

**THE IMPACT OF TEACHING STYLES ON STUDENT
LEARNING OF BIOLOGY IN HIGH SCHOOLS IN RWANDA:
A CASE STUDY OF THREE SCHOOLS IN KIGALI CITY**

Concilie Mukamwambali
(Student number: 416660)

Supervisors: Dr Femi Otulaja & Megan Doidge

A research report submitted to the Faculty of Humanities, University
of the Witwatersrand, Johannesburg, in partial fulfilment of the
requirements for the degree of Master of Education

Johannesburg, January 2012

DECLARATION

I, Concilie Mukamwambali, declare that this report is my own original unaided work. It has never been submitted before for any degree or examination at any other university. I am submitting it for the degree of Master of Education at the Faculty of Humanities of the University of the Witwatersrand.

A handwritten signature in dark ink, appearing to read 'Mukamwambali', is written over a horizontal dotted line. The signature is fluid and cursive, with a large initial 'M' and a long, sweeping tail.

Signed

20 January 2012.

DEDICATION

To Félicien Majoro, my cherished husband;

To Eric Buregeya – Mbabazi, my son;

To Xavérine Nyiragasani, my mother and Sylvère Munyentwali, my late father;

To all my sisters, brothers and friends; this thesis is dedicated.

ACKNOWLEDGEMENTS

First and foremost, I thank the God Almighty for his blessings conferred on me for the whole of my life, especially during the course of my Masters study at Wits University. I also address my thanks to the Rwandan Government for funding my studies through the Students' Financing Agency for Rwanda (SFAR).

The present thesis is the result of combined efforts of many persons to whom I am sincerely grateful. Particularly, I am indebted to Ms Megan Doidge and Dr. Femi Otulaja who, despite of their many responsibilities, voluntarily accepted to supervise this work. Their encouragement and advice are worth recognising.

I am also grateful to all lecturers of Science Education, Assessment in Schooling and in Higher Education, and Educational Theory in the School of Education at the University of the Witwatersrand. I especially acknowledge the contributions of Dr. Tony Lelliott, Prof. Hamsa Venkat and Prof. Elaosi Vhurumuku through the Research Design course which familiarised me with the world of research. The other lecturers include Prof. Yael Shalem, Mrs Cheryl Chamberlain, and Prof. Marissa Rollnick.

I am also indebted to all Rwandan high school students and their biology teachers who participated in this research. I hope that this work will contribute to the improvement of their teaching and learning.

Last, but not least, I thank my family in general and my cherished husband Félicien Majoro in particular, for undergoing my absence at home during the course of my studies at Wits. Equally, Eric Buregeya – Mbabazi, my son, heartened me and this increased my courage. I am grateful to all friends that I met at Wits including Benadette, Judith, Lieketseng, Maretsepile, and Maselise. I also acknowledge the moral support of the Rwandan group of 31 students at Wits University, a cohort of 2009 academic year. All those who, in a way or another, have contributed to the completion of this work, God bless you.

ABSTRACT

In this research, the teaching styles of one biology teacher in each of three high schools in Rwanda are investigated. The purpose of the research is to find out how the adopted biology teaching styles impact on the teacher-student interaction and on the student's learning of biology in Kigali City in Rwanda. This research is descriptive and it is conducted in the qualitative research paradigm. The research approach used is a case study in three state and subsidised high schools. The research methods included interviews with six students and three teachers, classroom observations of three biology lessons per teacher and field-notes.

The Rwandan education system has introduced a new approach to teaching i.e. the learner-centred pedagogy through an associative teaching style. In high schools, this new approach was first implemented in the school year 2011 but this implementation has been constrained by the scarcity of resources. Furthermore, some biology teachers, at the start of 2011, were not yet informed by educational authorities about the implementation of the learner-centred pedagogy. Thus, this research shows that some biology teachers are still using the teacher-centred approach; this is the case for Mr. Odumbe, whose teaching style is dominated by the transmissive approach, or the case of Mr. Kaggwa, whose view is that the educational authorities encourage the transmissive method of teaching. Even though the learner-centred pedagogy is encouraged because it fosters lasting knowledge and easy application of knowledge acquired in everyday life, the group work approach to teaching has been poorly managed and did not achieve desired results where it was used during this research. The participating biology students and teachers see the learner-centred pedagogy as slowing down the progression of teaching the content matter while the national examination covers the whole curriculum content. Therefore, although teachers were using different teaching approaches, once they are asked which approach they can choose to use, both students and teachers prefer to continue to use the teacher-centred approach in order to meet the content outcomes required in the national examination. Another result was that all participating students found their teachers supportive and nurturing and research is encouraged by all teachers regardless of their dominating teaching styles.

Key words: transmissive teaching style, inciting teaching style, associative teaching style, permissive teaching style, teacher-centred pedagogy and learner-centred pedagogy.

ABBREVIATIONS AND ACRONYMS

BCG:	Biology-Chemistry-Geography
DRC:	Democratic Republic of Congo
EDPRS:	Economic Development and Poverty Reduction Strategy
EDUC:	Education
KIE:	Kigali Institute of Education
LEM:	Laboratoire d'Enseignement Multimédia
MCB:	Mathematics-Chemistry-Biology
MINEDUC:	Ministry of Education
MUSE:	Multigrade School Education
NCDC:	National Curriculum Development Centre
PCB:	Physics-Chemistry-Biology
RNEC:	Rwanda National Examination Council
S:	senior
UC Santa Cruz:	University of California Santa Cruz
US:	United States.

TABLE OF CONTENTS

<i>DECLARATION</i>	<i>i</i>
<i>DEDICATION</i>	<i>ii</i>
<i>ACKNOWLEDGEMENTS</i>	<i>iii</i>
<i>ABSTRACT</i>	<i>iv</i>
<i>ABBREVIATIONS AND ACRONYMS</i>	<i>v</i>
<i>TABLE OF CONTENTS</i>	<i>vi</i>
<i>LIST OF APPENDICES</i>	<i>viii</i>
<i>LIST OF TABLES</i>	<i>ix</i>
<i>LIST OF FIGURES</i>	<i>ix</i>
CHAPTER ONE: GENERAL INTRODUCTION	1
1.1 BACKGROUND TO THE STUDY	2
1.2 STATEMENT OF THE PROBLEM	4
1.3 CRITICAL RESEARCH QUESTION	5
1.4 RATIONALE	6
1.5 OUTLINE OF CHAPTERS	7
CHAPTER TWO: THEORETICAL FRAMEWORK AND LITERATURE REVIEW	9
2.1 TEACHING STYLES AS MY THEORETICAL FRAMEWORK	9
2.1.1 <i>Transmissive teaching style</i>	10
2.1.2 <i>Inciting teaching style</i>	10
2.1.3 <i>Associative teaching style</i>	11
2.1.4 <i>Permissive teaching style</i>	11
2.2 CHARACTERISTICS OF DIFFERENT TEACHING STYLES.....	11
2.2.1 <i>Implementation of the curriculum content</i>	13
2.2.2 <i>Refresher course</i>	13
2.2.3 <i>Teaching methods</i>	13
2.2.4 <i>Structure of lesson presentation</i>	15
2.2.5 <i>Teacher's expertise</i>	15
2.2.6 <i>Types of assessment/evaluation</i>	16
2.2.7 <i>Image of the teachers from students' perspective</i>	18
2.2.8 <i>Nature of student-teacher interaction</i>	18
CHAPTER THREE: METHODOLOGY	20
3.1. INTRODUCTION TO THE METHODOLOGY.....	20
3.2. RESEARCH PARADIGM, APPROACH AND DELIMITATION OF THE FIELD.....	20
3.3. RESEARCH METHODS.....	22

3.4. JUSTIFICATION FOR THE CHOICE OF THE RESEARCH METHODS:	
INTERVIEWS AND CLASSROOM OBSERVATIONS.....	23
3.4.1. <i>Interview: advantages and limitations</i>	23
3.4.2. <i>Classroom observation and its advantages</i>	24
3.4.3. <i>Overcoming limitations of observations</i>	24
3.5. DEVELOPMENT OF RESEARCH INSTRUMENTS.....	25
3.6. ADMINISTRATION OF THE RESEARCH INSTRUMENTS	28
3.7. POTENTIAL ETHICAL PROBLEMS	28
3.8. METHOD(S) OF DATA ANALYSIS	29
CHAPTER FOUR: NEGOTIATING TEACHING: TEACHING STYLES, CURRICULUM, AND	
LEARNING OF BIOLOGY.....	31
4.1 INTRODUCTION	31
4.2 IMPLEMENTATION OF CURRICULUM CONTENT.....	32
4.3 REFRESHER COURSES ATTENDED BY TEACHERS.....	36
4.4 TEACHING METHODS	37
4.4.1 <i>How do teachers teach general principles in biology?</i>	37
4.4.2 <i>Group work approach of teaching</i>	40
4.4.3 <i>Whole-class teaching</i>	43
4.5 STRUCTURE OF LESSON PRESENTATION	48
4.6 TEACHERS' EXPERTISE	49
4.7 ASSESSMENT/EVALUATION	49
4.7.1 <i>Strategies to assess students</i>	49
4.7.2 <i>Who is the assessor and what kinds of assessment?</i>	52
4.8 IMAGE OF TEACHERS FROM STUDENTS' PERSPECTIVE	54
4.9 TEACHER-STUDENT INTERACTION	54
4.10 CONCLUSION TO CHAPTER FOUR	58
CHAPTER FIVE: STUDENTS' PERCEPTIONS OF THE TEACHING STYLES' EFFECTIVENESS.....	59
CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS	64
6.1 SUMMARY OF FINDINGS	64
6.2 GENERAL CONCLUSION	69
6.3 LIMITATIONS TO THE STUDY	70
6.4 RECOMMENDATIONS	70
6.5 ORIENTATION TO FURTHER RESEARCH.....	71
REFERENCES	72

LIST OF APPENDICES

1. INTERVIEW SCHEDULE FOR TEACHERS	I
2. INTERVIEW SCHEDULE FOR LEARNERS	II
3. CLASSROOM OBSERVATION GUIDE	III
4. CHAPTERS RELATED TO LESSONS OBSERVED	IV
5. REQUEST FOR PERMISSION TO CONDUCT THE RESEARCH IN DISTRICTS OF CHOICE.....	VII
6. REQUEST FOR PERMISSION TO CONDUCT THE RESEARCH IN SCHOOLS OF CHOICE.....	VIII
7. PARTICIPANT’S INFORMATION SHEET	IX
8. PARTICIPANT’S AUDIO-RECORDING ASSENT FORM	XI
9. PARTICIPANT’S AUDIO-RECORDING CONSENT FORM	XII
10. PARENT’S AUDIO-RECORDING CONSENT FORM	XIII
11. PARTICIPANT’S INTERVIEW & OBSERVATION ASSENT FORM	XIV
12. PARTICIPANT’S INTERVIEW & OBSERVATION CONSENT FORM	XV
13. PARENT’S INTERVIEW & OBSERVATION CONSENT FORM	XVI
14. PARTICIPANT’S VIDEO-RECORDING ASSENT FORM	XVII
15. PARTICIPANT’S VIDEO-RECORDING CONSENT FORM	XVIII
16. PARENT’S VIDEO-RECORDING CONSENT FORM	XIX
17. ETHICS CLEARANCE	XX

LIST OF TABLES

Table 1: Teaching styles- framework for developing the interviews and for analysis	12
Table 2: Schools in which the research has been conducted	21
Table 3: Major questions of the teachers' interview schedule.....	26
Table 4: Major questions of the students' interview schedule	27
Table 5: Topics covered in lesson observed in each school	33
Table 6: Teaching styles used by the participating biology teachers.....	65

LIST OF FIGURES

Figure 1: The four basic teaching styles according to Therer-Willermat	10
--	----

CHAPTER ONE: GENERAL INTRODUCTION

Education is believed to play a key role in the development of Rwanda. Science and technology education are particularly important because the government believes that science and technology enable the achievement of the objectives established for the vision 2020 and the Economic Development and Poverty Reduction (EDPRS) policy (Ministry of Education [MINEDUC], 2006). These objectives consist of equipping the population with knowledge, competences, and attitudes. These are, for example, the entrepreneurial skills or the practical and psychosocial skills related to health and well-being issues. As a land-locked country, Rwanda bases her economy on the human capital. Thus, according to MINEDUC (2003), Rwanda has decided to create a knowledge-based and technology-based economy. This economy will depend on capacity building through education in general, and science and technology, in particular.

The key objectives of capacity building in science and technology in Rwanda are to produce a large number of students who are trained at a high level, meaning at least six years of secondary education. According to MINEDUC (2006), at secondary school level, the need to ensure high quality science and technology education raises the need to provide schools with adequate science materials for the practical teaching of biology, physics and chemistry, and sufficient text books for students. Furthermore, MINEDUC (2006) added that the methods of secondary science teaching need to be reviewed to improve the classroom instruction in science areas. It is within this context that the Rwandan education system is experiencing a lot of reforms. This research focuses on biology teaching methods in use and their related teaching styles in predetermined schools.

1.1. BACKGROUND TO THE STUDY

The Rwandan education system operates on a 6-3-3-4 system, i.e. six years of primary school, three years of lower secondary, three years of upper secondary (also called high school), and four years of higher education. Rwandan schools are of three types, namely: state, subsidised, or private schools. The state schools are those schools created and totally funded and managed directly by the government. Subsidised schools are those created and run by individuals, parent associations or churches but receive subsidies from the government. The third type is the private schools, which are created and totally funded by individuals, parent associations or churches with no subsidies from the government. In the Rwandan context, both the state and subsidised schools are commonly called public schools.

Looking at Rwanda's education statistics, in 2008, there were 689 secondary schools. Sixty-eight percent (68%) of them are public schools while thirty-two percent (32%) are private schools. All secondary schools accommodated 288,036 students out of 1,308,403 children of secondary school age. Public schools accommodated 181,073 of these students while 106,963 students were accommodated by private schools. These data were gathered by Bridgeland, Wulsin, & McNaught (2009) from the MINEDUC. It is apparent from these statistics that there are more public schools than private hence more students attend public schools in Rwanda. From 2008 to 2010, the number of secondary students increased sharply to 425,587 students (MINEDUC, 2010). This large increase in number seems to be the result of the implementation of the nine-year basic education programme that started in 2007 and became fully effective for all Rwandan children in 2009. The nine-year basic education consists of six years of primary education and three years of lower secondary education. To facilitate the access of all Rwandan children, basic education is free of charge in state and subsidised schools (Ministry of Finance and Economic Planning, 2007).

The biology curriculum which was used in high schools prior to 2011 was conceived in 1999 (National Curriculum Development Centre [NCDC], 2010a) and was intended to be used for biology-chemistry option students (NCDC, 2010b). In the biology-chemistry option, all science courses, such as mathematics, physics, geography, are supposed to be taught, with the emphasis on biology and chemistry, without leaving out other courses like history, religion, and languages (French, English, and Kinyarwanda). However, this option no longer exists in the Rwandan education system. According to NCDC (2010b), the biology-chemistry option

has been replaced with the following new science combinations, namely: Physics-Chemistry-Biology (PCB), Mathematics-Chemistry-Biology (MCB), and Biology-Chemistry-Geography (BCG).

Each one of the three subjects in a given combination is mandatory. In the past, there were many subjects that were impossible to teach in detail within the time allotted to teach them. Now, the reduction of the number of subjects to be taught hopefully will allow in-depth teaching of the subject matter. Apart from the mandatory subjects, the school is free to offer other courses which are not subject to national examinations such as fine arts, computer science, and other extra-curricular activities like sport and music. Even though this new designation was to be effected starting from the 2007 school year, the biology curriculum is taking much more time to be revised. Therefore, in 2010, the old biology curriculum was still being used while teachers awaited the new one being adopted into the new education system.

The new biology curriculum became available in June 2010 and had to be implemented at the start of the 2011 school year in all grade levels of high school, i.e. S4, S5, and S6 according to the NCDC (2010b). Hence, when this data was collected in January-February 2011, it was the new curriculum that was being implemented by the biology teachers in Rwandan high schools at the time. That curriculum is the same in all combinations that offer biology as one of the principal subjects. The curriculum stipulated that seven periods of biology is to be offered per week. One period of a lesson is equivalent to 50 minutes of contact time and it is the same in all Rwandan secondary schools.

Furthermore, the new biology curriculum has a fixed time frame for each chapter to be taught and completed (whether it be in the first, the second or the third term). The curriculum has also estimated the number of periods to allocate to each topic/sub-topic of the content, and emphasises the learner-centred pedagogy. Covering the content of the above-mentioned curriculum might be affected by the fact that the school/teacher does not contribute to the setting up of examinations for his/her learners to move from primary education to lower secondary education, or from lower secondary to high school, or from high school to university in the Rwandan education system. Schools/teachers teach but the evaluation and assessment of learners' performance is the responsibility of the Rwanda National Examination Council (RNEC) which sets national examinations for students ending each phase mentioned above. The only examination not under RNEC control is the examination

conducted within the university systems. Specifically, for the end of high school, the national examination is based on the curriculum of S4, 5 and 6.

The school-based assessments only control learners' progression within a school year. It is also the assessment used to determine the promotion to the next grade within the same school (primary, lower secondary, upper secondary). The impact of national examinations (high-stakes standardised examinations) on the teaching/learning process is not only positive but could also be detrimental as teachers have been known to teach learners solely to pass the exams. Au (2008) claims that in the classroom, the national examination impacts negatively on the content, the form of content knowledge, and the teacher's pedagogical approach to teaching the content.

1.2. STATEMENT OF THE PROBLEM

As a result of the demand for learners to pass the high stake exams, teachers tend to use the lecturing method of teaching. From my own experience as a former high school biology teacher and currently as an Assistant Lecturer in the Biology-Chemistry and Physical Sports Department at Kigali Institute of Education (KIE), I realised that I used the lecturing method most of the time and have observed that lecturing seems to be the most common approach, the method of choice used in teaching biology in many Rwandan schools. Lecturing seems to be the traditional method commonly engaged by teachers. This traditional method might not allow all students to conceptualise and master the subject matter. The assumption is that traditional secondary science teaching has relied primarily on lecturing, which often requires memorisation of facts and long lists of specific vocabulary words and may contribute to a lack of learner motivation for subjects such as the sciences, poor retention of content, and the inability to apply concepts (Leonard, Speziale and Penick, 2001). Consequently, the transfer of knowledge to new situations of everyday life might be very difficult (Lord, 1998). Furthermore, I think that the lecturing method might not engage students to think critically and thus hampers learners' ability to analyse problems and find solutions as informed citizens.

If Rwandan teachers are still using mostly the traditional lecturing method, science students may leave school with poor conceptual development and may lack critical thinking skills and

motivation in the sciences. If this is the case for Rwanda, it might be very difficult for Rwanda to produce human resources useful for its socio-economic development whereas the Rwandan government emphasises that the socio-economic development will depend upon science and technology in education and professional life¹. This is why the teaching of science in Rwanda needs particular attention. This research attempts to find out what biology teachers' teaching styles are and their related influences on students' learning of biology in the selected schools in Kigali City.

A teaching method is made up of didactic procedures which can be used in teaching. The choice of teaching method used by a teacher is linked to her/his teaching style. The concept "teaching style" is related to the term "management," a special way of organising the teacher-student relationship in a teaching/learning situation (Nzabalirwa, 2004, p. 43). The same concept is also defined by Miller (2006) as the patterns of needs, beliefs and behaviours that teachers display in their classrooms. Miller claims that "one's teaching style influences the method of instruction, type of assessment, classroom management, teacher-student interactions, and emotional climate of the classroom" (p. 8).

My interests in teaching styles that teachers use in the teaching of biology and the influence of teaching styles on students' learning emerged from my career as a biology teacher in Rwanda. My interests also come from the Rwandan government's concern to make science teaching more fruitful for Rwanda as a country and for her citizens. Indeed, the objective of teaching science should be to prepare students who can use science to improve their own lives and make science-related informed decisions.

1.3. CRITICAL RESEARCH QUESTION

The purpose of this study is to find out how teaching styles impact students' learning of biology in state and subsidised high schools in Kigali City in Rwanda. The following research questions guide this investigation.

1) What are the teaching styles that teachers use in teaching biology in state and subsidised high schools in Kigali City?

¹ Retrieved February 17, 2011, from <http://www.mineduc.gov.rw/>

- 2) How do teaching styles impact student-teacher interaction during biology lessons?
- 3) How do students perceive the teaching styles as impacting their learning of biology concepts?

1.4. RATIONALE

As an assistant lecturer in charge of training secondary school teachers, most especially biology teachers, this study is based on my concern for producing high quality teaching and learning experiences for teachers and their students. In my postgraduate studies, I learned about the teaching and learning of science with the new theories on learning based on the constructivist theory (Piaget, 1964, 2003; Von Glasersfeld, 1991).

One of the reasons that prompted me to research on the biology teaching styles is the fact that the MINEDUC (2006) stipulated that the method of teaching science needed to be reviewed. In putting this wish into effect, the NCDC (2010b) requested that biology teachers use the learner-centred approach in their teaching beginning in the 2011 school year. I needed to know whether or not MINEDUC's policy is welcome by biology teachers and/or biology students. In fact, it is worthwhile to try to know what is wrong with the existing method/style of teaching on the one hand, and what the benefits of the new method/style of teaching are on the other hand with regard to the teaching/learning processes, as perceived by teachers and their students.

By focusing on this issue, this study attempts to find out what the biology teachers' teaching styles in high schools in Kigali City are; and how such teaching styles influence students' learning of biological concepts. Data collection included classroom interactions between students and their teachers. Data analysis highlights the impact of teaching styles on students' learning of Biology. I hope that this research can lead to self examination/reflection by teachers and can contribute to transformation of teachers' way of teaching in order to upgrade the teaching/learning process.

1.5. OUTLINE OF CHAPTERS

This research report is made up of six chapters as follows: the first chapter in this thesis is the general introduction. This chapter one discusses the importance accorded to education, in general, and science and technology education, in particular, and the requirements needed to ensure high quality science and technology education in Rwanda. I also discuss the background to this study in the first chapter. In discussing the background, I describe the Rwandan education system. Then I narrate the problem, bring up the research questions, and explain my rationale for the study.

In chapter two, I discuss the literature review and theoretical frameworks that I use to elucidate my research findings. I define and characterise the different teaching styles. The characterisation of the different teaching styles is based on the following criteria: 1) the implementation of the curriculum; 2) the refresher courses (professional development) attended by teachers; 3) the teaching method; 4) the structure of a lesson presentation; 5) the teachers' expertise; 6) the types of assessment/evaluation; 7) the teacher's image from students' perspective; and 8) the nature of student-teacher interaction.

Chapter three deals with the methodology employed in generating understanding and analyses of this study. In this chapter, I narrate 1) a short introduction to remind the reader of what my research is all about; 2) the research paradigm, approach and delimitation of the field (schools where I collected my data); 3) the research methods I used, which included classroom observations and interviews; 4) the justification for the choice of the research methods where I talk about the advantages and limitations; 5) the development and administration of research instruments; 6) the potential ethical issues; and 7) the method(s) of data analysis that I employed.

In chapter four, I discuss the types of teaching styles used by biology teachers as characterised on the basis of teachers' teaching practices. I discuss: 1) an introduction showing the context in which data collection took place; 2) the implementation of curriculum content in which the teacher's use of the programme is specified; 3) the refresher courses attended by the teachers; 4) the teaching methods used by different participating teachers to teach the biology general principles (these teaching methods include the group work approach and the whole class teaching approach); 5) the structure of a lesson presentation; 6)

the teachers' expertise; 7) the assessment/evaluation where I discuss the strategies to assess students, the assessors, and the types of assessments provided to students; 8) the image of the teachers from students' perspective; 9) the nature of student-teacher interaction; and 10) a short conclusion to the chapter.

Chapter five deals with the students' perceptions of the teaching styles effectiveness.

In chapter six, I deal with conclusions and recommendations. Thus, I present a summary of findings; a general conclusion; limitations to the study; recommendations; and I end this chapter by indicating the need for further research on this issue.

CHAPTER TWO: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Rwanda has introduced a new curriculum in which teaching should be learner-centred rather than teacher-centred. The teaching styles used in teacher-centred approaches are characterised by lecturing and demonstration, whilst those used in learner-centred approaches are characterised by problem-solving and discussions (Nzabalirwa, 2004 & Felder, 1993), critical thinking and learners playing active roles in their own learning. The new curriculum was introduced in 2011 and I was interested in whether teachers were using the learner-centred approaches as stipulated in the curriculum or the more traditional approaches where the focus was on transmitting the content. I therefore used Therer-Willemart's classification of teaching styles (Therer, 1998, p. 8), the one which is typically used in the teacher training colleges in Rwanda to identify the teaching styles, thus the extent to which learner-centred approaches were being used.

2.1 TEACHING STYLES AS MY THEORETICAL FRAMEWORK

Many researchers have described different teaching styles. Visser, Vreken & McChlery (2006) classified teaching styles on the basis of their centeredness on the teacher or on the learner. Referring to classroom management, Phelan (2005) describes four teaching styles which are authoritarian, permissive, detached, and authoritative.

In this research however, as indicated above, Therer-Willemart's classification of teaching styles has been adopted as my theoretical framework. There are four teaching styles identified and described by Therer-Willemart using a two-dimensional model which combines two aspects of teacher's attitudes, the one vis-à-vis the centeredness on the subject matter and the other vis-à-vis the centeredness on the learners (Therer, 1998). These four teaching styles are 1) the transmissive teaching style, which is more focused on the content; 2) the inciting teaching style, which is focused both on the content and on the learners; 3) the associative

teaching style, which is focused on the learners; and 4) the permissive teaching style, which has very little focus on both the learners and the content (please, see figure 1 below).

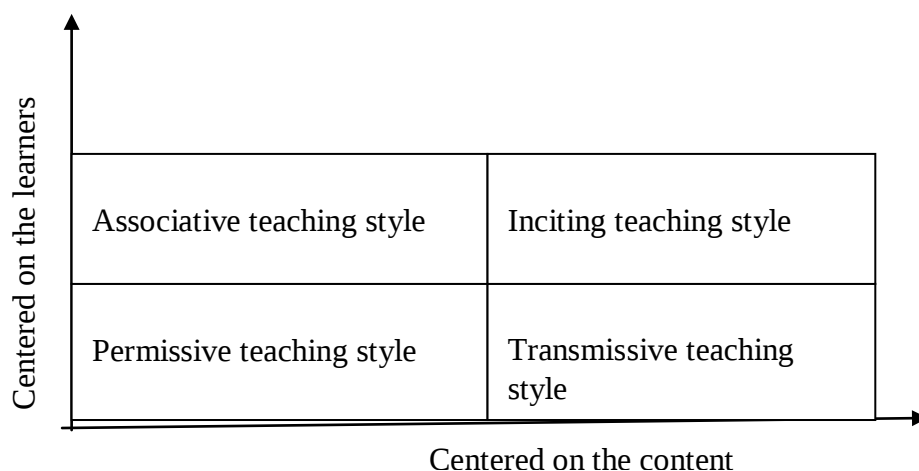


Figure 1: The four basic teaching styles according to Therer-Willemart (Therer, 1998).

2.1.1. Transmissive teaching style

In the transmissive teaching style, the most used teaching approaches are “ex cathedra” presentation and face-to-face teaching (Univ. Liège, 1982). The “ex cathedra” presentation is compared to church homilies where the Christians are not allowed to react and to criticise the priest or the pastor’s speech. In the face-to-face teaching context, the teacher is in front of the students, s/he talks while learners listen and take notes. In this case, the teacher is the only one to speak. In effect, s/he is transmitting knowledge to learners who listen passively. The transmissive teaching style leads to dependency of learners solely on the teacher’s teaching. This approach fits well in the early stages of learning when learning skills are still limited (Visser et al., 2006). The teacher becomes more authoritative as the number of students per class increases.

2.1.2. Inciting teaching style

The inciting teaching style derives from the Socratic questioning and discussions (Univ. Liège, 1982). Socrates initiated the questioning method through which interactive dialogue gets at pulling out potential ideas hidden in individual’s minds (Nzabalirwa, 2004). Through their spontaneous responses to the consecutive questions, students learn by discovering the essence of what is being taught. The greatest advantage of this questioning method is the fact that it permits the learner to be convinced that she/he has understood what is being taught. This method helps students to participate in classroom activities.

2.1.3. Associative teaching style

The associative teaching style derives from some techniques used in group work or practical activities (Univ. Liège, 1982). These techniques are related to modern education principles. They encourage values that are acquired through personal exercises, group work, and presentations even though it takes too much time to organise efficient group work. The teacher must be trained to use techniques to conduct meetings and organise group work activities (Nzabairwa, 2004). S/he supervises the activity, moves from one group to another clarifying and encouraging them towards the learning outcomes.

2.1.4. Permissive teaching style

The permissive teaching style is a self-study style with or without the help of someone (Univ. Liège, 1982). It is not adapted to students at the early stages of learning such as primary and lower secondary schools. This approach allows the learner to discover more through observation, analysis, verification, generalisation, and notions or rules by applying theories that s/he knows in a related field. The permissive teaching style is generally used at the university level and is not used in my analysis.

2.2 CHARACTERISTICS OF DIFFERENT TEACHING STYLES

In the table 1, the characteristics of the three most commonly used teaching styles, namely: the transmissive, the inciting and the associative teaching styles are summarised. Those characteristics are used to analyse my data. Miller (2006) claims that the teaching style influences the teaching method, type of assessment, classroom management, teacher-student interactions, and emotional climate of the classroom. In the literature review below some of these elements which are closely related to my research are discussed.

Table 1 is based on Therer-Willemart's description of four basic teaching styles (Therer, 1998).

Table 1: Teaching styles- framework for developing the interviews and for analysis

Teaching style Criterion	Transmissive teaching style	Inciting teaching style	Associative teaching style
Implementation of curriculum content	The curriculum is strictly followed. There is no existence of teacher-freedom	Only the essential parts are taught. There is teacher-freedom.	The curriculum is interpreted and adapted to the student's level. There is teacher-freedom
Teacher attends refresher courses on:	subject matter	pedagogy	pedagogy
Teaching method	Deductive by transmitting through lecturing, describing, and demonstrating	Inductive by questioning	Inductive by group work activities
Structure of lesson presentations	Highly structured teacher-centred presentations	Debates: the class is less structured.	Groupwork activities: class is much less structured.
Teacher has expertise in:	subject matter	questioning	human relations
Assessment/Evaluation	Mainly done by the teacher who attributes grades on the basis of tests, quizzes and essays.	Done not only by the teacher, but also by the students themselves and their peers. Grades based on participation.	By teacher, the student, and peers. Grades based on projects, presentations and participation. (Miller, 2006).
Image of the teachers from students' perspective	Figures of authority	Supportive and nurturing	Supportive and nurturing
Nature of student-teacher interaction	No close working relationship	Working together and sharing information	Working together and sharing information

The literature that is reviewed concerns the practices unavoidably connected to the teaching and learning process. A large number of practices have been described in the literature, but for this study, only the more relevant practices such as those depending on the implementation of curriculum content, refresher course attended, teaching method used, structure of the lesson presentation, teacher's expertise, type assessment/evaluation, teacher's image by students, and nature of teacher-student interaction have been selected.

2.2.1 Implementation of the curriculum content

Anderson (2002) claimed that what students are taught is more significant than how they are taught. In my opinion, it is that 'what of teaching' that is considered as the content of the curriculum to be covered in Rwanda. Anderson (2002) also indicated that studies of content coverage typically start by examining the instructional activities and materials and they also examine if the instructional activities covered are evaluated. Nzabalirwa (2004) claimed that the teacher whose teaching style is transmissive follows the programme strictly, the teacher who uses the inciting teaching style chooses to teach essential parts of the content through the interrogative methods, and the teacher whose teaching style is associative interprets the programme with the view to organise the activities adapted to the students' level.

2.2.2 Refresher course

Refresher courses represent a model of professional development for teachers. In-service professional development can be directed by government policies and emphases; and it is described as top-down in this case. It can also be driven by the needs of the schools, centres or individuals. This is described as bottom-up. Fullan and Hargreaves (1992) criticised the top-down refresher courses for they underestimate teachers' knowledge and experience and learning needs. These authors encouraged the model of professional development that takes into account the context in which teachers work, together with the teacher as an individual with individual values and purposes. They suggested therefore that teachers must be involved in the design of their refresher courses for such courses to be more effective. In addition, individual teachers or schools must decide whether to attend the courses, based on the course statement and aims. According to Thornton (2003), the course aims allow teachers to know whether the course will meet their individual interests and needs. According to Nzabalirwa (2004), a teacher whose teaching style is transmissive prefers to attend refresher courses related to the subject that s/he teaches whereas a teacher whose teaching style is inciting or associative prefers to attend refresher courses related to teaching methods.

2.2.3 Teaching methods

The concept of teaching methods refers to the specific instructional techniques. Examples of teaching methods are the lecturing method (talk, story, narrative, or telling method), the Socratic method (the question-and-answer, dialogic, developmental or heuristic method), the self-activity method, the problem-solving method, the project method, the discussion method and the demonstration method (Duminy, 1977). In addition to these, biology teaching uses

practical work, drawing, visual aids, seminars and fieldtrips (Dallas, 1984). As it can be seen, there is a wide range of teaching methods. The lecturing method is often the sole method used in Biology lessons (Özay, Ocak & Ocak, 2009). Havice (1999) claimed that teachers choose the lecturing method because they are often more comfortable with it. In the lecturing method, which Havice also called the traditional method, learners gain knowledge via the teacher talking or reading from a textbook or both, because it allows the teacher the control of time and content.

For science teaching to be more effective and more valuable, teachers should use effective techniques which involve student's active participation and engagement such as those based on the constructivist theory of teaching and problem-based inquiry. Teachers should use a variety of techniques to help students retain information and increase their understanding. It is the teachers' job to do whatever they can to organise learning experiences in a way that facilitates students' learning. Towards this purpose, teachers must help their students realise what they must do as learners and what teachers must do as teachers in order to achieve what Gowin (1979) in Novak (1981) called 'shared meaning of knowledge'. According to Novak (1981), biology teachers must work with the reality that concepts have an affective and a cognitive connotation that is unique for each person. Then, "new learning is primarily the extension of meanings of concepts we have or the acquisition of new concept meanings, and each learner must construct these meanings from the framework of idiosyncratic concepts s/he holds" (p. 12). However, in the survey done by Lord, some teachers said that the student-centred approach does not work in science subjects (Lord, 1998). According to this group of teachers, science consists of unavoidable truths that each student must know to succeed in the subject. According to Lord (1998, p. 582), "most supporters of this position believed that science content can't be learned through shared cooperation. Rather, each individual must learn the information on her/his own." Therefore, as claimed by Özay et al. (2009), the lecturing method remains the dominant approach, and this can even be the case for biology teachers in Rwanda.

The already described transmissive teaching style mostly uses the lecturing method (Univ. Liège, 1982) and the describing method (Felder, 1993). The inciting teaching style refers to the inductive method through questioning while the associative teaching style focuses on group work or practical activities (Univ. Liège, 1982). The study done in Spain by Burrowes (2003) compared the effectiveness of the traditional teaching methods which use lecturing to

the effectiveness of student-centred teaching methods which use constructivism, active teaching and cooperative groups in biology courses. She found that the constructivist method allows the development of more interests and higher performance in biology courses than the traditional method.

Recently, Özay et al. (2009) in Turkey conducted a study aimed at determining the effect of the use of sequential teaching methods on the academic achievement and retention level of students in biology courses. The sequential methods studied were composed of different arrangements of the following three teaching methods in a lesson: laboratory (student experiment), slide shows, and lecturing. Different sequences of these three methods were applied in teaching general characteristics of enzymes. The results showed that the academic achievement and retention level in lessons beginning with an experiment or slide demonstration was higher than in lessons that begin with lecture methods. They concluded that the lesson beginning with an experiment or slide demonstration attracted attention and motivation of students more than the lecturing methods. That means that learners learn better when a lesson begins with an inductive method through the use of practical work or visual aids or any other related method.

2.2.4 Structure of lesson presentation

A lesson can be highly or less structured depending on the teaching method adopted by the teacher. On the one hand, each stage of a highly structured lesson is described in detail. According to Nzabalirwa (2004, p.3), a teacher whose teaching style is transmissive prepares “clear and well structured presentations.” On the other hand, teachers with a less structured lesson may avoid following the documents of lesson preparation and may simply see what the world brings. In line with this description of a less structured lesson, Nzabalirwa (2004) posited that when a teacher whose teaching style is inciting presents her/his lesson, s/he takes into account her/his students’ answers. Likewise, a teacher who use the associative teaching style prepares her/his course in form of group work (Nzabalirwa, 2004), without knowing ideas that will be raised by each group of students.

2.2.5 Teacher’s expertise

The expert teachers possess a detailed knowledge needed by students in the subject matter they teach. However, the expert teacher may not necessarily be a good teacher or well-informed about teaching methods. According to Grasha (1994), such teachers are concerned

with transmitting information and challenging students to enhance their competence. Grasha added that their display of knowledge can be intimidating to the non-experienced students and these teachers may not always provide the underlying thought processes that produced knowledge. According to Nzabwirwa (2004), some teachers have expertise in designing questions and those teachers prefer to use the inciting teaching style. Another category of expert teachers are those who are experts in human relations or communications. This category of teachers tends to employ the associative teaching style according to Nzabwirwa (2004).

2.2.6 Types of assessment/evaluation

Assessment is a term that includes the full range of procedures used to gain information concerning student learning, either through observation, grading of performances or projects, which allows teachers, pupils and parents to judge the progress. Assessment provides an opportunity for students to demonstrate their knowledge, skills, and understanding of the subject matter.

There are various types of assessment, but the four main types I am focusing on in this study are baseline, diagnostic, formative, and summative assessments. A baseline assessment establishes the starting point of a lesson and allows the teacher to know from where to begin (Bamusananire, n.d.). Its tasks are based on individual experience and assessment of the current knowledge and skill level of learners so that learning activities can be adapted to learners' requirements. It can also serve as a form of orientation or induction. While a diagnostic assessment identifies learning difficulties of the learner, a formative assessment provides practice for learners on their learning in the current lesson in order to improve their level of understanding. While Bamusananire (n.d.) claimed that a diagnostic assessment can lead to radical re-appraisal of a student's needs, Perie, Marion & Gong (2009, p. 6) purported that a formative assessment is embedded in the learning activity and it "diagnoses where students are in their learning, where gaps in knowledge and understanding exist, and how to help teachers and students to improve student learning."

Formative assessments are not often graded and most of the times are anonymously done. These kinds of assessment are done in an on-going manner as the lesson progresses. Therefore, they can be spotted in a lesson observation. Formative assessments aim at improving the quality of student's learning (Angelo & Cross, n.d.). Lastly a summative

assessment is designed to grade and judge a learner's level of understanding and skill development for progression or certification. According to Perie, Marion & Gong (2009), summative assessments are distributed once at the end of semester/term or school year to evaluate students' performance in a defined set of content standards.

Gipps (1999) indicated that assessment is now being used to control curriculum and teaching. The process of assessment is based on students' participation in classroom activities and their performance in assigned works such as homework, reports, laboratories, essays, quizzes and exams. According to Ross (2006), a student can also do a self-assessment. Ross claimed that the value of self-assessment can be improved through a teacher's action which consists of training students on how to assess their own work.

Types of assessment can vary in accordance with the teaching style used by the teacher because it depends on the criteria and goals of such assessment. For example, in the transmissive teaching style, students' assessment may be conducted by the teacher on the basis of tests, quizzes and essays (Miller, 2006). In this traditional assessment, the relationship between the teacher and students is a hierarchical one. It is up to the teacher to set and define the task, and to determine its evaluation (Gipps, 1999). In general, students are not permitted to assess themselves. In the inciting teaching style, students' self-evaluation is based on students' participation in class. However, tests, quizzes and essays may not be avoided. The associative teaching style also allows students' self-evaluation on the basis of projects, presentations and participations (Miller, 2006). Wolf, Bixby, Gleen III, & Gardner (1991) argued that for effective teaching/learning to occur in the classroom, students need to be involved in the assessment process so as to monitor and reflect on their own performance in order to become self-monitoring and self-regulating. Professional development for teachers should train teachers to use new approaches of assessment in order to improve the student learning.

Although it is claimed that the role of assessment is a function of society's needs, the research done by Au in 2007 has revealed that assessment can sometimes have negative impacts on teaching/learning processes. Au (2008) generated three claims from his 2007 research findings that pointed out three central areas that high-stakes tests control. Au asserted that high-stakes tests/standardised examinations tend to define the legitimate school knowledge; if a knowledge domain is part of the test, then it is considered legitimate.

Consequently in the United States (US) for example, “non-tested subjects such as art, science, and social studies are pushed out of the curriculum at both the classroom and school levels” (Au 2008, p. 640).

Secondly, standardised examinations control the form of content knowledge in the classroom; in shifting the subject matter towards the knowledge domains contained on the tests, school teachers have shifted the forms in which they present this knowledge. As results, in the US, classroom knowledge was being presented as isolated facts that students need to memorise for the tests alone (Pedulla et al. (2003), cited in Au (2008)). Gipps (1999) has indicated that if isolated facts are learned, they quickly disappear from the memory because they have no meaning and do not fit into the learner’s conceptual map.

Lastly, teacher’s pedagogy is controlled by standardised examinations. It has been noted that teachers in the US were bringing back the teacher-centred, lecture-based pedagogies in efforts to keep up with the content and knowledge forms required by high-stake tests. This reduces opportunities for independent learning. The teacher-centred or the lecture-based pedagogy does not use a constructive pedagogy shown as facilitating the meaning making during the learning (Au, 2008).

2.2.7 Image of the teachers from students’ perspective

Teachers are seen differently by their students. A teacher who is a figure of authority is concerned with providing all kinds of feedback to students, establishing learning goals and rules of conducts for students, and concerned also with “the correct, acceptable, and standard ways to do things” (Grasha, 1994, p. 143). Another image of the teacher is represented by a teacher who is considered as a facilitator. The overall target for this teacher is to build in students the capacity for independent action and responsibility. According to Grasha (1994), such a teacher works with students in a consultative manner and provides them with much support and encouragements. However, this form of teaching/learning is often time consuming and it can be ineffective when a more direct approach would have been more suitable.

2.2.8 Nature of student-teacher interaction

There have been times when a science teacher stood in front of the classroom and presented scientific facts to students seated at their fixed places, listening passively and taking notes

from the board (Mehan,1979). Such approaches to science teaching still exist in some parts of the world and they are characteristics of a transmissive teaching style. However, things are changing towards the learner-centred and active teaching and learning approaches in science in many countries (Mortimer and Scott, 2003). Leach and Scott (2002) stated that science teaching and learning occurs through the teacher's and student's talk. However, Mehan (1979) stated that the interaction between students and their teacher can be non-verbal on the part of the students; for example when students listen actively, they make eye contact with the teacher and nod their heads. Such reactions indicate that students acknowledge or receive the instructional information provided by the teacher.

To discuss student-teacher interaction, one needs to know what biology teachers say and do as they teach and what students say and do as they learn biology in a classroom context. In fact, effective teacher-student interaction produces positive relationships among teachers and students and a well managed classroom that provides students with frequent and engaging learning activities.

To conclude this chapter two, the eight elements above will serve as a basis for my data analysis. For data collection, I will use the methodology that is discussed in next chapter.

CHAPTER THREE: METHODOLOGY

3.1 INTRODUCTION TO THE METHODOLOGY

In this research, the teaching styles used by biology teachers in Rwandan secondary schools are being investigated. The purpose of my research is to find out how the teaching styles of biology teachers impact on the teacher-students interactions and student's learning of biology in Kigali City in Rwanda. In this chapter I put forward the methodology used to get to the aims of this study.

3.2 RESEARCH PARADIGM, APPROACH AND DELIMITATION OF THE FIELD

This research is descriptive and conducted using the qualitative research paradigm. The research approach used is a case study in state and subsidised high schools in Kigali City, Rwanda. The choice of state and subsidised high schools was made because these types of schools receive students who have successfully passed the end-of-Lower Secondary national examinations according to the RNEC's regulations.

The teaching styles are supposed to impact on the level of students' performance. Therefore, it was preferable to work with schools whose students had almost the same academic performance level, that is, students who have successfully passed the national examinations. This study did not take into account private schools since the admission criteria in these schools are different from those mentioned above.

Kigali City was chosen as the area covered by the study for practical reasons that would make easier data collection. In effect, I live in Kigali City and transportation to and from the research sites is easier. The inventory of all schools showed that state and subsidised high schools were five in total from which a sample of three schools was selected: one mixed school and two girls' schools. If one mixed school, one boys' school and one girls' school has been chosen, this would have given a better balance. However, the only boys' school in

Kigali-City is private. Therefore, a boys' school could not be included in the sample since there was not any state or subsidised boys' school in Kigali City.

All biology teachers in the selected schools were invited to participate in the study. For each school, only one of those who were willing to sign the informed consent forms (see appendices #9, 12, & 15) was selected for the study, making a total of three biology teachers. For each selected biology teacher, only one of his high school classes has served for biology lesson observations.

Then students whose class was selected were invited to participate in the study if they were willingly to sign the informed consent. They were asked to sign the consent (see appendices #9, 12, & 15) if they were eighteen years old and above and the assent forms (see appendices #8, 11, & 14) if under eighteen years of age. In addition, parents/guardians of students under eighteen years of age were also asked to sign the parental/guardian consent forms (see appendices #10, 13, & 16). Of students under eighteen years of age, only those who had signed the assent form and whose parents/guardians had signed the parental consent form were selected to participate in the study. The selected schools and teachers' and students' pseudonyms are as follows in table 2.

Table 2: Schools in which the research has been conducted

Name of the school	Description of the school	Pseudonym of the teacher	Teacher's country of origin	Teacher's experience in teaching	Class selected	Number of students in a lesson	Pseudonyms of students interviewed
A	A mixed school of both girls and boys	Mr. Odumbe	Kenya	2 years	S6 PCB	36 with 8 girls and 28 boys	Claudine & Diogène
B	A girls' school	Mr. Kaggwa	Uganda	28 years	S6 MCB	36 girls	Eline & Francine
C	A girls' school	Mr. Tshibangu	Democratic Republic of Congo (DRC)	More than 30 years	S5 MCB	33 girls	Adeline & Berthe

(Key: PCB is the Physics-Chemistry-Biology combination;
MCB is the Mathematics-Chemistry-Biology combination.)

3.3 RESEARCH METHODS

Observations in classroom settings: Three biology lessons per teacher were observed. During the first of these three lessons, I was getting familiar with the context of the classroom while the students and their teacher were getting used to me. I wrote field-notes about all lessons observed, and I video-recorded all these lessons at two schools based on school permission, in order to allow the class to get used to the videoing. While the field-notes of all three lessons were analysed, only the video-recording of the second or third lesson was analysed in two schools. Observations focused on the teaching styles and the classroom interactions between teacher and students. Video-recording provides a “renewable” source of data that allows me to access the same data again and again (Latvala, Vuokila-Oikkonen, & Janhonen, 2000).

In this study, video-recording helped in analysing teachers’ teaching styles and elucidating teacher-student interaction in the context of the classroom. It also provides opportunities to slow down or speed up recorded actions so as to see things that could not be seen in the fleeting moment of unfolding classroom practices of teaching a lesson (Otulaja, 2010). During the lesson, I took field-notes of actions and interactions to augment what the video recordings captured. Field-notes are defined as the written accounts stemming from data gathered during observations and interviews². Pope and Mays (1995) indicated that field-notes consist of a descriptive part in which the observer captures the picture of events, people, actions, conversations, and objects in settings; and a reflective part in which s/he records thoughts, ideas, questions and concerns based on the observations and interviews. In the case of this research, field-notes were based on the classroom observations.

Interviews: Each third biology lesson per teacher was followed up with interviews. Interviews with one teacher per school helped in elucidating why teachers use the teaching style(s) adopted and how they think their teaching styles affect classroom interactions and student’s learning of biology. Two students per school were also interviewed to explore how they think their biology teachers’ teaching styles affect their learning of biology. The two students who were selected per school were those who showed opposing behaviours during

² Retrieved May 11, 2011, under the title of *Observation and field notes* from <http://hci.cs.siue.edu/NSF/Files/TeachingPD>

classroom observations. According to Liu (2006, p. 2), “students are the first beneficiaries” and are capable assessors of the process of teaching and learning. Interviews with students and teachers were audio-recorded. In brief, the field-notes from nine lessons, two video-recorded lessons, three interviews with teachers, and six interviews with students were analysed.

3.4 JUSTIFICATION FOR THE CHOICE OF THE RESEARCH METHODS: INTERVIEWS AND CLASSROOM OBSERVATIONS

There are many research instruments but the choice of a particular tool depends, among other elements, on the nature, the goals, the research questions, and the balance between possibilities and limitations that each instrument conveys in it. As stipulated by Apostolopoulou & Vega (2009, p. 47), “the method has to be chosen according to the type of answers needed, the availability of sources and the time restrictions.” In this study, the nature of responses that I am looking for to answer the research questions determined the choice of the instruments for data gathering.

3.4.1 Interview: advantages and limitations

The present research is a case study that focuses on the phenomenon of ‘teaching styles’, with very limited numbers of participants. I wanted to investigate the teaching styles in depth. The interview is the only instrument that allowed me to find out more details by probing the initial responses. To go in-depth and to remain focused on the themes proposed by the study, semi-structured interviews with open-ended questions (Opie, 2009) were used (see appendices #1 & #2). Some of these questions were suggested by me, others came from observations made in context; and others came naturally during the interview as raised by the prior response(s) to the previous question(s). Thus, the rapport built between me and the respondents was conversational. However, I cannot leave out the issue of language that I encountered during interviews. The Rwandan education system changed the instructional language from French to English in 2009. However, some teachers and students do not speak and understand English very well and they sometimes communicate using a mixture of English and French. Thus, while communicating with the participants, I allowed them to use French or Kinyarwanda whenever it was the language of their choice. Where I have quoted a French or

Kinyarwanda user while dealing with data presentation, these languages are given first in order to keep the originality of ideas, and they are followed by their translation in English.

3.4.2 Classroom observation and its advantages

Different methods pick up different pictures of data. In effect, classroom observations give me firsthand experience not available in the interview and I can record information as it is naturally revealed (Creswell, 2003). Thus, observations can overcome the issue of credibility raised by the interview. Observations were used to capture realities that could not be reached by interviews and allowed for the triangulation of the data thus increasing the credibility of the results and conclusions.

3.4.3 Overcoming limitations of observations

Observation is not without limitations. For example, people may change their behaviour when being observed (Opie, 2009), and the observation could be very difficult if the observer did not have good observing skills. Video recordings capture classroom activities and interactions as they unfold and are captured in real life. What could be missed during classroom observations is often captured on video. The video can then be played back to transcribe voice. With captured images, voices can be matched with images of spoken actions to generate understandings related to gestures, facial expressions, body orientations, head movements and participant physical orientation and location in relation to one another (Otulaja, 2010). In other words, video-recording helps in making sense of non-verbal activities (Opie, 2009). While the video camera may initially stimulate interest as a novelty, participants soon become used to its presence as part of the context. Playing to the camera is reduced to the barest minimum and no interference is noted (F. Otulaja, personal communication, May 9, 2010). I have video-recorded the first lesson but did not use the data, given that perhaps students and teachers may be acting up due to the novelty of the video camera. By the second or third lessons, video-recorder should create minimal disturbance in the classroom.

By triangulating observations with interviews and video data, the credibility of the study is likely to improve greatly.

3.5 DEVELOPMENT OF RESEARCH INSTRUMENTS

Interviews, observations, field-notes and video-recordings have been used to collect data to answer the research questions. However, question like “what are the teaching styles that teachers use in teaching biology courses in Kigali City?” could not be directly answered because the term ‘teaching style’ is complex. For this reason, one cannot identify her/his own teaching style without beginning by evaluating different criteria that are embedded in the teaching style.

To plan for getting information that covers all parts of teaching styles, each research question was translated into several interview’s themes/questions (see table 3 & 4) and/or into several questions in the classroom observation guide (see appendix #3) which aim to characterise each criterion of the teaching styles.

To answer the first research question, I needed to identify the teaching styles that the biology teachers employ in teaching biology concepts to their learners. As claimed by Kyriacou (1998), attempts to identify the teaching style could be problematic because there is a wide variety of styles that can be described. In addition, most teachers use a mixture of styles and these may vary from lesson to lesson and from class to class. In an attempt to identify a teaching style, it becomes necessary to examine each criterion of teaching style as indicated in my theoretical framework. These criteria should be examined through the analysis of biology lessons observations and through answers to interview questions related to the implementation of curriculum content, refresher courses attended by the teacher, teaching method, type of assessment, teacher’s expertise, teacher’s image by the students, and the teacher-student interactions. These questions are included in teachers’ and learners’ interview schedules as shown in the tables 3 and 4 below indicating the rationale of each question.

Table 3: Major questions of the teachers' interview schedule

Theme (question)	Research question	Rationale
1. What is the most common way in which you teach biology? Why did you choose it?	#1 Teaching styles used by teachers	Want to know teacher's perceptions of their own teaching styles
2. How do you teach general principles in biology?		Want to know from analysis whether the teacher uses inductive or deductive method
3. During a biology lesson, in different aspects of your teaching (like subject matter, questioning, human relations), where do you think you are more efficient?		Want to identify the teachers' perceptions of their efficiency in different aspects of their teaching.
4. What strategies do you use to involve students in the assessment process in the biology class?		Want to know the value given to students' self assessment and indirectly the methods of instruction.
5. What elements do you consider when you assess students' learning?		Want to know the method/type of assessment
6. Do you attend refresher courses or seminars? What does it cover or what do you want it to cover?		Want to know whether teachers are updated in their career and the focus of the teacher i.e. subject knowledge or pedagogy
7. Do you think that it is necessary to follow strictly the curriculum as it has been designed? How do you use the curriculum given to you?		Want to know teachers' perceptions about the implementation of biology curriculum in their classes.
8. How do you help your students to overcome difficulties in understanding biology concepts?		Want to know different approaches tried by the teacher in order to facilitate students' learning.
9. What interactions take place between yourself and your students during your teaching of biology?	#2 How teaching styles impact on student-teacher interaction	Gives information about teacher-student dialogues
10. To what degree do your students ask questions seeking explanation during the lesson?		Want to define the degree to which students interact with their teacher about the subject matter being taught
11. What importance do you attach to classroom discussions? How do you organize these discussions?		Want to know whether and how the teacher facilitates interactions amongst students

Table 4: Major questions of the students' interview schedule

Theme (question)	Research question	Rationale
1. Describe the way in which biology is being taught to you	#1	Want to know how students perceive biology teaching approaches
2. What do you do during your biology lesson?		Want to know student's activities and the teaching styles of biology teachers
3. Are you able and/or allowed to assess your own work or that of your peers? What are the elements to consider in that evaluation?		Want to know if and how self assessment is done by the students or allowed by the teacher
4. During biology lessons, do you interact with your teacher e.g. talk with your teacher, ask your teacher questions? If yes, describe the types of interactions you have with your teacher?	#2	Want to know whether the teaching approach used favours a free dialogue between the teacher and learners. Dialogue is the basis of an active participation in the process of learning
5. To what extent do these questions and discussions help you to better understand the biology lesson?	#3 Students' perception of teaching styles as impacting on their learning	Intended to capture students' perceptions of the role of classroom interactions resulting from the preferred kind of teaching style adopted by the teacher
6. To what extent do you ask your teacher questions when something is unclear to you in the biology lesson?	#2	Want to define the student-teacher relationships
7. Do you have occasions to share your ideas with your teacher and peers about the topic being taught in the classroom? If yes, how?		Want to find out the classroom interactions with the teacher and peers
8. How do you proceed to overcome eventual learning difficulties encountered in biology lessons?	#1	To get information on how students proceed to gain better understanding of biology concepts during lessons
9. To what extent do you think the way in which biology is being taught to you is effective?	#3	Want to know students' perceptions about the influence of the teaching approach on the learning of biology

3.6 ADMINISTRATION OF THE RESEARCH INSTRUMENTS

Initial data collection began with my introduction to the respondents. The purpose of the study was explained to the participants. They were asked whether they would allow video recording. A pen and pencil technique was planned to be used if participants declined video-recording. Classroom observations were conducted in natural classroom settings and at times determined by the biology class timetable. Every lesson observed consisted of a double period, equivalent to one hundred (100) minutes. Appointments for interviews were made with the interviewees. A quiet place, a date, and a time were fixed in advance. The one-to-one interview (Opie, 2009) was the most appropriate for this study given that interviews were conducted in their natural setting. I used face-to-face interviews to assure participants that the conversation was only between me and the interviewee and for free-flowing communication. This increased the confidentiality (Opie, 2009).

3.7 POTENTIAL ETHICAL PROBLEMS

Prior to data collection, I had obtained the Ethics Committee's clearance from the Human Research Ethics Committee at the School of Education of the University of the Witwatersrand (see appendix #17). The permission to conduct the study had been also requested (see appendix #5) and obtained from the Mayors of Districts in which the selected schools were situated; I do not show the letters of approval in the appendices so that anonymity of the schools can be retained. The Mayors had informed the principals of the selected schools but I have also myself requested permission from those school principals (see appendix #6). Then, the concerned teachers and students were informed by their respective principals. In fact, when I arrived at each school, the school principal and biology teachers were already half-informed about the research to be conducted, because the school had received a copy of the Mayor's approval letter.

At the first meeting with participants I informed them that participation was voluntary. Finally each teacher involved was asked to sign a consent form to ensure their willingness to voluntarily participate. Similar conditions were also applied to the participating students. Some of these students were 18 years old or older. These older students were able to make decisions as adults to participate in the research or not to. They were asked to sign the

informed consent form. However, some students were younger. Being unable to make such decision without parental consent, they were asked to take a parental consent form home to their parents for approval. This action was possible for the day students. The authority of the school was asked to sign the parental/guardian consent forms in cases of students in the boarding schools. When parents/guardians had consented by signing the forms, the child was asked to sign the assent forms. Students who did not sign a consent/assent form or whose parents/guardians did not consent to taking part in the study had their images obscured by silhouetting them and their voices were muffled in the video and were not reported. So, they did not have to miss the lessons. There was not any penalty against them (F. Otulaja, personal communication, May 9, 2010). Participation in the research was strictly voluntary. Respondents could withdraw from the research at any stage without consequences. Participants were informed that their proper names would not be mentioned in the final report to ensure their anonymity. Thus, participants' names/surnames in this thesis are pseudonyms (see appendix #7).

3.8 METHOD(S) OF DATA ANALYSIS

Data collected were in the form of words, sentences, or paragraphs of text. After data collection and transcription, the first step was to read and re-read the information gathered in order to consider the quality of the data, as proposed by Taylor-Powell & Renner (2003) because some of the data may not relate to the issues.

Qualitative data analysis consists of identifying, coding, and categorising patterns found in the data (Bryne, 2001). To get started, predetermined categories were selected in accordance with practices outlined by Hatch (2002) and these categories are informed by the research questions. These categories are as follows: the types of teaching styles engaged by the teacher, the impact of teaching styles on teacher-student interaction, and the students' perceptions of the teaching styles' effectiveness. These categories were further divided into subcategories on the basis of the tenets of the Therer-Willemart's classification of teaching styles to aide data analysis. Codes were generated from the data through the subcategories as indicated by McMillan & Schumacher (2006) by reading data and asking some questions like, "what is this about?"; "What were they talking about?" The answers to these kinds of

questions were coded, then a list of codes was made and information related to each code was identified throughout all interview responses and classroom observations for interpretation.

To sum up chapter three, this research is qualitative and has been conducted in one mixed school and two girls' schools all known as state or subsidised high schools in Kigali City. It has used data from the observations of biology lesson (fieldnotes and video-recorded lessons), as well as from the biology teachers' and students' interviews, to attempt to answer the research questions. The participants' rights have been respected during both data collection and data presentation given that participants have received the information sheet, signed the consent/assent forms, and parents/guardians of participants under eighteen years have guaranteed their consent.

CHAPTER FOUR: NEGOTIATING TEACHING: TEACHING STYLES, CURRICULUM, AND LEARNING OF BIOLOGY

4.1. INTRODUCTION

Data collection was conducted in three high schools in Kigali City between January and February, 2011. High schools in Rwanda have three forms, i.e. senior 4, 5 and 6 (S4, 5 and 6 respectively), in secondary education. The time of data collection corresponded with the start of the 2011 school year when lessons began with only senior 5 and senior 6 students. At the start of the 2011 school year, the RNEC had not yet published the results of the end-of-Lower Secondary national examinations of 2010 which would determine students who might attend the senior (S)4 during the 2011 school year. The S4 students started later in the second week in February (February 7, 2011), four weeks after S5 and S6 had started (January 10, 2011). Furthermore, one of the three schools (school A) has the practice of beginning the new school year by testing students for one week to evaluate their preparations in different subjects before the beginning of the school year. Therefore, the S5 and S6 students in that school started their classes on the 17th January 2011.

Even though I had waited for at least one week of continuous teaching in each school to allow participants to re-establish teaching/learning practices/processes after a two-month end-of-year holiday, the S4 lessons started while my data collection was already in progress. This is why the senior 4 students and teachers did not participate in my study.

Looking back at the research questions that guide my investigations as detailed in chapter one, the first research question is looking for teaching styles used by teachers in biology courses in state and subsidised high schools in Kigali City. Secondly I want to know how these teaching styles impact on student-teacher interaction in relation to student's learning of biology. And the last question is looking at how students perceive the teaching styles as impacting their learning of biology concepts. To identify the teaching style that the biology teachers employ in teaching biology concepts to their learners, I need to look at the way the curriculum content is covered, refresher course attended by the teacher, teaching method

used, structure of a lesson presentation, teacher's expertise, type of assessment, teacher's image by the student, and the nature of teacher-student interaction.

4.2. IMPLEMENTATION OF CURRICULUM CONTENT

Three biology teachers from the three different schools in my sample were interviewed and their lessons were observed. One teacher, Mr. Tshibangu was teaching an S5 class which has an MCB combination of science subjects. The other two teachers had S6 classes which had either an MCB or PCB combination of science subjects (Mr. Kaggwa's and Mr. Odumbe's classes respectively). All three teachers were teaching different topics of biology. Given that S6 PCB and S6 MCB have the same biology curriculum, and based on the fact that the research was done at the same time at all schools, I expected to see the two teachers in S6 teaching the same topics in biology. But that did not happen as you can see in table 5 on the next page and in the appendix #4.

Teachers were asked about the necessity of following the curriculum strictly as it has been designed, and they were asked how they use that curriculum (Question 7 of the interview schedule for teachers, Table 3). This question seeks for teachers' perceptions about the implementation of the biology curriculum in their classes. Going back to table 1, the manner adopted by the teacher to implement the curriculum is one of the factors that seem to influence a teacher's teaching style. One shared idea for all participating teachers is that it became more important to cover the whole curriculum because the national examination questions are set according to the dictates of the national curriculum. What they say is confirmed by the excerpt below from the NCDC's (2010b, p. 2) letter of instruction addressed to teachers and related to the use of the revised curriculum (new) for upper secondary schools. It says: "the national examination of academic year 2010 will be set based on the old curriculum designed for Biology-Chemistry option. The first national examination on the new revised Biology curriculum is stated for 2011". The examination of this excerpt indicates that teachers are informed of the curriculum on which the setting of the national examination will be based; therefore they know what to teach. However, the way to get to the common good (covering the whole curriculum) seems to be somehow different. This will be discussed later in the section on the teaching methods used.

The topics taught during lesson observations are based on the curriculum introduced in 2011. These topics are listed in Table 5, and the programmes, chapters and points in Table 5 refer to this new curriculum (NCDC, 2010a; see Appendix #4).

Table 5: Topics covered in lessons observed in each school

Teacher's name and level taught	Lessons observed		
	1 st	2 nd	3 rd
Mr. Odumbe (S6)	1. Adaptation of plants to arid and aquatic lands 2. Autotrophic nutrition (see S5 programme, chapter 5, subchapters 5.1 & 5.2).	1. Specific inhibitors. 2. Energy flow in the ecosystem. 3. Importance of photosynthesis (see S5 programme, chapter 5, subchapter 5.2)	Test for starch manufactured during photosynthesis (see S5 programme, chapter 5, subchapter 5.2 on methodology notes) .
Mr. Kaggwa (S6)	1. Need for transport system 2. Difference between an open and a closed circulatory system in animals. 3. Structure of an open circulatory system of an insect (see S6 programme, chapter 1, point 1.4.1)	1. Types of a closed circulatory system. 2. Structure of a single circulatory system of a fish.	Structure of a double circulatory system of a mammal (see S6 programme, chapter 1, point 1.4.3).
Mr. Tshibangu (S5)	1. Water properties. 2. Physiological functions of water. 3. Sources of mineral salts (see S5 programme, chapter 1, points 1.1.1, 1.1.2, & 1.2.1)	Functions of mineral salts (see S5 programme, chapter 1, point 1.2.3)	1. Mineral salts as determinants of osmotic pressure. 2. Essential minerals and their roles (see S5 programme, chapter 1, points 1.2.3 & 1.2.2)

Considering Au's 2007 research findings as described in the literature review, the implementation of the curriculum from the theory to the practice can be influenced by the national examination. Au (2008) claimed that high-stakes testing determines the knowledge

taught at school. The findings in this research support Au's claim, as illustrated by Mr. Odumbe's response when he was asked if it is necessary to follow the curriculum as it has been designed. Mr. Odumbe is a teacher at school A and he said:

It is very important [to follow the curriculum as it has been designed] because, as far as that I am concerned, I teach the candidate classes [to national examination], and the examiners, when they set exam, they base on the curriculum, and it's more important to deal with [it], but if per delay it comes to me to not finish, for flexibility I can handle the topics that are more often set in the examination. (Interview: February 10, 2011)

In Rwanda, it is a common belief that no one knows the content of the national examination questions before students sit for the examination. However, by using questions from past exams on a given subject from the institution date of RNEC in 1997 up to now, it is simple to know topics that are more often set, rarely set, or never tested. Even though the teacher is not 100% sure of what content will be tested, if time is lacking, s/he will try to teach the topics that are often tested. What seems surprising is that, from the interview, Mr. Odumbe highlights the importance of following the curriculum, but the lesson observations show him teaching in S6 the content that appears in the current S5 curriculum (see table 5 and appendix #4). This does not seem to be an error because the topic he was teaching was absent from both S4 and S5 programmes in the previous curriculum, the one formulated by NCDC (1999) and used when the current S6 students were in S4 and S5.

In fact, for the 2011 school year, a year taken as special because it coincides with the starting of the implementation of the new curriculum both at teaching and national examination level, S6 biology teachers were asked by NCDC (2010b) to teach the whole programme of S6 including the new topics that have been included in lower senior level. The additional contents make the S6 students and teachers more overloaded with work and therefore can lead to the difficulty of not finishing the programme for the school year 2011 if they have to follow it to the letter.

Moving to hear from another teacher, Mr. Tshibangu's response is quite similar to that of Mr. Odumbe. He too mentions the control of the curriculum by the national examinations and he adds that they are moreover obliged to follow the curriculum. He says:

On doit le suivre [le curriculum] à la lettre comme ça se présente. D'ailleurs on nous oblige de le suivre ... Bien sûr si on a à ajouter on peut ajouter mais en suivant ce curriculum, on ne

peut s'écarter totalement de ce curriculum. C'est un canevas à suivre obligatoire. (Interview: February 5, 2011)

(We must follow it [the curriculum] to the letter as it is given. Moreover, we are obliged to follow it ... Of course if there is something to add we can add it but while following the curriculum. We cannot totally deviate from the curriculum. It's a basic structure to obligatory follow).

In his words, Mr. Tshibangu alludes to elementary knowledge that is maybe forgotten in the curriculum and that can be included in the subject by the teacher, but he does not mention that something from the current curriculum can be left out. Asked about how to manage the curriculum when time is limited, Mr. Tshibangu revealed that the teacher needs to synthesise, simplify and summarise the content to finish the curriculum. According to Gipps (1999) and Au (2008), this management can lead him to teaching isolated facts that may have to be memorised for tests purpose alone but difficult to be applied, generalised, or retrieved. Mr. Tshibangu emphasises the importance of covering the programme as Mr. Odumbe did. But he also recognises that when a topic seems to be too hard for his students, he becomes flexible and adapts that topic to the students' level. Only Mr. Kaggwa, a teacher at school B gives a categorical 'no' to the strict following of the curriculum. He claims that: "a teacher should teach according to how he sees his students. As long as you cover the whole programme, it doesn't matter which one [chapter] you start with" (Interview: February 13, 2011).

Although Mr. Kaggwa's answer seems contrary, it is not much different from his colleagues' answers given that he too insists on coverage of the whole content on the mandated programme. His freedom in ordering topics is perhaps due to his responsibility in the students' progress evaluation within the year, as already mentioned. What Mr. Kaggwa says matches with what he does because I visited his lessons at the start of the first term, and he was teaching the transport system in animals (see table 5 & appendix #4), a point that is planned for the second week of the second term in the curriculum (NCDC, 2010a). He justifies his choice with the fact that when his students were in S5, he ended their biology course on the topic of blood as a type of tissue, and he wants to teach them the transport system in animals while they are still having a recent memory of blood tissue. His view is of great importance. Each teacher should structure his course according to the relationship

between different topics and subtopics, given that some topics or sub-topics are prerequisites for others.

4.3. REFRESHER COURSES ATTENDED BY TEACHERS

Refresher courses, as professional development for teachers, might be planned to inform teachers about reforms in education. However, in Rwanda, teachers express the view that refresher courses are scarce. For example, Mr. Tshibangu, who has been teaching for more than 30 years, says that he has participated in only three refresher courses. Furthermore, the workshops that the participating teachers have attended were on the teaching methodology, except for one workshop that Mr. Tshibangu has attended on the national examination marking. The teachers claim that they need refresher courses on the setting of concepts, approaches to learning, and on evaluation strategies. This is shown in the following excerpt of my interview with Mr. Odumbe (February 10, 2011):

Researcher: Okay, do you attend refresher courses or seminars?

Mr. Odumbe: Uh, so far, I underwent some training about teaching methodologies; it was in the beginning of last year from May up to August.

Researcher: And what do you want seminars to cover? Is it only [the] teaching methodology?

Mr. Odumbe: Teaching methodologies and setting of the concepts, and the approaches to learning, and also involving evaluation strategies for the students.

Furthermore, these teachers informed me that it is not the teacher who chose to participate in a given refresher course. Rather it is the collaboration of the school principal and the administrative organs of education at different levels that decided on the refresher course to be given and on which teachers would attend it, regardless of the teachers' willingness. Given the fact that the refresher courses are controlled by the education authorities and are skewed towards only teaching methodology (Interview with Mr. Tshibangu: February 5, 2011), it can be assumed that the authorities are not in tune with the needs of teachers. This indicates that the authorities do not care about the teacher's expertise in the subject matter that characterises the transmissive approach; rather they need biology teachers to be updated with modern teaching approaches such as the learner-centred pedagogy for example. I take this example

because Mr. Kaggwa indicated during interview that he was once sent to a school in England to learn how learner-centred pedagogy is used there.

4.4. TEACHING METHODS

The participating biology teachers in this research show the need to cover the whole curriculum content as indicated in previous pages above where I discussed the implementation of the curriculum, but the way they organise the learning experiences seems to be different.

4.4.1. How do teachers teach general principles in biology?

This question is the second in the interview schedule for teachers (see appendix #1). It is asked of teachers in order to analyse their answers so as to uncover whether the teacher uses inductive or deductive teaching methods. Mr. Odumbe claims that he uses practical lessons and demonstrations. By looking at the way he plans a practical lesson in relation to the theoretical one, the practical lesson is described as being used in the more traditional method where the introduction of a concept comes in a lecture prior to the laboratory activities. In this case, the concept is introduced in a pure verbal way, then the laboratory activity carried out is seen by students as a place to prove the teacher correct, and not a place to conduct meaningful observations and hence not a place to develop certain practical skills. This teaching method is qualified by Lawson & Renner (1975) as opposed to the spirit of scientific inquiry. According to these authors, experience with materials produces learners who should be able to understand abstract content; but studying abstract content does not necessarily produce learners who are able to interact with the materials and produce abstract generalisations. Therefore, laboratory work ought to precede the introduction of an abstract generalisation. This proposition is supported by Özay et al. (2009). Moreover, from my observation, Mr. Odumbe delivers practical lessons using a lecture-demonstration method. It is a teaching technique which “combines oral explanation with ‘doing’ to communicate processes, concepts and facts” (Sola & Ojo, 2007, p. 125). According to these authors (and I agree with them), an effective way of teaching biology practical is to allow students to conduct experiments, report observations, and make conclusions. This teaching approach would help learners to develop their scientific knowledge, experimental skills, and interests in the subject matter.

Mr. Odumbe agreed during an interview (February 10, 2011) that, when students discover through observation when running some experiments, they learn and understand the concepts better. He added that his learners also learn much through demonstration, rather than merely reading about the concept which can lead to lack of retention of knowledge. Thus, Mr. Odumbe's way of teaching seems to keep the concepts in the learners as they are able to generate a meaning to the concepts. This approach tends to agree with an old Chinese adage that says: "if I hear – I forget, if I see – I remember, if I do - I understand" (Lord, 1998, p. 580). However, seeing and doing do not always result in automatic recall without students being provided with an environment that stimulates the thinking process about what is being heard, seen and done (Lord, 1998).

Mr. Odumbe mostly uses the demonstrating and describing methods to deliver a theoretical lesson. Although lessons delivered through the describing or the demonstrating methods seem to be highly structured, Mr. Odumbe claims that when he is teaching, he tries to identify students with difficulties, especially those linked to the new instructional language. He shows how he helps students with language difficulties in these words:

In class I have already identified those students who have difficulties in the language. So I keep on giving more time to them, and at that over time, I slow my pace, I don't rush and I am always ready to explain, explain and explain, till the students get something that they are taught. (Interview: February 10, 2011)

Mr. Odumbe's claim above shows how much he is interested in his students' learning.

Asked how he teaches the general principles in biology, Mr. Kaggwa says that:

It is normally theoretical mainly. I don't have practical way of,.... They don't see what I teach them. They need to see it but we have a model only of skeleton system. Suppose I am teaching on skeleton system, that is the one I can show them. (Interview: February 13, 2011)

The utterance shown above indicates that Mr. Kaggwa's students learn biology almost entirely through abstraction. Mr. Kaggwa continues by showing what he could do if models that illustrate the concepts were available:

If we had some models, we could use at least maybe discovery method, you ask students: 'what do you see here?' 'What...?' But now we don't have it, so it is always talk, talk. That's how we normally teach. (Interview: February 13, 2011)

It seems from Mr. Kaggwa's words that, he chooses to teach by chalk-and-talk because he is constrained by lack of teaching resources such as materials for practical experiments/models. Although Mr. Kaggwa makes this claim, the video-recordings of the lesson observed and interviews with students indicate that mostly, he teaches by the discovery method using questioning. Students respond by answering a series of questions as the teacher introduces a concept. Most of the time, Mr. Kaggwa uses diagrams instead of models in employing the discovery method. The use of discovery method implies that students are encouraged and they take a more active role in their learning. According to Mayer (2003), this teaching method increases retention because the student organises the new information and integrates it with information that has already been stored.

As for Mr. Tshibangu, he declared that he sometimes uses diagrams on the board, videos, or Internet, or just merely he explains. He claims that his method varies depending on the content to be taught. I see explaining as transmitting information (knowledge) to students in a deductive way. But the use of diagrams, videos, and Internet are teaching that help in inductive reasoning. According to Toth (1980), diagrams are stimulating visual aids. For Toth (1980), diagrams provide maps and schemes that help students to reassemble divergent words into new and complete conceptualisation. This author explained the role of diagrams in the following words: "planned, drawn-out diagrams can productively accompany the audible words of explanation much as music accompanies a song" (p.410). On the use of videos in the classroom, Meisel (1998) claimed that when used properly, video has the power to captivate the students and creates maximum impact on their learning. As to the Internet, according to Francis (2000), it offers a rich source of potential teaching aids that can be used to enhance the biology lesson. Taking into account the teaching aids that are used by Mr. Tshibangu, and considering the results from observation of his lessons as well, it seems that he mostly use an inductive teaching approach.

To conclude this section, Mr. Odumbe's teaching method is mostly deductive while Mr. Kaggwa and Tshibangu's teaching method is mostly inductive.

Mr. Odumbe and Mr. Kaggwa, teachers at school A and B respectively, use the 'whole-class teaching', a teaching approach recognised by Novak (1981) as a traditional teaching practice. Mr. Tshibangu, the teacher at school C, plans 'group work' activities, a kind of learner-

centred pedagogy. Mr. Tshibangu claims that he uses that approach because it is encouraged in Rwanda. In the following sections, I describe the ‘group work’ and the ‘whole-class teaching’ as observed in participating schools.

4.4.2. Group work approach of teaching

Rwandan education is encouraging the learner-centred pedagogy in these words:

The new methodology ‘learner-centred approach’ recommended by the new curriculum must be used at all grade levels (S4, 5 & 6) by the beginning of academic year 2011, but it is not forbidden for any interested schools to start using the methodology during the third semester [term] of the year 2010. (NCDC, 2010b, p. 1)

One of the tools to practice the learner-centred pedagogy is the organisation of group work activities. Group work has been considered by Brodie in Brodie and Pournara (2005) as an alternative to traditional chalk and talk teaching. Brodie and Pournara (2005) affirmed that there is no single definition of group work. In fact, teachers use group work differently, depending on their theoretical perspectives and assumptions. How is group work being used in the schools that were observed? In this sub-chapter, I describe the group work activity as I have observed it in one Rwandan school.

Organisation of group work activities in the lesson

The group work method is tried by Mr. Tshibangu at school C. He had instructed his class to work in groups. This teacher did not distribute students into groups when I observed his class, even though he said that groups constantly change and students are interchanged as well in order to avoid the (negative) interactions. He claimed that students could be joking instead of discussing the topics assigned to them. I remarked that the lesson observations were conducted in a short period of time in Mr. Tshibangu’s classroom, just one week (from the 21st to the 28th January, 2011) and it was not necessary to interchange the students.

What I observed is that when I entered in the classroom for the first lesson observation, all students were informed about their groups which were coded by numbers: group number 1, 2, 3, 4, 5, & 6. This is confirmed by the fact that once tasks were distributed, the class quickly divides into groups. This could be more facilitated if desks were arranged to form groups of students seated together (Kyriacou, 1998) rather than being arranged into rows as observed. Prior to students getting together into groups, the teacher wrote a summary on the blackboard,

and students copied it in their exercise books. Then as the summary was divided into paragraphs, the teacher assigned different paragraphs to different groups for explanations, and then students met in their respective groups for discussions. I call this kind of students' activities 'group discussions' because when two or more people verbally interact with each other, they are involved in discussion.

Students' and teacher's activities during group discussions and group presentations

While students were discussing, Mr. Tshibangu moved around the classroom, listening to and seeing what students were doing in their groups, and sometimes reminding those who seemed not to be participating that everyone need to contribute. That nudging by the teacher is important given that students can either not be talking or talking about other things. After discussing, they came to present their work, group by group, to the classroom. When one group was going to present, its members stood up and went in front of the classroom while the remaining students sat attentively to catch what their peer group was saying; and whenever they did not understand, they asked questions of the presenting group. Although the group chose a presenter, all members were keen to respond to questions that were asked. The atmosphere of the class was supportive and all students were eager to contribute.

I also noticed that when there was a point that the teacher wanted the group to discuss but which was missed or not deeply researched in the presentation, the teacher tried to raise it through questions he asked of the presenting group. The use of this form of interaction is facilitated by the fact that Mr. Tshibangu is efficient in questioning. Therefore, he resorts to the associative teaching style which is characterised by group work activities and to the inciting teaching style which uses the question-answers sessions as it is said in the theoretical framework (table 1). When the question asked by the teacher or by a peer seems to be very difficult to the presenting group, other students were eager to give their ideas. But ultimately, it was the teacher who responded to such questions when no appropriate answer came from students.

At the end of a group presentation and responding to questions, students and teacher applauded. I found the applause as a reward that encourages students to talk and to participate in group discussion and presentation. According to Brodie and Pournara (2005), since group

work allows for the exchange of ideas, for students' activity and engagement, and for students' verbalisation of ideas, it is likely to promote better learning.

When asked about activities that they are expected to do in a lesson (Question two (2) of the interview schedule for the learners), the student Berthe at school C claims that during an interview:

We just explain those sentences that they [he] put on the blackboard, we just search for explanations of difficult words, and we try to explain for example a paragraph of a text they [he] gave us on the blackboard. (Interview: February 2, 2011)

What is to be given attention in the group work activity-based lesson is that what participating students do for most of time in the context I observed was to paraphrase what they have written down, instead of bringing new ideas based upon their prior knowledge. In fact, the faultiest element of this group work was the absence of a specific problem/question to address. It is known that not all discussions are powerful; the University of California Santa Cruz (UC Santa Cruz) (2009) listed the following four factors for a good group discussion: 1) the discussion must have a clear purpose; 2) the students must have something to say; 3) the students must feel comfortable in participating; and 4) meaningful questions must be asked. A weakness in one or more of these factors leads to the discussion failure. Thus, as there was no specific question for the group work activities that I have observed, I can assume that the group work teaching approach did not achieve the expected results such as the development of communication skills during problem solving.

Group work outside the lesson

Even though only school C's teacher, Mr. Tshibangu, tries to use the group work approach, no participating teacher ignores the importance of group working. For example Mr. Odumbe, at school A, claims that he uses group work as remediation after regular class when he gives extra-work to students. Even his students, Diogène and Claudine, support his claim that they work in groups outside the regular lesson to overcome their learning difficulties. According to Mr. Odumbe, the group work encourages student-student interactions. So students exchange ideas, do more research, and understand better. This is not new, Brodie and Pournara (2005) wrote that students of higher grades often organise study groups and do their homework together, and that students-initiated activity can be built on by the teacher, like in this case of school A. Group work is considered here as a social support for individual

constructions of knowledge. This view is supported by the socio-constructivist theory of teaching/learning. According to this theory, learning occurs through participation in social practices. Then, personal cognitive processes result from reflection or internalisation of collective or external processes (Davis, 2004). In accordance with the socio-constructivist theory, “knowledge is generated in the collaborative activities of individuals” and in turn, “that knowledge operates to frame the activities, understandings, and identities of those individuals” (p. 204).

4.4.3. Whole-class teaching

Teaching consists of communication with two important components namely: sending and receiving information. In the typical whole-class teaching, the class is considered as a whole, and is taught in a common framework (Multigrade School Education [MUSE], n.d.). In addition, the lesson is presented often in a chalk-and-talk style, then an exercise is set for the whole-class or a discussion is initiated.

As I observed in some schools of Rwanda, communication through the chalk-and-talk approach of teaching was commonly used. This approach is viewed as a traditional method of teaching. It has been analysed by Damodharan & Rengarajan (2007) who consider the teacher as the sender or the source, the educational material as the information based on lecturer notes and textbooks, the student as the passive receiver who interacts insufficiently with the teacher, and the chalk-and-talk method as the delivery medium. The chalk-and-talk method is a one-way communication with information being transferred by the teacher to students.

Although the Rwandan biology curriculum is supposed to be learner-centred, two of the three participating teachers were mostly using the chalk-and-talk approach of teaching, where the teacher is the central figure in the process of teaching and learning. Here is Mr. Kaggwa’s description of the way he teaches:

The most common way of teaching is the traditional teaching, chalk-and-talk method. Because I talk a word and I write it on the blackboard, I draw diagrams on the blackboard, simply because the students don’t have textbooks where I can refer them to, so I have to write everything on the blackboard for them to know what I am teaching. So, mostly I teach like that, chalk and talk. (Interview: February 13, 2011)

The centeredness on the teacher can be also seen in Diogène's description of the way that biology is being taught to them (Question one (1) of the interview schedule for the learners, a question that solicits the students' perceptions of biology teaching approaches): "the main way is going on the blackboard, first explaining, giving course outline, after that he [Mr. Odumbe] introduces the subject he is going to talk about, explain more about it and then after he gives notes" (Interview: February 9, 2011).

The same teacher-centeredness is evident in Claudine's activities during Mr. Odumbe's biology lesson (Question two (2) of the interview schedule for the learners), she says:

What I do in my biology lesson, I am just so attentive to catch every word that comes from the teacher's mouth, and be so keen to see what he should be writing maybe on the board, I catch by head, or I understand what it truly means. (Interview: February 9, 2011)

Diogène answers that during Mr. Odumbe's biology class, he just sits and observes, and listens to what the teacher is saying, and he has time to ask questions. These utterances are not very different from those of Eline and Francine, both students at school B and whose biology teacher is Mr. Kaggwa. Francine for example states that:

He [the teacher] gives us notes before. During weekends, we write those notes in our free time. Now if it comes to go in classroom, we already have notes, then he explains, he asks questions and we answer, if you do diagrams, he corrects you. ..., if you have another question but concerning biology, he answers. (Interview: February 12, 2011)

Although students like Claudine and Diogène listen passively to the teacher, given that they are allowed to ask questions, those "questions can stimulate cognitive processes and reveal the thinking frameworks of the questioners, acting as a diagnosis of their understanding" (Pedrosa de Jesus & Moreira, 2009, p. 194). Furthermore, students are actively engaged in learning when they formulate meaningful questions.

Notes writing and questioning in a whole class teaching

One difference between the ways of teaching in school A and B is in writing notes. School A's teacher gives notes during the lesson but after explanations while the school B's teacher gives them before the lesson. Asked why the teacher gives them notes before the lesson, Francine, Mr. Kaggwa's student, says that the teacher has to save time. This can be shown in the following excerpt of the interview with Francine (February 12, 2011):

- Researcher:** You've told about notes, but I've never seen you writing notes. When do you write notes?
- Francine:** Okay. Writing notes, he gives us notes before. During weekends, we write those notes in our free time. Now if it comes to go in classroom, you [we] already have notes, then he [the teacher] explains.
- Researcher:** Why do you take them [notes] in your free time? Why not taking them during the lesson?
- Francine:** He [the teacher] gives us notes, and then he comes, that he has to save time.

The difference in time of notes taking at school A and B could lead to two kinds of learning: an inductive learning if the short time allocated to questions and answers is properly used by school A. But question and answer time in school B could be a waste of time because if students have really read notes before the lesson, they know how to respond to any teacher's question if answers are easily found in the teacher's notes. However, this is not what happens because the teacher in school B is gifted in questioning, he seems to use higher order questioning and challenging tasks that require students to think and to interpret before they respond. This type of questioning often leads to an inductive form of learning. According to Lord (1998), activities that include questions with answers not directly found in books/notes work well for constructivist-based teaching.

The fact that Mr. Kaggwa wants his students to think when he asks questions is confirmed by his student, Eline, who says: "if he gives questions, he wants you to think. You first must think, and after you answer when you've finished thinking" (Interview: February 12, 2011). Another fact which shows that Mr. Kaggwa wants his students to think comes from lesson observations where he would often not volunteer an answer to his own question when the learners failed to give the right answer. He would give back the question to the learner again and again in various forms by simplifying the question to the learner's level so that the learner can figure out the answer by her/himself. Effectively in implementing this Socratic method, students tend to get stuck sometimes and need teacher's explanations of some aspects of the question. The teacher also sometimes gets stuck and finds it difficult to figure out a question that will provide the kind of answer or point desired. In such cases, the teacher can just 'tell' what s/he wants to get across. Hopefully if telling does occur at that time, "the students have been aroused by the questions to a state of curious receptivity to absorb an explanation that might otherwise have been meaningless to them" (Garlikov, n.d., p.1). It

seems obvious that many questions are decided before the class began; but depending on what answers are given, some questions have to be thought up serendipitously.

Mr. Kaggwa used questions to arouse the student curiosity and at the same time those questions seem to serve as a logical and step-wise guide that enable students to figure out complex topics with their own thinking and insights. Nevertheless, Lord (1998, p. 588) affirmed that students do not only need time to think about challenges, but they should also “be provided with time to discuss their thoughts and ideas with others in their classes.” Lord (1998) added that through such discussions with peers, students test the new knowledge and correct their misinterpretations; therefore the new knowledge fits with the students’ prior knowledge and knowledge is widened.

Strategies to reduce the drawback of the chalk-and-talk approach of teaching

A teacher who adopts the chalk-and-talk teaching method tends to present lesson facts to students and illustrates the essential points on the chalkboard. This method tends to stimulate the student’s senses of hearing and seeing. Students are generally passive and inactive in this case and it can be an opportunity for them to talk when the teacher is writing on the chalkboard with her or his back to them. To overcome certain drawbacks using this approach, the teacher should leverage chalk-and-talk approach with other teaching methods such as questions-answers method. Meng, in Thien & Begawan (The Brunei Time published on April 25, 2009), states that “teachers who practise the chalk-and-talk method ought to use more teaching aids that can stimulate student's interests in learning as well as to assist students in concept formation.”

The way that Mr. Kaggwa widens the students’ knowledge about the blood circulation in a fish’s gills is shown in the excerpt below. The teacher draws a single circulatory system of a fish on the board; he gives time for students to draw it properly. The drawing took about 13 minutes, and then the teacher starts to explain.

Teacher: I think everyone has finished, I’m going to explain. When you look at this circulatory system (pointing to the diagram), the most striking feature is that the heart has only 2 chambers. It has got the chamber called atrium. The atrium receives blood from the body. Then the atrium pumps the blood into the ventricle which pumps blood to the aorta which carries it to the gills (he every time points to the part that he says). Why should blood go to gills?

Student: To be oxygenated.

Teacher: To be oxygenated, that is one. Another reason?

Student: for gaseous exchange.

Teacher: I think that is the better answer. Gaseous exchange is a full answer more than oxygenation. Because gaseous exchange means that blood is going to lose carbon dioxide in water and it is going to receive oxygen from water. There is something which you should understand here. There is what we call a counter current flow of blood (he writes the 'counter current flow' on the board). As blood passes through the gills, it flows in a counter current flow method. What is a counter current flow? That is what we are going to try to explain now. As you can see, in the gills, blood is flowing in one direction. Ok? It is flowing upwards, what means in a counter current flowing, water must be flowing downwards. Ok? Water, you know gills, when a fish is swimming, water passes over the gills. Ok? Now it passes over the gills. If water is flowing backwards, the blood in the gills is flowing forwards. So blood and water they flow in opposed directions. Why now? The question is why? The counter current flow increases exchange of materials between blood and the fluid that surrounds blood ('water in this case') (he writes this sentence on the board, then he continues). Because we are going to find counter current flow in another area of the body, that is the kidney. When we will study the kidney, I will be talking about the counter current flow. So, I want you to reason, if they were flowing in the same direction the exchange would not be too much, ok? It would be less. Do you understand?

Student: Yes (in a common response at once)

Teacher: Because, ah, I want somebody to come, I'm going to show you, I demonstrate to you the counter current, who can come? (A volunteer goes in front of others to demonstrate with the teacher how the counter current works, she begins with the teacher to move in the same direction). I show you a flow that is not in a counter current. If we are moving in the same direction, remember that she [the volunteer] has oxygen; I have carbon dioxide, right? I'm blood, [she is water] and we are moving in the same direction, we are moving in the same direction, she is giving me oxygen, I'm giving her carbon dioxide, (they move in the same direction, and at a certain distance from where they started to walk the teacher says:) "by the time we reach here she is already full, but we are continuing together" (students realise that the volunteer cannot receive any more). But if we are moving in opposed direction (the teacher leaves the volunteer there and goes back to begin the demonstration of a counter current flow, they move one towards the other and when they meet, the teacher says:) I give her carbon dioxide she gives me oxygen, she goes and another one comes, I give her carbon dioxide, she gives me oxygen, she goes and another one comes (and so and so on), as you can see, none will be full (that means the continuing exchange of gases, the role of counter current in increasing the exchange) and that is very important.

In this excerpt of an observed lesson, the part reported above emphasises the role of counter current circulation of blood and water in the fish's gills. It is built on the basis of the existing knowledge of students on the role of gills as a place for gaseous exchange between blood and water. The counter current's role is explained in a kind of funny scenario that might be difficult to be forgotten; therefore it is likely to be retained for a long time.

For the case of Mr. Kaggwa's teaching practices, the chalk-and-talk method is mixed with questions-answers method and demonstrations. Mr. Odumbe, depending on the topic, also mixes the chalk-and-talk with the use of teaching aids that can be touched and felt through different student's senses, and therefore students remain concentrated on the lesson (Classroom observation: January 26, 2011). Students are even invited to write on the blackboard, especially when it comes to their turn to respond to teacher's questions (Classroom observations: January 26 & February 8, 2011). During this action, the teacher controls the class, thus students are prevented from disturbing; an action that could happen when the teacher is writing on and facing the chalkboard.

The drawback of chalk-and-talk approach to teaching are due to the exclusive use of that approach, but when it is mixed with science experiments, with questions and answers approaches, with enough teaching aids, or with a funny scenario or story telling, the disadvantages become reduced and students remain concentrated on the lesson, like in lessons observed at schools A and B.

4.5. STRUCTURE OF LESSON PRESENTATION

As the method of teaching impacts the structure of lesson presentation, Mr. Odumbe's lesson is highly structured and teacher-centred due to the describing or the demonstrating teaching method. In fact, as Mr. Odumbe wants to teach the whole curriculum content, he makes little time for engaging students in discussions. As for Mr. Kaggwa, he uses an inductive method of questioning; he presents materials in a more or less structured way. In fact, his lesson, though mainly structured as a questions-answers session and teacher-centred, leaves room for students' responses to modify the way the lesson is delivered. Thus the same lesson becomes somewhat learner-centred. Coming to Mr. Tshibangu's lesson, it is much less structured and

more learner-centred due to the group work activities that Mr. Tshibangu engages students in as he seems to value students' voices and ideas.

4.6. TEACHERS' EXPERTISE

Asked about their expertise, teachers claim that they are experts in the subject matter and in questioning. The lesson observations confirm that they know what they teach because they give clear ideas without confusing students. Even though they are experts in questioning, Mr. Kaggwa seems to be the more expert in questioning because he mostly used questioning in the lessons observed. He also confirms his expertise in these words:

I have the matter and students tell me and other people tell me that I know to deliver it, to tell it to them. Because, you may know the matter and you don't know how to give it to others. But they tell me that I know to tell it to others, I can teach properly, because I have the system of putting questions on every part of the subject which I am teaching. (Interview: February 13, 2011)

The verbs like to 'deliver' or to 'tell' used in the excerpt above seem to indicate that Mr. Kaggwa resorts to the transmissive teaching, but the last part of this excerpt talks of 'questioning', a characteristic of the inciting teaching as described in my conceptual framework. The excerpt indicates that Mr. Kaggwa mixes the transmissive and the inciting teaching styles, a fact that has been confirmed by the observation of his lessons.

4.7. ASSESSMENT/EVALUATION

4.7.1. Strategies to assess students

The students' self-assessment is an important component of formative assessment. Responses to question four (4) of the interview schedule for teachers is meant to find out the teachers' strategies for involving their students in the assessment process. Mr. Tshibangu prefers to encourage students to engage in classroom discussions.

As for Mr. Odumbe, he claims that he encourages students' participation. Sometimes he would introduce the concept and then he would allow students to explain something about it, and the students themselves have to indicate where they are still right or wrong. This is the

case when a student (Claudine) asks Mr. Odumbe the products that he had put in the boiling tube and in the water bath. This question was raised in the practical lesson done by Mr. Odumbe on the demonstration of starch production during the photosynthesis phenomenon. That question occurred after Mr. Odumbe had already finished demonstrating how to proceed to prepare the test for starch contained in a green leaf. Then, Mr. Odumbe had to repeat what he had previously said.

Mr. Kaggwa involves the students in the assessment processes mainly by the questioning approach. He uses monthly exercises and mid-term exams. In addition to the regular exercises and exams evoked above by Mr. Kaggwa, he always put in the notes given to students some questions at every subtopic. He also asks the students questions to evaluate whether they understand what he is teaching. Even though Mr. Odumbe used another approach, the lesson observation of his practical lesson showed something similar to what Mr. Kaggwa describes above: Mr. Odumbe put evaluation questions on the blackboard just after noting the procedure but before carrying out the experiment. So, as the experiment was going on, students were recording their observations and thinking on answers to those questions on the basis of observations.

Lesson observations showed that questions asked by teachers were varied.

a) Questions aimed to recall factual knowledge learned in previous lessons; these are for example:

- 1) “When you look at the circulatory system of an insect, where does blood pass when it comes into the heart?”
- 2) “In S3, you have [been] taught hormones: which hormone is used to regulate water?”

b) Questions that recall factual knowledge and are aimed at introducing a certain part of a lesson by eliciting the student’s prior knowledge on the concerned part; these are for example:

- 1) “What does single circulatory system mean?”
- 2) “What does double circulatory system mean?”
- 3) “What is a counter current flow?”

c) Questions for understanding which require logical reasoning; these are for example:

- 1) “Why should blood go to [the] gills?”

- 2) “Why should blood go to the liver?”
- 3) “Where does hydrogen peroxide come from?”
- 4) “Why is water the best medium for chemical reactions?”
- 5) “Where does the heat to your body come from?”
- 6) “Why should blood pass through the stomach and intestines?”
- 7) “Why should blood pass through the kidney?”
- 8) “Why should gonads have a lot of blood?”
- 9) “Why do we use the water bath when we are doing the test for starch contained in a leaf?”

Note: all the questions listed above (in a, b & c groups) are asked by Mr. Kaggwa except the question 9 (in c group) which is asked by Mr. Odumbe.

d) Questions for understanding that require understanding of processes like, for example, “how does the liver do the detoxification?” This question is asked by Mr. Kaggwa.

e) Questions for application that may help to formulate a hypothesis that is going to be supported by data from observations like, for example, “why do we boil the leaf in alcohol when we are doing the test for starch?”

f) Question for making observations like, for example, “what is the positive result for iodine solution when we are doing the test for starch?”

Note:

1) The two last questions (in e & f groups) are asked by Mr. Odumbe. All of Mr. Odumbe’s questions above are asked during the practical lesson on demonstration of starch manufactured during photosynthesis (Mr. Odumbe’s 3rd lesson). All of Mr. Kaggwa’s questions above are asked during the lesson on the single circulatory system of a fish (Mr. Kaggwa’s 2nd lesson), a lesson preceded by the lesson on the open circulatory system of an insect.

2) The types of questions asked by teachers depend on the types of the lesson, but Mr. Kaggwa’s lesson uses questioning more than Mr. Odumbe’s lesson as it is already mentioned in the teacher’s expertise.

The point is that when different kinds of questions are arranged in a lesson in an inciting manner, the teacher provides a timely inquiry process which helps students to recall what potentially resides within their minds. According to Kritis University (2004), as students were sure that their answers are the right ones, a set of questions allows students to put into doubt their prior knowledge and to reopen the space for renewing and deepening the learning process.

4.7.2. Who is the assessor and what kinds of assessment?

Students benefit from training in self-assessment and in peer-assessment, which helps them to share and understand the assessment criteria and what they need to do to achieve, and therefore manage their own learning (Gioka, 2007). The elements considered in doing a given assessment determine its kind. These elements were supposed to be revealed by both students' and teachers' answers to question three (3) in the interview schedule for learners and question five (5) in the interview schedule for teachers. The question to teachers needs to uncover the methods/types of assessment while that to learners aims to know if and how the self-assessment is done by the students.

When asked whether a self-assessment or the assessment of peers is possible or not, student Adeline's answer is affirmative. Adeline belongs to Mr. Tshibangu's class in which the group work approach is used. In fact, for students in groups, the peer-assessment is recommended for awareness of one's own thinking and a capacity to understand the thinking of others. Adeline claims that the assessment she does is like comparing the levels of different group members. She explains further that when they receive a text to work on in a group and have to thereafter present to the class, they compare the capacity of each other to express oneself in some languages like French and English, and the capacity to rapidly understand biology concepts, mechanisms, and what the teacher wants. The comparison of students' capabilities established by students themselves characterises the group work approach of teaching that is indicative of the associative teaching style. This comparison is very important because it creates a certain thirst in those students who seem to underachieve. Therefore, they can work hard in order to fill the gap between them and those who seem to overachieve. So it is not really formal but rather informal peer or self assessment. Mr. Tshibangu claims that he evaluates his students by quiz, homework, by assessing the students' writing skills and expression, and by assessing group work activities done in the classroom. As discussed in my

theoretical framework, these are ways of assessing in the associative teaching style where it is not only the assimilation of the subject matter which is assessed.

For Diogène who studies in Mr. Odumbe's class, in a whole-class teaching approach, Diogène evaluates his improvement through the marks he gets in tests or through his ability to reproduce by himself the experiment done as a demonstration by a teacher. It seems obvious here that what is evaluated is the memorisation of procedures to follow during an experiment. Asked whether he can evaluate the improvement of a peer, Diogène says that it is impossible except when that colleague asks a question or shows him the way s/he does not understand. Diogène's answers above seem to point to the fact that Mr. Odumbe uses a transmissive teaching style.

Claudine's answer about her self-assessment is similar to that of her classmate Diogène but concerning the peer-assessment, she says that she observes the improvement of her peers when they try to follow the teacher and do not disturb. For her, the non-disturbance shows that her classmates like the subject and understand it. For me, Claudine's assessment of her peers can sometimes be unreliable. In fact, if the teacher is authoritative, and thus s/he is likely to be obeyed, most students are obliged to not disturb. Therefore not disturbing is not necessarily linked to her assertion. So, a student can pretend to follow without understanding anything. The common element of self-assessment pointed out by all students in a whole-class teaching approach is the improvement shown by class tests/exams marks. However, a student's marks are shown by the assessment done not by the student her/himself, but by the teacher who set the test/examination. This is to mean that, it is the teacher who mainly assesses the students and that self-assessment is negligible in a whole-class teaching. The teaching style in which the assessment is mainly done by the teacher is transmissive.

From the teachers' answers, Mr. Odumbe asserts that he assesses the student's ability to understand the concepts while Mr. Kaggwa looks for the understanding of the content and its application. These are Mr. Kaggwa's words:

I try to assess if the student has understood why he is learning a certain part of ... for example, I may be teaching circulation, and I tell them that the blood vessels, the big one has got normal pressure, but when blood vessel becomes small, the pressure increases. That one applies to eating fats. When you are eating a lot of animal fats, blood vessels become small,

and you get blood pressure. So in most cases every part I teach, we normally look at the application part of it. (Interview: February 13, 2011)

Mr. Kaggwa shows through the above mentioned excerpt the importance he gives to the application of biology knowledge in everyday life. From Mr. Kaggwa's claim, I assume that students can learn biology in order to not only get high marks in examinations, but also to adopt a behaviour that is favourable to their future life. This view is supported by Kaggwa's student Eline where she illustrates the importance of biology in her life as described in chapter five. This is a very important point because Tinto (1987) in Lord (1998) found that many students are unable to apply information provided by their courses to everyday situations. Another point is that passing an examination successfully is not an essential indication for being able to apply the knowledge in life. Astin (1985) in Lord (1998) claimed that it is not unusual for students to retain information and be successful in courses without understanding the content of the courses. The knowledge applied to everyday life might be retained longer and be useful for the rest of life.

4.8. IMAGE OF TEACHERS FROM STUDENTS' PERSPECTIVE

Interviews with students reveal that when a student shows any learning difficulty or a teacher discovers a certain gap in learning of a particular student, the teacher is willing to help and does whatever he could to assist the student. Thus, all participating teachers are seen by students as supportive and nurturing. This is supported by the teacher-student interaction that I discuss in the following sub-chapter.

4.9. TEACHER-STUDENT INTERACTION

Interaction between the teacher and student is essential in the teaching/learning process. It is by asking questions that children explore and learn about the world around them. It is this culture of learning that accompanies learning everywhere. Mr. Odumbe claims that the interaction between him and the students comes in the question session (Interview: February 10, 2011). He says:

I can shoot a question to a student, basing [based] on the basic knowledge in biology s/he has, and from that, if s/he answers, I have a gauge depending on the concept and the way I know it, then we can interact. (Interview: February 10, 2011)

In fact, by receiving answers or questions from students, the teacher may be informed about what went well in the lesson, what did not go well and what needs to be done (Gioka, 2007). Apart from these interactions described above by Mr. Odumbe, his student Claudine claims that she also asks him for advice from his experience that can help her to reach the teacher's level of knowledge. This shows that the teacher is seen as a model to follow, and he is not considered as an authoritarian that elicit fear; rather he is looked up to as an adviser of students who provides guidance in their intellectual development.

As with Mr. Odumbe's classroom, Mr. Kaggwa says in the interview that the interaction between him and his students is mediated by his questions to them and their questions to him. This kind of interaction is also evident in the lesson observed where he is engaged in the use of questions-answers teaching method. In addition, this teacher gives room to students to ask their questions. This assertion is confirmed by his student Francine who says:

During class we ask him questions if we don't understand. Some questions we usually ask him are like: how does such one appear? Why? Explain, and describe how this one is like that; that's how we usually ask him. (Interview: February 12, 2011)

These types of question as listed above show that questions asked of teachers are generally related to students' attempt to understanding of the concept being taught. Although Mr. Kaggwa mostly uses the questions-answers teaching method, he declares that he often varies the methodology when it comes to a practical lesson because students need to have practical skills. Thus, he gives them practical work and just tells them to do it. Mr. Kaggwa has noticed that students find many challenges with the practical work, especially with the very first lessons. He states that:

They [students] say 'teacher, you don't like us, you are not helping us', and some even they may call you to draw for them. And when you refuse, then they start realising that things are serious, and they draw properly, and then they start to observe and make their observations. After some times, they will get okay. They fix after about three or four practical [activities], then they start also understanding what they must do, and life goes on, but at the first time, they loaf. (Interview: February 13, 2011)

Even though the very first practical lessons seem to be problematic for students as noted by Mr. Kaggwa, the students produce knowledge and make sense of the body of information associated with the experiment being carried out by having a hands-on experiment, observing and reporting their observations. Furthermore they may retain the information gained through the practical lesson better than the lesson transmitted to them by their teacher.

Although Mr. Kaggwa claims that the students want him to draw for them, he is not always the one who must intervene if a student is having difficulties in learning. His student Eline, for example, claims that she often seeks assistance first from her peers around her, and then she goes to the teacher only when no peer is able to help her. Asked about the extent to which she asks questions of her teacher when something is unclear to her, she says that it's not often; it's rare. Eline's classmate Francine confirms Eline's utterance by claiming that her fellow students are her better teachers; and that she asks the teacher only when the discussion amongst her fellows fails to provide the solution. This confirms learning as a form of social action. Claudine (Mr. Odumbe's student) shares the same views with Eline and Francine about the role of their peers. She claims that the teacher's response eventually helps both the student who asks the question and her/his peers. Student Diogène, Claudine's classmate, also conjectures social learning. He begins by asking questions of the teachers first and then comes to his peers seeking answers. He says: "I ask questions till I understand it. Or, sometimes, when I see the professor is tired, or he is not getting well my problem, I just leave him and I ask to my colleagues" (Interview: February 9, 2011). Although all participating students have a free question-answer interaction with their teachers, those who are taught through the whole-class approach say that they do not have time to exchange their ideas with their teacher about the topic being taught because, when the teacher is in, he needs all their attention. So he is logically the only one to be followed. But after the lesson, they discuss in groups.

Mr. Odumbe and Mr. Kaggwa, whose students' views are indicated above, are those teachers who use the chalk-and talk-method of teaching. The third teacher, Mr. Tshibangu who tried the group work approach, talks about question-answer interaction, but also he adds the counselling. He says: "les élèves posent des questions et vous répondez, et vous leur posez des questions, elles aussi répondent. C'est tout. Vous leur conseillez aussi, vous leur demandez de lire les livres, etc." (Interview: February 5, 2011). (*"Students ask questions and you answer, you ask questions of them and they also answer. That's all. You also advise*

them, you ask them to read books, etc.’). His student Adeline adds that the teacher also encourages students in their group work if they are progressing well; and he gives the guidance when they are on the wrong track. Furthermore, Mr. Tshibangu’s participating students claim that they share freely their ideas in their groups, and they share ideas with their teacher when they are presenting and receiving some information and feedback from their teacher.

Asked about the degree to which students ask questions for explanations during the lesson, Mr. Odumbe answers that they do that often where the concept is not well understood by them. On his part, Mr. Kaggwa claims that there are some students who do not ask him question at all. The reason given by Mr. Kaggwa why those students do not seem to ask question is that they seem to fear being ridiculed. Thus they don’t want other students to hear their mistakes. He continues by showing the strategies he has adopted to help such students:

You go to that student alone, especially after giving them exercise, when she fails, you ask that student to come, and you explain to her normally alone. Or, when you come out of class and you are in break you can talk to that student, ‘do you understand’? S/he will tell you ‘no’, when you are two, s/he asks you. (Interview: February 13, 2011)

It is surprising to see that some students fear their peers, but not their teacher. This indicates that Mr. Kaggwa’s image is not perceived as an authoritarian authority to be feared. As for Mr. Tshibangu, he recognises that his students ask many questions. His declaration below indicates how he enables student learning.

On ne peut pas quand même arrêter un enfant et l’empêcher de poser des questions, et à toute question correspond une réponse, bête soit elle, mais on doit quand même répondre parce que l’enfant l’a tellement besoin. (Interview: February 5, 2011)

(You cannot stop a child and prevent her/him from asking questions. And any question calls for an answer. Whether stupid or not, you must give the answer, because the child needs it so much).

It comes from the discussion above that the students’ questions were welcome regardless of the teaching approach that the teacher has adopted. Furthermore, students consider their peers as able to help them in biology learning, and thus they do not wait for the teacher when they do not understand something related to the biology subject.

4.10. CONCLUSION TO CHAPTER FOUR

In concluding this chapter four, it is obvious that teaching/learning with regard to the curriculum content coverage seems to be examination-oriented in these participating schools. Therefore, teachers want to teach the whole curriculum content for the examination and students prefer to do their own research to complement what they learn during biology lessons for the sake of success in the national examination. A quick look at the teaching methods adopted shows that not all teachers are implementing the learner-centred approach. Two of the three participating teachers use the whole-class teaching approach by lecturing, demonstrating, and questioning methods, thus only one of them (Mr. Tshibangu) attempts to use the group discussions in the classroom. However, even Mr. Kaggwa's lesson is not entirely teacher-centred: by drawing out the student's ideas through the questions-answers method of teaching, his teacher-centred lesson becomes also centred on the student. Whereas a self/peer-assessment plays a key role in the process of learning, students taught through the whole-class teaching method do the self-assessment on the basis of their marks in a test/exam. Through what these students say, they are unable to do a peer-assessment while their peers whose teacher uses the group discussions do it by comparing the group members' achievement, and evaluating their expressions and participations.

Having a look at the teacher-student interaction, it is principally observed in the question-response sessions where I see active participation of students who ask questions and receive answers from the teacher or a peer. Students are free to ask any question from their teacher wherever they do not understand. The teacher also asks questions from the students to encourage them to express what they think. However, an open discussion between the teacher and students is not always possible except in the group work approach of teaching. What can be appreciated on the students' side is that when the teacher does not allot time to group discussions in the classroom, students organise for themselves and have group discussions outside the lesson. This has been revealed by Mr. Odumbe's students and Mr. Odumbe himself, but even Mr. Kaggwa's students shares ideas outside the lesson even though it is not always done in group activities.

After the attempt to identify the participating biology teachers' teaching styles, the students' perceptions of their effectiveness is discussed in the next chapter.

CHAPTER FIVE: STUDENTS' PERCEPTIONS OF THE TEACHING STYLES' EFFECTIVENESS

The effectiveness of any teaching style used by a biology teacher is determined by the impact they have on the learning of students. The results on this particular aspect as perceived by students are discussed in this chapter.

According to Kyriacou (1988, p.41), the debate on the relative effectiveness of different teaching styles is a complex one; and “what works best will vary from situation to situation, depending on the type of class taught and the particular type of learning outcomes being fostered.” Francine and Claudine, even though taught by two different teachers (by Mr. Kaggwa & Mr. Odumbe respectively), in responding to question five (5) on the interview schedule for learners, which captures students' perceptions of the role of classroom interactions resulting from the preferred kind of teaching style adopted, give the similar answers. They say that the questions they ask their teachers allow them to acquire more knowledge, because when the teacher is asked to explain, he explains deeply on the bases of some examples whereas if students try to hide that they don't understand something by not asking questions, still they will not know. In the utterance below, Mr. Odumbe's student (Claudine) shows her positive affective learning toward biology subject and why she is proud to be taught in the way in which she is taught:

The very thing that makes me like it [biology course] more is that whenever you try to ask questions, he [the teacher Mr. Odumbe] responds to them in the way you ask them, and he does not care whether you ask them more and more times, he is always there to explain everything. (Interview: February 9, 2011)

Francine, Mr. Kagwa's student, as a day student, adds that she tries to compare notes she gets with notes from other schools and she finds that they learn a lot at her school. She even compare question papers or exercises from other schools and she finds that there are some questions that students from other schools cannot answer while those from her school are able to answer them. For these reasons she is proud to be taught in the way they are taught. Francine is taught by Mr. Kaggwa, a teacher known as having the questioning skills and who always put up questions for learners to think about at the end of each topic/sub-topics' notes,

in order for student to read their notes not like newspaper. Thus a student reads notes and thinks all the same time. Then the student tries to respond to the question. If she is not able to give the answer, she can read and read again in order to understand more and get the right answer to the question. If she continues to miss the answer, she can even ask from her peers till she gets the response needed.

When students think about a question asked of them, they make meaning of what they have learned. Eline, who is a classmate of Francine, evokes the importance of biology in her everyday life. She talks of the feeding habit, for example, where she knows what to prepare and take as food according to the needs of the body. She is also aware of changes that appear during the growth and development of a human being (both sexes) and therefore she cannot be afraid or surprised by those changes. This importance, signalled by Eline, is due to the application part of biological knowledge which their teacher Mr. Kaggwa insists on as already revealed.

As for Diogene, a student, he claims that the teacher refers him to books and websites where to search in order to get more information on the concerned topic. In fact, all students interviewed say that they do some research on the Internet and read biology books to overcome their deficiencies in learning. So it is not only the teacher who gives answers, rather teachers, in additions, emphasise on students doing research. What is very interesting is the fact that even students who are taught in the whole-class teaching approach, and who receive well structured notes, work to overcome their learning difficulties by doing research. I think that what makes students to do the research and try to gain deeper understanding of whatever they learn is the need to succeed in the national exam that they are waiting for. It tends to shape the use of the curriculum by teachers, as well as students' learning. Students know that it is not their teacher who will set the national examination. Therefore, they cannot be bound to their notes. By reading and searching, students understand well than when the teacher gives a response that maybe limited in scope.

As for Berthe, another student, she says that the answer from the teacher improves their knowledge better than the one that comes from a peer because the teacher knows better what he is teaching than his students. She keeps in mind that a student can explain to his/her peer better than the teacher, given that they are always together in group discussions and know the

level of understanding of each other. But she underscores the students' knowledge with these words:

For the groups that we do, we ourselves don't understand a lot, because we didn't have explanations from the teacher. It's up to us to just try to understand, and then if others don't understand, we explain [to] them. I accept the thing that learners explain to their colleagues better than the teacher, but when they don't understand themselves, they won't be able to explain well to their colleagues. (Interview: February 2, 2011)

This is not surprising because Berthe has been taught through the lecturing method for a long time. She trusted the teacher; and it will take a long time for her to also trust her colleagues and to be self-confident in the use of group discussions.

However, Berthe does not see group discussion approach in its entirety as bad; she hails the improvement in expressing themselves, the improvement of the general knowledge about biology due to the exchange of ideas, and the fact that if a colleague explains something to his/her peers, they understand better than if it was the teacher who did. Her classmate, Adeline, adds that the new method of teaching permits for a better assimilation of what has been discussed in groups than that of content transmitted through the ex-cathedra method of teaching in a whole-class teaching, which can be easily forgotten. In other words, the group work activities allow for the meaning making and retention of knowledge by students. Nevertheless, Adeline shows her preference for coverage of the entire curriculum. She claims that the group work approach is too slow if compared with a whole-class teaching. This is true according to MUSE (n.d.) where it is noted that the whole-class teaching saves both time and effort for the teacher. However, Burrowes (2003), who had successively applied Lord's (1998) constructivist model to teaching general biology, claims that the group work does not require more class time. According to Burrowes, "it just cuts from the time the teacher is speaking, and gives it to the students to question, discover, and learn on their own" (p. 499).

By the way, Adeline wonders whether the curriculum will be covered. She says this in the following words:

Iy'ubushize [the ex-cathedra method] twaravansaga [avancer] muri matiere, ubungubu dushobora kurisika [risquer] kutarangiza programme, kandi muri sixieme hari amashapitre [chapitres] bazanye, bayatwempozaho [Imposer] muri cinquieme, bayongera kuri matiere twari dufite muri cinquieme. Urumva byagiye biraba byinshi, uko bigenda biba byinshi

mukorera no mu magurupe [groupes], niko igihe kigenda gitakara mutari kwavansa [avancer] vuba. Ubwo rero dushobora kuzarisika [risquer] kurangiza cinquième programme itarangiye. (Interview: February 2, 2011)

(The previous method [the ex-cathedra method] allowed us to progress in content. This time, we could very likely not finish the biology programme while there are some chapters from S6 that are imposed on us in S5. They have been added to the previously existing matter of S5. So, the S5's programme became too vast, and as we are using the group work method, much time is lost without progressing and therefore, it is possible for us to finish the S5 with a part of the programme not yet learned).

So, due to the slowness of the group work approach of teaching that likely prevents students from meeting the outcomes required to succeed in the national examinations, and the undermined knowledge of peers, Adeline and Berthe prefer to be taught in a transmissive way rather than in the group work approach. This choice is made after balancing the advantages and disadvantages of both the transmissive and the group work teaching approaches.

Their teacher, Mr. Tshibangu, also feels strongly about the issue of slowness raised by his students. Mr. Kaggwa, who never uses this method but who does not demean it gives the reason of its slowness. He says that it is because the teacher himself is not sure of these groups; he wants everybody in the group to get to the same level of understanding, or many students are waiting for few students who are active to bring them what they have done. In fact, the group work observed in school C, as a form of cooperative learning, failed to engage each group member to participate equally and actively. There is no mechanism for teachers to ensure that the work is being equally shared within the group. However, in the real world, a given work is rarely shared equally by all members of the team (Lord, 1998). Therefore, according to Mr. Kaggwa, evaluation shows that some students still do not understand. Hence the teacher is then obliged to repeat many times for all students to understand. This is in agreement with one of Mr. Tshibangu's students (Adeline) assertion that the teacher cannot leave a given concept and go forward when some students fail to understand it.

In fact, in the group work approach, the teacher constantly appraises the learning taking place as the content and direction is being led to some degree by the students (Jones & Tanner,

n.d.). Asked if there is hope finishing the syllabus, Mr. Tshibangu answered that: “as it is said in French, ‘on n'apprend pas à un vieux singe à faire des grimaces’” (Interview: February 5, 2011). This French proverb can be translated in the following words: ‘*you don’t teach an old monkey to make funny faces*’, meaning that you cannot offer advice to someone who has more experience than yourself. Then he continues by saying that: “ça fait longtemps que nous enseignons, et nous arrivons quand même à terminer, à terminer entre guillemets, entre guillemets parce que c’est très long, en biologie c’est très long, la matière est très longue, mais quand même...” (Interview: February 5, 2011). (“*We have been teaching for a long time, and we get to finish anyway, we finish in inverted commas, in inverted commas because it’s too vast, in biology it’s too vast, the content is too vast, but anyway, ...*”)

This verb ‘to finish’ is used in an inaccurate way, to mean that they will finish but without doing it in the supposed ‘right way.’

In conclusion it is apparent that what comes out from the student’s freedom to ask questions, the teacher’s willingness to answer and attend to the student’s problems, and the fruitful discussions during/outside of the lesson, is the student’s satisfaction of the way biology is being taught to them. However, students who are taught through group work activities, even when they say that they assimilate and retain the content better tend to worry that they may not complete the curriculum. But their teacher, Mr. Tshibangu, claims that he has enough experience and will manage to finish the curriculum.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1. SUMMARY OF FINDINGS

The new biology curriculum introduced in Rwanda stipulates that teaching should be learner-centred rather than teacher-centred. I was interested in finding out whether learner-centred approaches were being used, whether teacher-students interactions were engaging learning activities, and whether students perceive their biology teacher's teaching style as effective in their learning of biology concepts. The table 6 on next page represents my analysis of the teaching styles used by the participating teachers in this research.

Looking at that table, it can be seen that Mr. Odumbe's teaching style is transmissive due to his strictly adherence to following the curriculum, his describing and demonstrating approach to teaching, his highly structured teacher-centred presentation, his expertise in the subject matter, the assessment done mainly by only the teacher on the basis of tests, quizzes, and essays, and the lack of time for reviewing information with students. However, this transmissive teaching style is mixed to a certain degree with the inciting teaching style due to the questioning approach that he sometimes uses, his expertise in questioning, and his ability in identifying personal difficulties of each student and his willingness to assist them.

On his part, Mr. Kaggwa's teaching practice is dominated by the inciting teaching style due to his inductive methods by questioning, his expertise in questioning, the more or less structured presentation, his ability in identifying personal difficulties of each student and his willingness to assist them. This inciting teaching style is mixed with a transmissive teaching style characterised by the teaching of the whole curriculum content, the explaining method sometimes used through chalk-and-talk, the assessment done mainly by the teacher on the basis of tests, quizzes, and essays, and the lack of creating enough time for sharing information with students.

Table 6: Teaching styles used by the participating biology teachers

Pseudonym of the teacher ↓ Criterion	Mr. Odumbe	Mr. Kaggwa	Mr. Tshibangu
Implementation of curriculum content	The curriculum is strictly followed. But only the more often set topics in national exams are taught in case of time constraint.	The teacher-freedom concerns the succession of topics, but the whole content is covered	The curriculum is covered as a whole, but the teacher adapts it to the student's level
Teacher attended refresher courses on:	Teaching methods	Teaching methods	Teaching methods & national examination marking
Teaching method	Mostly deductive by describing, and demonstrating through chalk and talk, but sometimes inductive by questioning.	Mostly inductive by questioning, but sometimes deductive by explaining through chalk and talk	Inductive through group work activities and sometimes by questioning
Structure of presentations	Mostly highly structured teacher-centred presentations	The lessons are more or less structured and both teacher-centred and learner-centred	Groupwork activities: lessons are much less structured
Teacher has expertise in:	Subject matter and questioning	Subject matter and questioning	Subject matter and questioning
Assessment/Evaluation	Mainly done by the teacher who attributes grades on the basis of tests, quizzes and essays	Mainly done by the teacher on the basis of students' answers in a lesson, tests, quizzes and essays	Done by the teacher, the student, and peers. Grades based on presentations, participation, tests, quizzes, and essays
Image of the teachers from students' perspective	The supportive and nurturing figure is seen in identifying personal difficulties of each student and trying to solve them	The supportive and nurturing figure is seen in identifying personal difficulties of each student and trying to solve them	Supportive and nurturing
Nature of student-teacher interaction	No time for sharing information	Insufficient time for sharing information	Working together and sharing information
Teaching styles implied by above criteria	Transmissive teaching style mixed with some inciting teaching	More inciting than transmissive teaching styles	Associative teaching styles mixed with some inciting teaching

As for Mr. Tshibangu, his teaching practice is dominated by the associative teaching style characterised by his ability to adapt the curriculum content to students' level, the inductive approach through group work activities, the much less structured class, the assessment done by teacher and students and based on presentations and participations in addition to other methods of assessment, his supportive and nurturing approach, and the sharing of information with students. This associative teaching style is mixed to a certain degree with the inciting teaching style due to the inductive methods through questioning and his expertise in questioning.

My analysis of the extent to which learner-centred approaches were being used shows that, despite the promotion of these approaches by the current curriculum, two participating teachers (Mr. Kaggwa and Mr. Odumbe) are still using the teacher-centred/traditional approaches for most of the times or sometimes. One can ask why the learner-centred pedagogy is not being used by all biology teachers while it is the approach encouraged by the new biology curriculum guidelines.

The first reason seems to be the lack of enough refresher courses or seminars for teachers on the application of the learner-centred pedagogy outlined in the new curriculum. As a new element, enough refresher courses for biology teachers and focussed on learner-centred methods should have been organised by the Ministry of Education.

The second reason, perhaps, is connected to the unavailability of teaching materials, books, Internet access, etc. as found in Mr. Kaggwa's claim stated below about his experience in Gordano School in England where he went to see, learn and bring back the learner-centred pedagogy:

The refreshers course the government has set for us are not very helpful because for example they organised and I went to England, in a school called Gordano School. The purpose was to see how they teach, and I also taught seventy students, so that they can see how we, in Africa we teach. What they wanted, they wanted me to get their methods and bring them here. But you find that we are quite in different environment, it's not applicable. They have materials, and even their way of life is quite different. We find that we can't teach as they do. (Interview: February 13, 2011)

The issue of applying the learner-centred approach in Rwanda as it is applied in England has a *raison d'être*. In fact, as claimed by Fullan & Hargreaves (1992), different approaches to teaching are appropriate in different settings, and sensitivity to the context is important to an attempt to improve teaching. The problem of resources for learner-centred teaching in Rwanda is not only seen by secondary school teachers. It is a generalised problem even at the tertiary level of education. This is found in the research done by Gahutu (2010) in the National University of Rwanda, where his results showed that students were satisfied with active learning methods but were complaining about the limited contact hours with the lecturer, the limited number of computers and Internet access, and the limited number of textbooks in the library.

The third reason could be the lack of adequate information on what needs to be done. As an example, Mr. Kaggwa gave this answer when he was asked if there is a teaching method encouraged by Rwandan education system:

They want us to use the traditional method. They expect us to teach in a traditional method, 'chalk-and-talk'. When the inspectors come to evaluate teachers, to inspect teachers, that is what they normally based their assessment on. They assess you in [on] how you are delivering the materials to students in a chalk-and-talk method. (Interview: February 13, 2011)

This declaration is totally different from the current curriculum statement. It shows that not all necessary information gets to the teachers. Therefore, I doubt if Mr. Kaggwa's assertion about the inspectors, when they evaluate the teachers, is correct unless inspectors too do not know of the new policy on teaching and learning.

The fourth reason is likely that it is practically impossible to cover the entire curriculum content. Students and the teacher in school C, who were trying the student-centred approach, claim that the approach is slowing down the completion of the content. It is like in a survey in Pennsylvania done by Lord (1998), who found many biology teachers who were willing to adopt new forms of instructions if they were sure that the new forms of instruction would lead to higher learning of their students. However, he discovered that a large group of these teachers who claimed to have used student-centred teaching for years reverted to traditional teaching because they could not cover all the content that they were accustomed to teach.

The last reason is probably linked to the rigid biology curriculum and the national examination-oriented learning that does not seem to favour the learner-centred pedagogy. With the examination-oriented learning, Kagoda (2009) states that teachers and students are pre-occupied with grades, certificates and examinations, and this behaviour impacts negatively on the main purpose of acquisition of knowledge and skills. In fact, the secondary exit examination in Rwanda is still focused on facts covered in the curriculum, even the few items that are open-ended/subjective questions in the examination are still carrying questions which depend on rote memory.

In summing up, the scarcity of resources, the lack of enough refresher courses, teacher's lack of updated information, the slowness of the group work approach to teaching, and the heavy biology curriculum does not seem to help the teaching/learning process in using learner centred approach to teaching/learning of biology in selected Rwandan schools.

About the extent to which teacher-student interactions were engaging the learning activities, this study has shown that students who learn in a whole-class instruction talk less and their teachers talk more. These students talk when they ask questions or when they respond to teachers' questions. The teacher talks when he is lecturing, demonstrating, describing, explaining, clarifying, giving instruction, summing up or when he is asking questions of students. The lecturing, demonstrating, and describing approaches do not allow for more exploration of ideas, a free decision of students on when to speak, and a free direct communication among students.

For students to speak, they must wait and be called on by the teacher who calls them mostly at the end of a topic or few minutes before the end of a lesson. Sometimes, teachers ask a rhetorical question, that is a question that the teacher directs at the students but does not really expect them to answer. Such questions are for example the following ones: Have you ever ...? Can you imagine...? Do you know that ...? Such questions require the students not to say something but rather to nod their heads, in order for the teacher to progress and control the time at the same time. Thus, the pacing is the responsibility of the teacher. Students ask questions from the teacher when he is available. They recognise that the teacher has many other classes he teaches and he cannot find time to hear and solve all the students' problems. For this reason, students have adopted the strategy of reading more and discussing with their peers outside the lesson. This is what I call learning through social interaction,

where students make meaning of knowledge in a social environment composed of peers to facilitate individual internalisation of knowledge.

With the students who learned through group work activities, they talk more in their group discussions than their teacher. They have enough opportunities to explore ideas and generate knowledge, and they speak to each other without asking permission from the teacher. Thus, they learn in a social environment during classroom activities. They try to help each other to make meaning of what they are learning. They learn to organise their ideas for the presentation; and they develop their communication skills during both group discussions and group presentations.

As the results about the effectiveness of biology teachers' teaching styles as perceived by students show, students are glad of their teachers' way of responding to questions asked. They also recognise the role of doing research as emphasised by their teachers. They seem to discover much by doing research thereby complementing the knowledge gained from the teacher. Therefore, doing research by reading books, visiting websites related to the topics taught in classroom, and discussing with peers allow the students to understand better than if the teacher was considered as a unique source of information. However, I noticed that those students who are taught using the group work discussions approach still consider the teacher as the expert (knower). Therefore, they minimise the importance of exchange of ideas between students. This minimisation is due to the fact that they think that knowledge only come from outside (from the teacher) and ignore their personal embodiment of knowledge. Students do not often realise that knowledge potentially resides within one's body, as posited by Lord (1998). I cannot finish without noting that students also see the new approach of teaching, that is group work, as slowing down the content completion progress; and they share this view with their teachers.

6.2. GENERAL CONCLUSION

Regardless of the teaching approach advocated by the current (new) curriculum in Rwanda that is learner-centred, this research shows that some biology teachers are still using the transmissive teaching style even though they do not fulfil some criteria for such a teaching style.

The learner-centred pedagogy is new in high schools in Rwanda. Some of its advantages include promoting student's critical thinking, allowing more understanding and enduring knowledge, and the application of knowledge acquired in everyday life. However, the group work teaching approach in Rwanda, as a way of implementing the learner-centred pedagogy, seems to be facing difficulties mainly due to the structure of the national examination, the lack of enough teaching resources, the lack of appropriate refresher courses for teachers, the teacher's lack of updated information, the slowness of group work approach of teaching, and the heavily-loaded biology curriculum. Therefore, students do not seem to enjoy being taught in a learner-centred pedagogy very much. Rather they seem to prefer the transmissive approach instead. This confirms Taylor's (2008) assertion that in poor schools, effective teaching is the visible pedagogy, where it is up to the teacher to explicitly regulate the organisation, timing and pacing of learning. He bases this statement on Christie et al's (2007) research that found that the poor but successful schools experience "the 'conventional' teaching with much 'chalk and talk' evident in the classroom" (Taylor, 2008, p. 13).

6.3. LIMITATIONS TO THE STUDY

As this research is qualitative, I could not generalise the results and apply them to all the schools in Rwanda. Given that teachers knew which lessons would be observed, they may have changed their teaching practice while being observed. Therefore, for each teacher, I may possibly have observed the best lessons. If there were no time constraints, more visits would have provided opportunities to observe teachers when perhaps they are not at their best. In Rwanda, there are male and female teachers. For example in 2010, 26.8% of teachers were female while 73.2% were males (MINEDUC, 2010). Female teachers are not represented in this study.

6.4. RECOMMENDATIONS

- The Ministry of Education should prepare refresher training courses for teachers prior to the implementation of any reform in teaching and learning. It should also ensure that all the required material is in place.

- The Rwanda National Examination Council should reduce items that demand recall of facts in the national examination and increase items that demand interpretation and application of biology knowledge, i.e. critical thinking.
- Teachers should adapt the curriculum in ways which enable them and their students to achieve new ways of working in their classrooms. They should also provide ways of generating discussions to help students actively participate by having something to say in a group discussion.
- For students, when they meet for group discussions, teachers should organise the groups in a manner that each group member has a role to play; like being the reader, the recorder, the material manager, or the group coordinator. The coordinator might alternatively call on all members to participate in a cooperative way. In order for all students to develop to their maximum potential, students in group discussions might also change their role whenever they change the topic.

6.5. ORIENTATION TO FURTHER RESEARCH

Given the similarities of the perceptions of students on the effectiveness of their biology teachers' teaching styles, it may be worthwhile to study these perceptions further. One other avenue for research is in the area of students' performance in high schools in the Rwandan context, or in the area of duration of retention of information/knowledge. For example, a comparative study can be conducted to compare the students' performance in different subjects whose teachers adopt different teaching styles. Such a venture could be rewarding and contribute to the body of knowledge about Rwandan education system.

REFERENCES

- Anderson, L. W. (2002). Curricular alignment: a re-examination. *Theory into Practice*, 41, 255-260.
- Angelo, T. A. & Cross, K. P. (n.d.). *Classroom assessment techniques, a handbook for college teachers* (2nd ed.). Retrieved from <http://honolulu.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/assess-1.htm>
- Apostolopoulou, I. & Vega, R. P. (2009). *Mechanisms for effective knowledge integration in consulting firms*. Published Master's Thesis, Umeå University. Retrieved April 20, 2010, from umu.diva-portal.org/smash/get/diva2:292810/FULLTEXT01
- Au, W. W. (2008). Devising inequality: a Bernsteinian analysis of high-stakes testing and social reproduction in education, *British Journal of Sociology of Education*, 29, 639-651.
- Bamusananire, E. (n.d.). *The use of national assessment to enhance the quality of education*. Retrieved April 21, 2011, from www.curriculum.wcape.school.za/resource_files/22153835_19.doc
- Bridgeland, J., Wulsin, S., & McNaught, M. (2009). *Rebuilding Rwanda: from genocide to prosperity through education*. New York: Civic Enterprises LLC with Hudson Institute.
- Brodie, K. & Pournara, C. (2005). Towards a framework for developing and researching groupwork in South African mathematics classrooms. In R. Vithal, J. Adler & C. Ketel (Eds.). *Mathematics Education Research in South Africa: Possibilities and Challenges*. (pp. 28-72). Pretoria: Human Sciences Research Council.

- Bryne, M. (2001). Data analysis strategies for qualitative research-research corner. *AORN Journal*. Retrieved from http://findarticles.com/p/articles/mi_m0FSL/is_6_74/ai_81218986
- Burrowes, P. A. (2003). A student-centered approach to teaching general biology that really works: Lord's constructivist model put to a test. *The American Biology Teacher*, 65, 491-494; 496-502.
- Creswell, J. W. (2003). *Research design: qualitative, quantitative, and mixed method approaches (2nd ed.)*. California: Sage Publications, Inc.
- Dallas, D. (1984). *Teaching biology today*. London: Hutchinson & Co. (Publishers) Ltd.
- Damodharan, V. S. & Rengarajan, V. (2007). Innovative methods of teaching. *Learning Technologies and Mathematics Middle East Conference*. Sultan Qaboos University Oman.
- Davis, B. (2004). *Inventions of teaching: a genealogy*. London: Lawrence Erlbaum Associates.
- Duminy, P.A. (1977). *General teaching method (3rd ed.)*. Cape Town: Longman Penguin Southern Africa (PTY) LTD.
- Felder, R. M. (1993). Reaching the second tier: learning and teaching styles in college science education. *Journal of College Science Teaching*, 23, 286-290.
- Francis, J. W. (2000). Use of Internet resources in the Biology lecture classroom. *The American Biology Teacher*, 62, 90-93.
- Fullan, M. & Hargreaves, A. (1992). *What's worth fighting for in your school? Working together for improvement*. Buckingham: Open University Press.
- Gahutu, J. B. (2010). Physiology teaching and learning experience in a new modular curriculum at the National University of Rwanda. *Advances in Physiology Education*, 34, 11-14.

- Garlikov, R. (n.d.). *The Socratic Method: Teaching by asking instead of by telling*. Retrieved April 21, 2011, from http://www.garlikov.com/Soc_Meth.html
- Gioka, O. (2007). Assessment for learning in biology lessons. *Journal of Biological Education*, 41, 113-116.
- Gipps, C. (1999). Socio-cultural aspects of assessment. *Review of Research in Education*, 24, 355-392.
- Grasha, A. F. (1994). A matter of style: the teacher as expert, formal authority, personal model, facilitator, and delegator. *College Teaching*, 42, 142-149.
- Hatch, J.A. (2002). *Doing qualitative research in educational settings*. Albany: New York Press. (pp. 147-210).
- Havice, W. (1999). *College students' attitudes toward oral lectures and integrated media presentations*. Retrieved from <http://scholar.lib.vt.edu/ejournals/JOTS/Winter-Spring-1999/PDF/havice.Pdf>.
- Jones, S. & Tanner H. (n.d.). *Teachers' interpretations of effective whole class interactive teaching*. Retrieved April 21, 2011 from <http://math.unipa.it/~grim>
- Kagoda, A. M. (2009). Teaching and learning Geography through small group discussions. *Current Research Journal of Social Sciences*, 1, 27-32.
- Kritis University (2004). *The role of questioning in a learning process: a typology of inquiry methods and results*. Kritis, Inc. Retrieved from <http://www.interoctave.com/publishing/newlibrary/articles/RoleofQuestioning.pdf>
- Kyriacou, C. (1998). *Essential teaching skills* (2nd ed.). Cheltenham: Nelson Thornes.
- Latvala, E., Vuokila-Oikkonen, P. & Janhonen, S. (2000). Videotaped recording as a method of participant observation in psychiatric nursing research. *Journal of Advanced Nursing*, 31, 1252-1257.

- Lawson, A. E. & Renner, J. W. (1975). Piagetian theory and biology teaching. *The American Biology Teacher*, 37, 336-343.
- Leach, J. & Scott, P. (2002). Designing and evaluating science teaching sequences: an approach drawing upon the concept of learning demand and a social constructivist perspective on learning. *Studies in Science Education*, 38, 115-142.
- Leonard, W. H., Speziale, B. J. & Penick, J. (2001). Performance assessment of a standards-based high school biology curriculum. *The American Biology Teacher*, 63, 310-316.
- Liu, S. (2006). *Study of the impacts of the quality assessment of undergraduate education policy in China: students' perceptions*. London: University of London.
- Lord, T. (1998). Cooperative learning that really works in biology teaching. Using constructivist-based activities to challenge student teams. *The American Biology Teacher*, 60, 580-588.
- Mayer, R.E. (2003). *Learning and instruction*. New Jersey: Pearson Education, Inc.
- McMillan, J. H. & Schumacher, S. (2006). *Research in education: evidence-based inquiry (6th ed.)*. New York: Pearson Education, Inc.
- Mehan, H. (1979). *Learning lessons*. Cambridge, Mass: Harvard University Press.
- Meisel, S. (1998). Videotypes: considerations for effective use of video in teaching and training. *Journal of Management Development*, 17, 251-258.
- Miller, B.M (2006). *The impact of individual teaching styles on student academic achievement*. Published Master of Education Thesis, Graduate School of Marietta College, Ohio. Retrieved April 20, 2010, from <http://etd.ohiolink.edu/send-pdf.cgi/Miller%20Brandi%20M.pdf?marietta1154992170>
- MINECOFIN (2007). *Economic development and poverty reduction*. Kigali: Ministry of Finance and Economic Planning.
- MINEDUC (2003). *Education Sector Policy*. Kigali: Ministry of Education.

- MINEDUC (2006). *Education Sector Strategic Plan 2006-2010*. Kigali: Ministry of Education.
- MINEDUC (2010). *2010 Education statistics*, Kigali: Ministry of Education.
- Mortimer, E. F. & Scott, P. H. (2003). *Meaning making in secondary science classrooms*. Maidenhead: Open University Press.
- MUSE (n.d.). *Whole class teaching training module*. Retrieved April 21, 2011, from <http://www.ellinogermaniki.gr/ep/muse>
- NCDC (1999). *Biology curriculum for advanced level: section Biology-Chemistry*. Kigali: Ministry of Education
- NCDC (2010a). *Advanced level biology curriculum: principal subject (Form 4, 5 & 6)*. Kigali : Ministry of Education. Retrieved August 09, 2011, from <http://www.ncdc.gov.rw/BIOLOGY%20NEW%20CURRICULUM.pdf>
- NCDC (2010b). *Instruction related to the use of revised biology curriculum for advanced level*. Kigali: Ministry of Education. Retrieved August 09, 2011, from <http://www.ncdc.gov.rw/INSTRUCTIONS%20FOR%20BIOLOGY.pdf>
- Novak, J. D. (1981). Applying learning psychology and philosophy of science to biology teaching. *The American Biology Teacher*, 43, 12-20+42.
- Nzabalarwa, W. (2004). *General teaching methods: education module 7*. Kigali: KIE
- Opie, C. (2009). *Doing educational research*. London: Sage.
- Otulaja, F. S. (2010). *Using cogenerative dialogue to afford the teaching and learning of biology in an urban high school*. Published doctoral dissertation. New York City: The City University of New York. Retrieved May 09, 2011, from <http://gradworks.umi.com/33/96/3396455.html>
- Özay, E., Ocak, İ. & Ocak, G. (2009). Sequential teaching methods in biology and their effects in academic achievement. *Kuramsal Eğitimbilim*, 2, 32-43.

- Pedrosa de Jesus, H. & Moreira, A. C. (2009). The role of students' questions in aligning teaching, learning and assessment: a case study from undergraduate science. *Assessment & Evaluation in Higher Education*, 34, 193-208.
- Perie, M., Marion, S., & Gong, B. (2009). Moving toward a comprehensive assessment system: a framework for considering interim assessments. *Educational Measurement: Issues and Practice*, 28, 5-13.
- Phelan, T.W. (2005). Teaching style and classroom management. *Parent Magic Newsletter*, Special teachers' edition. Retrieved from <http://www.bridges4kids.org/articles/2005/8-05/Phelan7-05.html>
- Piaget, J. (1964, 2003). Development and learning. *Journal of Research in Science Teaching*, 40, Supplement, S8-S18.
- Pope, C. & Mays, N. (1995). Reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health services research. *British Medical Journal*, 311, 42- 45.
- Ross, J. A. (2006). The reliability, validity, and utility of self-assessment. *Practical Assessment Research & Evaluation*, 11(10). Retrieved from <http://pareonline.net/pdf/v11n10.pdf>
- Sola, A. O. & Ojo, O. E. (2007). Effects of project, inquiry and lecture-demonstration teaching methods on senior secondary students' achievement in separation of mixtures practical test. *Educational Research and Review*, 2, 124-132.
- Taylor, N. (2008). What's wrong with South African Schools? Presentation to the conference. *What's Working in School Development*. JET Education Service 28-29 February 2008.
- Taylor-Powell, E. & Renner, M. (2003). Analyzing qualitative data. *Program Development and evaluation*. Retrieved from <http://learningstore.uwex.edu/assets/pdfs/G365812.pdf>

- Therer, J. (1998). Styles d'enseignement, styles d'apprentissage et pédagogie différenciée en sciences. *Informations Pédagogiques*, 40, 2-23. Retrieved August 08, 2011, from <http://www.restode.cfwb.be/download/infoped/info40a.pdf>
- Thien, R. & Begawan, B. S. (April 25, 2009). Chalk and talk teaching method not enough. *The Brunei Time*. Retrieved August 11, 2011, from http://www.bt.com.bn/home_news/2009/04/25/chalk_and_talk_teaching_method_not_enough
- Thornton, K. (2003). Teacher refresher courses and effective professional development for teachers. *New Zealand Annual Review of Education* 12, 75-94.
- Toth, M. A. (1980). Figures of thought: the use of diagrams in teaching sociology. *Teaching Sociology*, 7, 409-424.
- UC Santa Cruz (2009). *Getting More out of classroom discussion*. California: The Regents of the University of California. Retrieved April 28, 2011, from <http://ctl.ucsc.edu/resources/tips/tips-discussion.html>
- Univ. Liège (1982). *Définir son style d'enseignement en se situant dans la grille de Therer-Willemart*. Retrieved August 08, 2011 from <http://francois.muller.free.fr/diversifier/apprenti1.htm>
- Visser, S. Vreken, N. & McChlery, S. (2006). Teaching styles versus learning styles in the accounting sciences in the United Kingdom and South Africa: a comparative analysis. *Meditari Accountancy Research*, 14, 97-112.
- Von Glasersfeld, E. (1991). A constructivist's view of learning and teaching. In R. Duit, F. Goldberg & H. Niedderer (Eds.), *Research in physics learning: theoretical issues and empirical studies* (pp. 29-39). Proceedings of an international workshop. Kiel, IPN.
- Wolf, D., Bixby, J., Gleen III, J. & Gardner, H. (1991). To use their minds well: investigating new forms of student assessment. *Review of Research in Education*, 17, 31-74.

APPENDIX #1: Interview schedule for teachers

I. Teaching style used in biology teaching

1. What is the most common way in which you teach biology? Why did you choose it?
2. How do you teach general principles in biology?
3. During a biology lesson, in different aspects of your teaching (like subject matter, questioning, human relations), where do you think you are more efficient?
4. What strategies do you use to involve students in the assessment process in the biology class?
5. What elements do you consider when you assess students' learning
6. Do you attend refresher courses or seminars? What does it cover or what do you want it to cover?
7. Do you think that it is necessary to follow strictly the curriculum as it has been designed? How do you use the curriculum given to you?
8. How do you help your students to overcome difficulties in understanding biology concepts?

II. The influence of teaching styles on teacher-student interaction

9. What interactions take place between yourself and your students, and amongst your students during your teaching of biology?
10. To what degree do your students ask questions seeking explanation during the lesson?
11. What importance do you attach to classroom discussions? How do you organize these discussions?

APPENDIX #2: Interview schedule for learners

1. Describe the way in which biology is being taught to you
2. What do you do during your biology lesson?
3. Are you able and/or allowed to assess your own work or that of your peers? What are the elements to consider in that evaluation?
4. During biology lessons, do you interact with your teacher e.g. talk with your teacher, ask your teacher questions? If yes, describe the types of interactions you have with your teacher.
5. To what extent do these questions and discussions help you to better understand the biology lesson?
6. To what extent do you ask your teacher questions when something is unclear to you in the biology lesson?
7. Do you have occasions to share your ideas with your teacher and peers about the topic being taught in the classroom? If yes, how?
8. How do you proceed to overcome eventual learning difficulties encountered in biology lessons?
9. To what extent do you think the way in which biology is being taught to you is effective?

APPENDIX #3: Classroom observation guide

1. How does the teacher and students interact in the learning process (to what extent do learners participate in building the new knowledge)? When/where do teachers/learners participate the most?
2. Are the teaching/learning materials adequately **made/chosen** (characteristics of the teaching/learning materials) and **used** (the ways the teacher use the teaching/learning materials)?
3. To which level of thinking (level of taxonomy) does the teacher **bring** the learners?
4. Does the teacher help learners to establish the relationship between different areas?
5. Has the teacher the ability to help learners to build new knowledge on the basis of prior knowledge?
6. To what extent is the assessment integrated in the learning process? Is the assessment contributing to the learning process?

APPENDIX #4: Chapters related to lessons observed

Chapters of the programme (NCDC, 2010a) related to lessons observed in different participating schools.

Level observed	Original design of the new biology curriculum		
	Level in the curriculum	Contents: Topic/ sub-topics	Methodology notes
S5 MCB	S5	Chapter I. CHEMICALS OF LIFE (NCDC, 2010a, p. 27) 1.6. Water 1.6.1. Physical and chemicals properties of water: -Hydrogen bond -High boiling point - Density 1.1.2. Physiological functions: - Thermal regulator - Reactant - Medium of life 1.7. Mineral salts 1.7.1. Sources of mineral salts 1.7.2. Essential minerals (Na^+ , Ca^{2+} , Mg^{2+} , Cu^{2+} , $\text{Fe}^{2+}/\text{Fe}^{3+}$, I^- , Cl^- , BO_3^{3-} , $\text{NO}_3^-/\text{NO}_2^-$, SO_4^{2-} , HCO_3^- ...)	-Students discuss about the physical and chemical properties of water in the three states of matter -Experiments on the physical properties of water - Teacher-students discussions about physiological functions of water -Students discuss different types of mineral salts
		1.7.3. Roles of mineral salts 1.7.4. Effects of mineral salts deficiency	-Students observe and compare healthy plants and plants with common deficiency symptoms. -Use charts, photographs and videos. -Visit nursery beds.

S6 PCB	S5	Chapter V. PLANT PHYSIOLOGY (NCDC, 2010 a, p. 35-36) 5.1. Transport in plants Water transport - Absorption of water - Transpiration Mineral salts transport Organic matter transport (translocation) Factors affecting transpiration Plants adaptation to avoid water loss Importance of transpiration 5.2. Photosynthesis (Autotrophic nutrition) - Importance - Structure of leaf - Chloroplast and photosystems - Photosynthetic pigments - Biochemistry of photosynthesis (photochemical reactions, cyclic reactions) - C₃ and C₄ plants - Factors affecting photosynthesis - Photorespiration - Chemosynthesis	- Use charts and diagrams - Use of a potted plant [w]rapped with polythene bag to demonstrate transpiration - Use potometer to show water up take by plants - Discuss ringing experiments to illustrate translocation (where it is possible, carry out these experiments) - Use model to show mass flow hypothesis Simple experiments should be carried out to show the effects of light intensity, concentration of CO₂ and the temperature Simple means of measuring rate of photosynthesis. E.g. oxygen production in water plants and starch production in terrestrial plants.
--------	----	--	---

S6 MCB	S6	Chapter 1. ANIMAL PHYSIOLOGY (NCDC, 2010 a, p. 44-45) ... 1.4. Transport in animals 1.4.1. Need for transport system 1.4.2. Blood component Blood functions (e.g. oxygen dissociation curve, immune system, transport) 1.4.3. Blood circulation in mammals Definition of blood circulation Structure of the human heart Heart beat Types of blood circulation Difference between systemic and pulmonary circulation 1.4.4. Some disorders of blood circulatory system	Use chart, dissect mammals and fish
--------	----	--	--

Source: NCDC (2010a).



APPENDIX #5: Request for permission to conduct the research in districts of choice



**Marang Centre for Maths & Science Education
School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg**

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

THE MAYOR

District name:

Email:

Dear Sir/Madam,

Request for permission to conduct research

I am a Masters of Education student in the School of Education at the University of the Witwatersrand doing research as part of my degree requirements. The title of my research is **“The Impact of Teaching Styles on Student Learning of Biology in High Schools in Rwanda: A case study of three schools in Kigali City.”** My research aim is to investigate the teaching styles used by biology teachers in biology courses in state and subsidised high schools of Kigali City. I also intend to investigate how these teaching styles impact students’ learning of Biology.

I am kindly requesting your permission to conduct this research project at the following schools, namely, where I will observe biology classes and then conduct interviews with Biology teachers and their students.

This exercise is intended to take place in January and February, 2011. The observations will focus on the teaching styles and the classroom interactions between biology teachers and their students. As a follow up, I will then conduct interviews to seek further understandings from teachers and their students.

Any and all information collected will be kept private and confidential and no mention of the names of schools and/or the participants involved will be revealed in the report. Instead of proper names, pseudonyms will be used to insure anonymity of all participants. The data collected are not meant for public consumption and would be locked up in a metal cabinet and will be accessed and analyzed by me (the researcher), only. Data collected will be destroyed two years after completion of the research.

Thank you for your cooperation.

Yours Faithfully,
Concilie MUKAMWAMBALI



APPENDIX #6: Request for permission to conduct the research in schools of choice



Marang Centre for Maths & Science Education

School of Education

University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

THE SCHOOL PRINCIPAL

School Name:

PO. Box:

Dear Father/Sister Sir/Madam,

Request for permission to conduct research

I am a Masters of Education student in the School of Education at the University of the Witwatersrand. I am doing research as part of my degree requirements. The title of my research is **“The impact of teaching styles on student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City.”** My research aim is to investigate the teaching styles used by biology teachers in biology courses in state and subsidised high schools of Kigali City. I also intend to investigate how these teaching styles impact students’ learning of Biology.

I am kindly requesting your permission to conduct this research project at your school where I will observe biology classes and then conduct interviews with the Biology teachers and their students.

This exercise is intended to take place in January and February, 2011. The observations will focus on the teaching styles and the classroom interactions between biology teachers and their students. As a follow up, I will then conduct interviews to seek further understandings from teachers and their students.

Any and all information collected will be kept private and confidential and no mention of the names of schools and/or the participants involved will be revealed in the report. Instead of proper names, pseudonyms will be used to insure anonymity of all participants. The data collected are not meant for public consumption and would be locked up in a metal cabinet and will be accessed and analyzed by me (the researcher), only. Data collected will be destroyed two years after completion of the research.

Thank you for your cooperation.

Yours Faithfully,
Concilie MUKAMWAMBALI



APPENDIX #7: Participant's information sheet



Marang Centre for Maths & Science Education

**School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg**

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

Dear Teacher/Student,

PARTICIPANT'S INFORMATION SHEET

Title: The impact of teaching styles on student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City

I am a Masters of Education student in the School of Education at the University of the Witwatersrand. I am doing research as part of my degree requirements. The title of my research is as stated above. My research aim is to investigate the teaching styles used by biology teachers in biology courses in state and subsidised high schools of Kigali City. I also intend to investigate how these teaching styles impact students' learning of Biology.

I wish to observe your biology class and then conduct interviews with you (teachers and students). This exercise is intended to take place in January and February, 2011. The observations will focus on the teaching styles and the classroom interactions between biology teachers and their students. As a follow up, I will then conduct interviews to seek further understandings from teachers and their students. The interviews focus mainly on teaching style adopted by teachers and how it affects classroom interactions and student learning of Biology. I will be video-recording during interviews and during observations. Any and all information collected will be kept private and confidential, and no mention of the names of schools and/or the participants involved will be revealed in the report. Instead of proper names, pseudonyms will be used to insure anonymity of all participants. The data collected are not meant for public consumption and would be locked up in a metal cabinet and will be accessed and analysed by me (the researcher), only. Data collected will be destroyed two years after completion of the research.

Participation in this study is voluntary and participants may, at any time, without prejudice, withdraw their consent and participation from the study. Participants will have a sufficient opportunity to ask questions/explanations during the interview with the researcher.

For further information, you can either email me to mukamwambalic@yahoo.fr or call +250788430354 (in Rwanda) or +27789083090 (in South Africa). You may also contact HREC at x 73055 or Matsie Mabeta at 27117173055 or email Matsie.Mabeta@wits.ac.za

Thank you for your cooperation.

Yours Faithfully,

A handwritten signature in black ink, appearing to read 'Concilie MUKAMWAMBALI', with a long horizontal flourish extending to the right.

Concilie MUKAMWAMBALI



**APPENDIX #8: Participant's audio-recording
assent form**
(Students under 18 years)



Marang Centre for Maths & Science Education
School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

PARTICIPANT'S AUDIO-RECORDING ASSENT FORM

I, _____, hereby confirm that I have been informed by the researcher, Mr.s
Concilie MUKAMWAMBALI, about the nature of her study on **"The impact of teaching styles on
student learning of biology in high schools in Rwanda: a case study of three schools in Kigali."**

The research aims to investigate the teaching styles used by biology teachers in biology courses in state
and subsidised high schools of Kigali City. It also intends to investigate how these teaching styles impact
students' learning of Biology.

I may, at any time, without prejudice, withdraw my consent and participation from this study. I have had
sufficient opportunities to ask questions/explanations about the study and declare that I accept voluntarily
the use of audio recorder in my interview.

I have received, read and understood the information provided by the researcher regarding this study. I am
aware that all the information I give will be treated confidentially and processed anonymously in this study
and its final report. I also understand that the data collected for this study will be destroyed by the
researcher two years after completion of the research. I hereby give assent with the understanding that
strict confidentiality will be observed and assured.

- Using an audio recorder during interview

Yes ☐ No ☐
Tick the appropriate box

Signature (initials)

Date

Signature (Initials)

Date

Concilie Mukamwambali (Researcher)



**APPENDIX #9: Participant's audio-recording
consent form
(Teachers & 18 years and above students)**



Marang Centre for Maths & Science Education

**School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg**

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

PARTICIPANT'S AUDIO-RECORDING CONSENT FORM (18 years & above)

I, _____, hereby confirm that I have been informed by the researcher, Mr.s Concilie MUKAMWAMBALI, about the nature of her study on **“The impact of teaching styles on student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City.”**

The research aims to investigate the teaching styles used by biology teachers in biology courses in state and subsidised high schools of Kigali City. It also intends to investigate how these teaching styles impact students' learning of Biology.

I may, at any time, without prejudice, withdraw my consent and participation from this study. I have had sufficient opportunities to ask questions/explanations about the study and declare that I accept voluntarily the audio-recording of my interview.

I have received, read and understood the information provided by the researcher regarding this study. I am aware that all the information I give will be treated confidentially and processed anonymously in this study and its final report. I also understand that the data collected for this study will be destroyed by the researcher two years after completion of the research. I hereby give consent with the understanding that strict confidentiality will be observed and assured.

- Audio-recording the interview

Yes ☐ No ☐

Tick the appropriate box

Signature (initials) Date

Signature (Initials) Date

Concilie Mukamwambali (Researcher)



APPENDIX #10: Parent's audio-recording consent form



Marang Centre for Maths & Science Education
School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

PARENT'S AUDIO-RECORDING CONSENT FORM

I, _____, hereby confirm that I have been informed by the researcher, Mr.s Concilie MUKAMWAMBALI, about the nature of her study on **“The impact of teaching styles on student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City.”**

The research aims to investigate the teaching styles used by biology teachers in biology courses in state and subsidised high schools of Kigali City. It also intends to investigate how these teaching styles impact students' learning of Biology.

My child may, at any time, without prejudice, withdraw his/her assent and participation from this study. I have had sufficient opportunities to ask questions/explanations about the study and declare that I accept voluntarily the audio-recording of my child's interview.

I have received, read and understood the information provided by the researcher regarding this study. I am aware that all the information that my child will give will be treated confidentially and processed anonymously in this study and its final report. I also understand that the data collected for this study will be destroyed by the researcher two years after completion of the research. I hereby give consent with the understanding that strict confidentiality will be observed and assured.

- Using an audio recorder during interview

Yes ☐ No ☐

Tick the appropriate box

Signature (initials)

Date

Signature (Initials)

Date

Concilie Mukamwambali (Researcher)



APPENDIX #11: Participant's interview & observation assent form
(Students under 18 years)



Marang Centre for Maths & Science Education
School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

PARTICIPANT'S INTERVIEW & OBSERVATION ASSENT FORM

I, _____, hereby confirm that I have been informed by the researcher, Mr.s Concilie MUKAMWAMBALI, about the nature of her study on **“The impact of teaching styles on student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City.”**

The research aims to investigate the teaching styles used by biology teachers in biology courses in state and subsidised high schools of Kigali City. It also intends to investigate how these teaching styles impact students' learning of Biology.

I may, at any time, without prejudice, withdraw my consent and participation from this study. I have had sufficient opportunities to ask questions/explanations about the study and declare that I am participating voluntarily in this study.

I have received, read and understood the information provided by the researcher regarding this study. I am aware that all the information I give will be treated confidentially and processed anonymously in this study and its final report. I also understand that the data collected for this study will be destroyed by the researcher two years after completion of the research. I hereby give assent with the understanding that strict confidentiality will be observed and assured.

• Being interviewed	Accepting classroom observations
Yes ☐ No ☐	Yes ☐ No ☐

Tick the appropriate box

_____ Signature (initials)	_____ Date
-------------------------------	---------------

_____ Signature (Initials)	_____ Date
-------------------------------	---------------

Concilie Mukamwambali (Researcher)



APPENDIX #12: Participant's interview & observation consent form
(Teachers & 18 years and above students)



Marang Centre for Maths & Science Education
School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

PARTICIPANT'S INTERVIEW & OBSERVATION CONSENT FORM (18 years & above)

I, _____, hereby confirm that I have been informed by the researcher, Mr.s Concilie MUKAMWAMBALI, about the nature of her study on **“The impact of teaching styles on student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City.”**

The research aims to investigate the teaching styles used by biology teachers in biology courses in state and subsidised high schools of Kigali City. It also intends to investigate how these teaching styles impact students' learning of Biology.

I may, at any time, without prejudice, withdraw my consent and participation from this study. I have had sufficient opportunities to ask questions/explanations about the study and declare that I am participating voluntarily in this study.

I have received, read and understood the information provided by the researcher regarding this study. I am aware that all the information I give will be treated confidentially and processed anonymously in this study and its final report. I also understand that the data collected for this study will be destroyed by the researcher two years after completion of the research. I hereby give consent with the understanding that strict confidentiality will be observed and assured.

- | | |
|--|--|
| • Being interviewed | Accepting classroom observations |
| Yes ☐ No ☐ | Yes ☐ No ☐ |

Tick the appropriate box

Signature (initials)

Date

Signature (Initials)

Date

Concilie Mukamwambali (Researcher)



APPENDIX #13: Parent's interview & observation consent form



Marang Centre for Maths & Science Education

School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

PARENT'S INTERVIEW & OBSERVATION CONSENT FORM

I, _____, hereby confirm that I have been informed by the researcher, Mr.s Concilie MUKAMWAMBALI, about the nature of her study on **“The impact of teaching styles on student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City.”**

The research aims to investigate the teaching styles used by biology teachers in biology courses in state and subsidised high schools of Kigali City. It also intends to investigate how these teaching styles impact students' learning of Biology.

My child may, at any time, without prejudice, withdraw his/her assent and participation from this study. I have had sufficient opportunities to ask questions/explanations about the study and declare that my child will participate voluntarily in this study.

I have received, read and understood the information provided by the researcher regarding this study. I am aware that all the information that my child will give will be treated confidentially and processed anonymously in this study and its final report. I also understand that the data collected for this study will be destroyed by the researcher two years after completion of the research. I hereby give consent with the understanding that strict confidentiality will be observed and assured.

- Being interviewed

Yes ☐ No ☐
Tick the appropriate box

Signature (initials)

Signature (Initials)

- Accepting classroom observations

Yes ☐ No ☐

Date

Date

Concilie Mukamwambali (Researcher)



**APPENDIX #14: Participant's video-recording
assent form**
(Students under 18 years)



Marang Centre for Maths & Science Education

**School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg**

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

PARTICIPANT'S VIDEO-RECORDING ASSENT FORM

I, _____, hereby confirm that I have been informed by the researcher, Mr.s
Concilie MUKAMWAMBALI, about the nature of her study on **“The impact of teaching styles on
student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City.”**

The research aims to investigate the teaching styles used by biology teachers in biology courses in state
and subsidised high schools of Kigali City. It also intends to investigate how these teaching styles impact
students' learning of Biology.

I may, at any time, without prejudice, withdraw my consent and participation from this study. I have had
sufficient opportunities to ask questions/explanations about the study and declare that I accept voluntarily
the use of video recorder during classroom observations.

I have received, read and understood the information provided by the researcher regarding this study. I am
aware that all the information I give will be treated confidentially and processed anonymously in this study
and its final report. I also understand that the data collected for this study will be destroyed by the
researcher two years after completion of the research. I hereby give assent with the understanding that
strict confidentiality will be observed and assured.

- Using a video recorder during classroom observations

Yes ☐ No ☐
Tick the appropriate box

Signature (initials)

Date

Signature (Initials)
Concilie Mukamwambali (Researcher)

Date



**APPENDIX #15: Participant's video-recording
consent form
(Teachers & 18 years and above students)**



**Marang Centre for Maths & Science Education
School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg**

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

PARTICIPANT'S VIDEO-RECORDING CONSENT FORM (18 years & above)

I, _____, hereby confirm that I have been informed by the researcher, Mr.s
Concilie MUKAMWAMBALI, about the nature of her study on **“The impact of teaching styles on
student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City.”**

The research aims to investigate the teaching styles used by biology teachers in biology courses in state
and subsidised high schools of Kigali City. It also intends to investigate how these teaching styles impact
students' learning of Biology.

I may, at any time, without prejudice, withdraw my consent and participation from this study. I have had
sufficient opportunities to ask questions/explanations about the study and declare that I accept voluntarily
the use of video recorder during classroom observations.

I have received, read and understood the information provided by the researcher regarding this study. I am
aware that all the information I give will be treated confidentially and processed anonymously in this study
and its final report. I also understand that the data collected for this study will be destroyed by the
researcher two years after completion of the research. I hereby give consent with the understanding that
strict confidentiality will be observed and assured.

- Using a video recorder during classroom observations

Yes ☐ No ☐
Tick the appropriate box

Signature (initials) Date

Signature (Initials) Date

Concilie Mukamwambali (Researcher)



APPENDIX #16: Parent's video-recording consent form



Marang Centre for Maths & Science Education
School of Education
University of the Witwatersrand
Private Bag 3, WITS 2050, Johannesburg

Concilie MUKAMWAMBALI
Cell: +250788430354 (Rwanda)
Cell: +27789083090 (South Africa)
Email: mukamwambalic@yahoo.fr

November 18, 2010

PARENT'S VIDEO-RECORDING CONSENT FORM

I, _____, hereby confirm that I have been informed by the researcher, Mr.s Concilie MUKAMWAMBALI, about the nature of her study on **“The impact of teaching styles on student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City.”**

The research aims to investigate the teaching styles used by biology teachers in biology courses in state and subsidised high schools of Kigali City. It also intends to investigate how these teaching styles impact students' learning of Biology.

My child may, at any time, without prejudice, withdraw his/her assent and participation from this study. I have had sufficient opportunities to ask questions/explanations about the study and declare that I accept voluntarily the use of video recorder in my child's classroom observations.

I have received, read and understood the information provided by the researcher regarding this study. I am aware that all the information that my child will give will be treated confidentially and processed anonymously in this study and its final report. I also understand that the data collected for this study will be destroyed by the researcher two years after completion of the research. I hereby give consent with the understanding that strict confidentiality will be observed and assured.

- Using a video recorder during classroom observations

Yes ☐ No ☐

Tick the appropriate box

Signature (initials) Date

Signature (Initials) Date

Concilie Mukamwambali (Researcher)

APPENDIX #17: Ethics clearance



Wits School of Education

27 St Andrews Road, Parktown, Johannesburg, 2193 • Private Bag 3, Wits 2050, South Africa
Tel: +27 11 717-3007 • Fax: +27 11 717-3009 • E-mail: enquiries@educ.wits.ac.za • Website: www.wits.ac.za

STUDENT NUMBER: 416660
Protocol: 2010ECE62C

12 July 2010

Ms. Concilie Mukamwambali
Kigali Institute of Education
KIGALI
RWANDA

Dear Ms Mukamwambali

Application for Ethics Clearance: Master of Education

I have a pleasure in advising you that the Ethics Committee in Education of the Faculty of Humanities, acting on behalf of the Senate has agreed to approve your application for ethics clearance submitted for your proposal entitled:

The impact of teaching styles on student learning of biology in high schools in Rwanda: a case study of three schools in Kigali City

The Protocol Number above should be submitted to the Graduate Studies in Education Committee upon submission of your final research report.

Yours sincerely

A handwritten signature in black ink, appearing to read "M Mabeta".

Matsie Mabeta
Wits School of Education

Cc Supervisor: Dr. F Otulaja and Ms. M Doidge (via email)