ya pumu, na magonjwa ya njia ya hewa.					

II. Baioteknolojia na afya ya binadamu

Angalizo: Baioteknolojia inamaanisha

	Sentensi	Sikubaliani kabisa	Sikubaliani	Nakubaliana	Nakubaliana kabisa	Sijui lolote kuhusu swali
1.	Ninafurahia kusoma elimu ya afya inayohusisha baioteknolojia.					
2.	Shuleni ni sehemu huwa ambayo napata mara kwa mara elimu juu ya mahusiano ya baioteknolojia na afya ya binadamu					
3.	Napata elimu juu ya mahusiano ya afya na baioteknolojia nje ya mazingira ya shule.					
4.	Elimu ninayopata shule juu ya mahusiano ya afya na baioteknolojia haina matumizi katika maisha yangu ya kila siku.					
5.	Ninasoma shule juu ya matumizi ya viumbe vilivyofanyiwa mabadiliko kwa baioteknolojia katika kutengeneza chakula na dawa.					
6.	Naamini kuwa chakula kilichofanyiwa mabadiliko kwa kutumia baioteknolojia kinaweza kuleta madhara kiafya.					
7.	Naamini kuwa chakula chenye virutubisho bora na vitamini vinaweza vikawa					

	vimetengenezwa kupitia viumbe hai vilivyopitia mabadiliko genetikali.					
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Appendix G: Students' focus group interview

- 1) What are the Biology related challenges that face young people in Tanzania today?
 - Unafikiri ni changamoto zipi za kibaiolojia mnakutana nazo kama vijana wa kitanzania?
 - Kwa mtazamo wako unafikiri nini kifanyike kuwasaidia vijana wa kitanzania kuweza kukabiliana na changamoto hizo?

- 2) What are the main challenges related to science and Biology do you confront in your village/city?
 - Unafikiri ni changamoto zipi za kisayansi na kibaiolojia mnakabiliana nazo katika kijiji chenu/ au mji wenu?
 - Unataka nini kifanyike ili kuweza kupunguza changamoto hizo katika kijiji chenu/ au mji wenu?

- 3) What are the main health challenges that confront Tanzanian nation? How do these challenges affect your life?
 - Unafikiri ni changamoto zipi kubwa za kiafya ambazo taifa la Tanzania linakabiliana nazo? Ni kwa vipi hizi changamoto zina athiri maisha yenu?
 - Nini kifanyike kuboresha hii hali ya kukabiliana na hizi changamoto?

- 4) How do culture, climate change and biotechnology affect health issues in Tanzania? Explain to what extent (Prompts will be made in issues of FGM, HIV/AIDS, Malaria).
 - Unafikiri tamaduni, mabadiliko ya hali ya hewa, baioteknolojia yanauhusiano na afya ya binadamu? Unaweza kuelezea mahusiano hayo hasa ukielezea upande wa madhara?
 - Unafikiri ni kwa kivipi na kiwango gani tamaduni za kitanzania, mabadiliko ya hali ya hewa na baioteknolojia vinaadhiri mambo ya afya ya binadamu?
 - Nini kifanyike kuboresha zaidi hali ya afya katika Nyanja hizo

- Elezea ukihusianisha ya hali halisi ya mambo kama ukeketwaji wa wanawake, ukimwi na Malaria.
- 5) How do schools help you to confront health challenges you encountered in your everyday life? If the school is not helping or little is happening, what do think should be done to improve the situation?
- Kwa kivipi na kwa kiwango kipi shule inakusaidia kupambana na changamoto zako za kila siku za kiafya katika jamii yako? Elezea kwa mifano.
 - Unafikiri shule inakusaidia au la? Nini kifanyike shuleni kuboresha utoaji wa elimu ya afya kwa wanafunzi?
- 6) Do you intend to continue with Biology studies in the future? Why or why not?
- Unategemea kuendelea na masomo yanayohusu baiolojia hapo baadaye maisha mwako? Kama ndiyo au sio ni kwa sababu gani?
 - Unafikiri shule na ufundishaji inahusiana ya uwamuzi wako wa kutoendelea au kuendelea na masomo ya baiolojia? Elezea kwa kivipi?
- 7) Do you expect to work in Biology related jobs or profession one day? Why or why not? If not, what would be the things that would prevent you from doing this job/ profession?
- Unategemea kufanyakazi maishani mwako zinazohusiana na baiolojia? Niambia sababu za maamuzi yako?
- 8) Is there adequate support outside of school for you to develop Biology literacy skills? Please describe your experiences (positive and negative experiences).
- Unafikiri kwa kiwango kipi maisha yako nje ya shule/nyumbani yanakusaidia katika kuondoa ujinga wa kibaiolojia kwa maisha yako? Unaweza kutoa mifano pia ya maisha yako ya kila siku.

9) What do you think are the differences between going to school in rural areas and urban areas in Tanzania?

- Unafikiri ni kwa kivipi na kiwango kipi kunatofauti kati ya shule za mji na vijijini? Elezea ukitoa mifano katika tofauti hizo.
- Kama zipo nini kifanyike kuondoa hizi tofauti?

Note: Keeping in mind that English language competency may influence students' responses, prompts and explanations will be used in Kiswahili.

Appendix H: Research information sheet for the Head of Schools

Dear Sir/Madam

I am a doctoral student at Te Kura Maori, Faculty of Education, Victoria University of Wellington in New Zealand. As part of this degree, I am required to conduct a research project leading to a thesis. I am writing to ask for your permission in order to conduct my research in your school. I would like to invite year four Biology teachers and students in your school to participate in my study.

My research intention is to explore how the development of biological literacy amongst Tanzanian junior secondary school students' helps them to make informed socio-scientific decisions in their everyday lives. In order to carry out this research I am asking for your permission to:

1. Invite Biology teachers and their students in a school/ district to participate in this research.
2. Observe Biology lessons for one class in a school/ district throughout one week
3. Conduct one focus group interview with a small group of 4-6 students in the participating teacher's Biology class
4. Interview the participating teacher before and after the lesson observations
5. For the students in the participating teacher's class to complete a brief questionnaire [Approximately 20-30 minutes]

Prior to conducting the research, I will provide a research information sheet and ask for informed consent from the participating teachers and students. This implies participation is entirely voluntary. In addition, if any participants wish to withdraw from the project for any reason, they may do so without question at any time before the data is analysed (a month after collecting data in your school). Just let me know at the time.

This research is approved by Victoria University Faculty of Education Ethics Committee Application Number 2012/KURA/59, New Zealand. The school, teachers and students will not be identified in this study in any way. No information obtained

in the study will be discussed with anyone else except for me and my supervisors and the participants without their written permission. All information will be strictly confidential and will be stored in a locked facility and electronic files will be protected password protected. All data will be destroyed three years after the completion of the research project.

If you agree to participate in this project, please go through this information sheet carefully before signing the attached consent form. Should you have any queries, please do not hesitate to contact me at e-mail: zawadi.juma@vuw.ac.nz

Or

Should you have any further queries please contact me or my supervisors.

Dr. Joanna Kidman
Senior Lecturer
Te Kura Maori

Faculty of Education
Victoria University of Wellington
Joanna.kidman@vuw.ac.nz

Dr. Azra Moeed
Senior Lecturer
School of Education Policy and
Implementation
Faculty of Education
Victoria University of Wellington
Azra.moeed@vuw.ac.nz

I would be very grateful if you would give consideration to my request to conduct my study in your district/institution.

Thank you so much in advance,

Yours sincerely,

Zawadi Richard Juma.

Note: “If you have any ethical concerns please contact the Chair of the Victoria University of Wellington Human Ethics Committee, Dr Allison Kirkman (Allison.Kirkman@vuw.ac.nz)”.

Appendix I: Letter to district educational officials

District Executive Director,

.....

RE: Asking for permission to conduct research in district secondary schools

Dear Sir/Madam

I am a doctoral student at Te Kura Maori, Faculty of Education, Victoria University of Wellington in New Zealand. As part of this degree, I am required to conduct a research project leading to a thesis. I am writing to ask for your permission in order to conduct my research in your secondary schools in this district. I would like to invite year four Biology teachers and students in the district's secondary schools to participate in my study.

My research intention is to explore how the development of biological literacy amongst Tanzanian junior secondary school students' helps them to make informed socio-scientific decisions in their everyday lives. The investigation process of this research will be as follows:

1. Invite Biology teachers and their students in your district to participate in this research
2. Observe Biology lessons for one class throughout one week in a school in your district
3. Conduct one focus group interview with a small group of 4-6 students in the participating teacher's Biology class
4. Interview the participating teacher before and after the lesson observations
5. For the students in the participating teacher's class to complete a brief questionnaire [Approximately 20-30 minutes].

Prior to conducting the research, I will provide a research information sheet and seek informed consent from the participating teachers and students. This implies participation is entirely voluntary. In addition, if any participants wish to withdraw from the project for any reason, they may do so without question at any time before the data is analysed (a month after collecting data in your school). Just let me know at the time.

This research is approved by Victoria University Faculty of Education Ethics Committee Application Number 2012/KURA/59, New Zealand. The school, teachers and students will not be identified in any way. No information obtained in the study will be discussed with anyone else except for me and my supervisors and the participants without their written permission. All information will be strictly confidential and will be stored in a locked facility and electronic files will be protected password protected. All data will be destroyed three years after the completion of the research project.

Should you have any further queries please contact me or my supervisors.

Dr. Joanna Kidman
Senior Lecturer
Te Kura Maori

Faculty of Education
Victoria University of Wellington
Joanna.kidman@vuw.ac.nz

Dr. Azra Moeed
Senior Lecturer
School of Education Policy and
Implementation
Faculty of Education
Victoria University of Wellington
Azra.moeed@vuw.ac.nz

I would be very grateful if you would give consideration to my request to conduct my study in your district.

Thank you so much in advance,

Yours sincerely,

Zawadi Richard Juma.

Note: “If you have any ethical concerns please contact the Chair of the Victoria University of Wellington Human Ethics Committee, Dr Allison Kirkman (Allison.Kirkman@vuw.ac.nz)”.

Appendix J: Consent forms

For students' focus group discussion/ For students' questionnaire/ For students in classroom observation/ For teacher's participation in classroom observation

Please tick in the check boxes:

- I have read the information sheet and understand what will be required of me if I participate in this project.

- I understand the group discussion will be audio-taped and the recordings will be wiped three years after completion of the study.

- I understand that the study will be kept confidential by the researcher and her supervisors. Also, the published results will not use my name or my school and I will not be identified in any presentation or publications that draw on this research.

- I understand that my participation is voluntary and I have right to withdraw from the study at any time without consequences.

- I understand that I can receive the feedback on the findings of the study. I have written my e-mail/postal mail address below for the report to be sent to.

- I understand that I can get more information about this project from the researcher, and that I can contact Victoria University of Wellington if I have any complaints.

- I consent / do not consent (delete one) to be involved in this focus group discussion.

All information will be strictly confidential and will be stored in a locked facility and electronic files will be protected password protected. All data will be destroyed three years after the completion of the research project. In addition, I want to assure you that everything discussed in the focus group is confidential and also, please keep your friends' information confidential. In addition, if any participants wish to withdraw from the project for any reason, they may do so without question at any time before the data is analysed (a month after collecting data in your school). Just let me know at the time.

Full name (student)

Class

Signature

Date

E-mail

Postal mail address

Note: "If you have any ethical concerns please contact the Chair of the Victoria University of Wellington Human Ethics Committee, Dr Allison Kirkman (Allison.Kirkman@vuw.ac.nz)".

Appendix K: A Sample of Constant Comparison Analysis (Teacher's interview sample which is similar to Focus group and Classroom observation analysis)

A. Biology curriculum and its implementation

Subthemes	Urban teachers' response	Rural teachers' response
General issues	Syllabus do not much with real situation in the teaching environment	Syllabus is useful but has many challenges accompany it.
	Students join first year with pre-conception that Biology is difficult. Some may believe to study they need to be bright science scientists are clever; it is difficult to get jobs in science.	
		Syllabus need to be uniform for the whole country because there is much interaction among Tanzanians across the country.
Content	Biology content useful but to some extent	Biology content useful but it has some shortcomings
	Topics which have socio-scientific matters like reproductive health, classification and diseases.	Topics mentioned were reproduction, reproductive health, healthy and immunity, waste disposal, diseases like malaria, typhoid, diarrhea, STDs.
	Syllabus has too much content for the available teaching time.	Syllabus has too much content in relation to time allocated for teaching.
	Students have pre-conception that Biology is difficult because of too much content	
	Topics used to integrate cultural issues are diseases, reproduction , reproductive health, HIV/AIDS and nutrition	Topics used to integrate cultural issues are HIV/AIDS, reproduction and nutrition.
	Cultural issues integrated are FGM, early marriages, poor circumcision techniques and forbidding pregnant women to eat some food.	Cultural issues integrated are FGM, early pregnancies, early marriages, inheritance of widows and forbidding pregnant women to eat some food.
	Biotechnology rare mentioned in health issues like genetics	Rarely integrating biotechnological issues in health mentioned topics like genetics and reproduction.
	Teachers do not have enough content knowledge of biotechnological techniques and issues. Hence do not have confidence to teach; find it difficult to explain to students.	
	Possible impact of climate change is rarely integrated in education or learning about health issues related to waste disposal, diseases and environment. Example of malaria, cholera.	Rarely integrating issues of climate change in health in topics like diseases such as cancer and malaria.
	One participant thought issues of climate change are for the rural people not urban communities and that the rural people are the one who are likely to feel the effects.	
		Historically, teaching of health issues in the syllabus started with general public health then later HIV/AIDS was integrated.

Teaching methods	Teachers were aware that the syllabus promoted the use of student-centred teaching methods but implementation was challenging.	Teachers realised that syllabus promoted the use student-centred approaches though it was difficult to implement them. They said that student-centred methods are too demanding. One participant commented that student-centred approaches are interactive and enhance students' understanding.
	Heavy teaching load to implement student-centred methods	Heavy teaching load for Biology teachers
	Very large classes to practice student-centred methods	Large classes a barrier to student-centred teaching
	Too much content to allow the use of student-centre methods which is time-consuming	Availability of time. Too much content to be covered in a short time.
	There are some student-centred methods that can be applied in large classes but were rarely used for example exploration of students' prior knowledge through whole class discussion; question-answer techniques.	Teachers do integrate some component of student-centred methods sometimes. Components like using surrounding environment, diagrams, illustrations, small group discussions, whole class discussion, laboratory work, question-answers techniques. Using real life examples.
	Lack of teaching and learning materials like books, laboratory equipment	Lack of teaching and learning materials like books, lack of laboratories, teaching equipment and few Biology teachers.
	One participant thought teachers should change their traditions and include practical sessions in their teaching.	
	Use of teacher-centred methods like lecturing is predominant in the classes. Teachers believe is not time consuming. They sometimes use real examples in life in discussions.	Teacher-centred methods are predominant in the classes.
	Teachers address and clear misconceptions	Teachers often address and clarify students' misconceptions
	Cultural issues like FGM are usually taught theoretically	
	Biotechnology teaching needs different type of teaching pedagogy like discovery methods and discussions in the class.	
	In teaching health issues teachers face cultural barriers like teaching about issues which seem to be taboo in the society for example teaching students how to use condoms seemed to be controversial.	Cultural barrier example male teachers find it difficult to name sexual organs in front of female students because they consider it to be taboo.
		Teaching is more examinations oriented; teaching students to answer questions in the examination.
		One participant argued that student participation is discussion was very low despite using both languages in teaching and being giving access to books. She thought there was a culture of silence.
	Poor attendance because of truancy and inability to pay school fees on time.	

Assessment techniques		National examinations are not good determinant of students' ability in make decisions about issues in everyday life.
		"Alternative to practical examinations" is not good practice as it limits students learning of useful skills in life.
	Syllabus does not reflect issues in the society neither do the national examinations.	National examinations do not cover all societal issues relevant to student learning
		Sometimes final results of national examinations do not reflect students' abilities. Some teachers were unsure if students' progress report provided by teachers were considered when decisions about students passing and grades were made.
	Use application questions but few students who understand are able to answer. These kinds of questions are good determinant of students' acquisition of useful skills in life. Also, check students understanding tests, exams and quizzes.	Teachers are incorporating some of the application questions in their exams, tests and quizzes.
		Teachers use the observation technique of students' daily actions in school to check the acquisitions of useful socio-scientific skills and knowledge for students' lives.
	Students doing national examination for the intentions of getting good pass mark not to use in life. They usual forget after examination.	