CHAPTER ONE: INTRODUCTION

1.0 General layout

This chapter presents the background to the investigation into the topics that were perceived as difficult in biology, and the pupils' difficulties in learning biology. After this, there is the presentation of the problem being investigated, the purpose of the study, the objectives and the specific questions through which the objectives are addressed. The chapter ends by giving operational definitions of terms as employed in the study.

1.1 Background

Various Scholars have investigated difficulties pupils face in learning biology in other countries such as Scotland, Nigeria, Turkey and Israel (Johnstone and Mahmoud 1980). In their findings, Johnstone and Mahmoud (1980) suggested that genetics was among the most challenging topics in biology for secondary school pupils. Lazarowitz and Penso (1992) identified cells, physiological processes and hormonal regulation as being the biological concepts that posed learning difficulties to the secondary school pupils. According to Johnestone (1999), monohybrid, dihybrid crosses and linkages in genetics, meiosis, central nervous system, alleles and genes were largely perceived by pupils as being topics of the highest difficulty.

While adequate research has been conducted in other countries of the world as named above in relation to biology topics perceived as difficult, and pupils' learning challenges, very little research of this nature had been carried out in Zambia. Despite the teachers' full knowledge of the difficulties that pupils face in learning some of these topics in biology which actually lower their overall performance in biology examinations, teachers have taken no serious steps to redress the situation. This is partly due to the teachers' lack of specific research-based information on how to teach such problem topics which could otherwise serve as a tool in alleviating the pupils' difficulties in learning the aforesaid topics.

This study therefore established the topics in biology which were perceived as difficult and examined the pupils' difficulties in learning biology, and highlighted

some of the possible teaching strategies that the biology teachers could use in order to address the learning challenges.

1.2 Statement of the problem

For some time now, various cohorts of senior high school pupils have exhibited unsatisfactory performance in some biology topics that are perceived as difficult to learn, and the reasons for their learning challenges are not known. While adequate research has been conducted in other countries of the world in relation to biology topics perceived as difficult, and pupils' learning challenges, very little research of this nature has been carried out in Zambia.

1.3 Purpose of the study

The purpose of this study was to determine the topics in biology pupils perceived as difficult in learning them, and also to highlight some of the possible teaching strategies that the biology teachers could use in order to address the learning challenges.

1.4 Objectives

This study sought to address the following objectives:

(i). To identify topics in biology that were perceived to be difficult for high school pupils to learn.

(ii). To find out why the topics identified in (i) above were perceived to be difficult.

(iii).To establish the effect of gender differences on the perception of learning difficulties in high school biology.

(iv).To suggest possible practical teaching and learning strategies that would address pupils' learning difficulties in high school biology and improve their understanding of the difficult topics in the subject.

1.5 Main Research Question

What difficulties do high school pupils face in learning the topics perceived as difficult in high school biology?

1.5.1 Sub-Research Questions

(i). Which topics in biology are perceived to be difficult for high school pupils to learn?

(ii). Why are these topics perceived to be so difficult?

(iii). What is the effect of gender differences on the perception of learning difficulties among high school pupils?

(iv). What possible practical teaching and learning strategies would address pupils' learning difficulties and improve their understanding of the topics perceived to be difficult in biology.

1.6 Significance of the study

A lot of research has been done on pupils' difficulties in learning biology across the globe generally. However, not much research, according to the literature, has been done on pupils' learning difficulties in biology in the Zambian high schools. The study was therefore important as it may provide useful data on the pupils' learning difficulties in biology. It is hoped that data from this study may be useful to policy makers and curriculum designers in the Ministry of Education who may prescribe some changes in teaching methods. The results of the study would equally be useful to educational institutions, school heads; teachers of biology, parents of pupils studying biology, and other stake holders who may wish to improve classroom teaching and learning. It is also hoped that this study will motivate other scholars to carry out similar research into pupils' learning difficulties in biology and other science subjects or scale up this work beyond Kasama and Mungwi.

1.7 Theoretical framework

This study is premised on the theory of constructivism as expounded by Jean Piaget and Vygotsky. The formation of this theory is generally attributed to Jean Piaget who explained the mechanism by which knowledge is internalised by pupils. He suggested that through the process of accommodation and assimilation, individuals construct their own knowledge from their experiences and during assimilation they incorporate the new experiences without changing the already existing frame work. This occurs when the individual's experiences are aligned with their internal representation of the

world. The exponents postulate that pupils construct their own knowledge, ideas and meaning from their experiences (Bennett, 2002; Vygotsky, 1978).

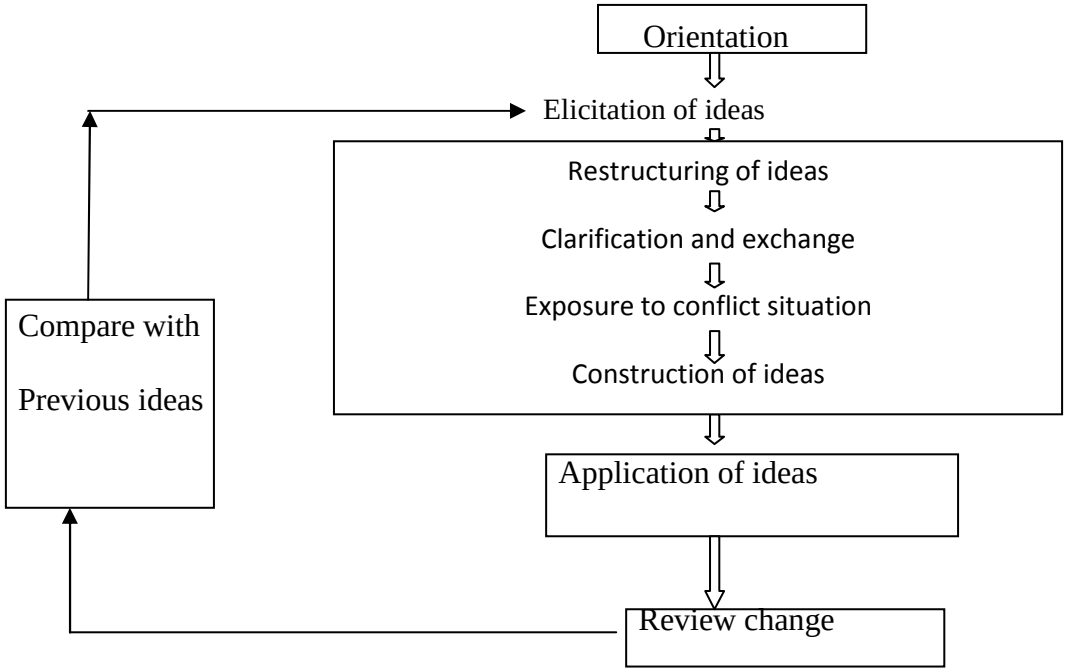
The theory of constructivism holds that:

- Learning outcomes depend not only on the learning environment but also on the knowledge of the learner;
- Learning involves constructing meaning;
- Construction of a meaning is influenced to a large extent by existing knowledge;
- The meanings constructed are evaluated and can be accepted or rejected;
- There are patterns in the types of meanings pupils construct due to shared experiences with the physical world and through their natural language **(**Bennett, 2002; Vygotsky, 1978).

This theoretical framework is appropriate because it clearly explains why pupils would fail to understand the difficult biological concepts as their complexity bears no relationship with the student's existing knowledge. Simply put, the strange and difficult 'specialist vocabulary' that characterise some biological concepts or topics will cause a failure on the part of the student to construct their ideas or meaning of these concepts as the relevant knowledge is absent. Construction of meaning depends upon the already existing knowledge in the learner and their experience with the learning environment. The complex biological terms and concepts such as genetics, nervous system and other related concepts would be deemed as not being part of the learning environment with which the pupils has had experience.

There is considerable research evidence to support the notion that children construct their own explanations for scientific phenomena and that such explanations may differ from the accepted scientific explanations. Areas where this has been demonstrated to be the case include: photosynthesis, respiration, biological classification, evolution (Bennett, 2012. p.34). Figure 1.1 below shows how an individual who is exposed to a learning experience constructs his or her ideas and meaning which undergo restructuring, clarification and evaluation before accommodation of the new ideas.

Figure.1.1 Process of knowledge construction and accommodation



(Source: Bennett, 2002.)

The theory suggests that as long as some topics remain alien, complex in terms of terminologies, and the pupils lack prior knowledge, the pupils will certainly fail to construct meaning and make sense out of their learning experiences. This is so because construction of knowledge, ideas or meaning largely depends upon the already existing knowledge in the student. It is therefore, as Bennett (2002) puts it, important for the pupils to be exposed to an environment of elicitation of ideas in the biological topics that have been demonstrated to cause difficulties for the pupils because they hold ideas or patterns of ideas which differ from the accepted scientific explanations.

1.8 Limitations and delimitations of the study

The researcher employed the purposive sampling procedure which might have rendered the results of the study less representative and less generalisable. Another limitation emanated from the fact that the enrolment of pupils in senior classes significantly varied. The target was 50 pupils per class per school but the enrolment ranged from 25 to 40 which slightly reduced the sample size. The study was carried out only one (Northern) Province out of the ten provinces of Zambia and in only two districts (Mungwi and Kasama). The results of the study could have been more generalisable if more districts and more provinces were included.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.0 Introduction

This chapter reviewed related literature on topics perceived as difficult and pupils' learning difficulties in biology especially the literature that has particular significance to this study. The review also attempted to relate similar studies to this one as a way of justifying the present study.

2.1 Impact of Language

It is well known that language plays a cardinal role in determining the degree of understanding of biological concepts (Lemke, 1990 in Bennett, 2003). Language is what communicates the ideas to the pupils, and that if the language is not learner-friendly; pupils will inevitably experience learning difficulties in biology. This means, as Bennett (2003) observes, that understanding science is more than just knowing the meaning of particular words and terms but making meaning through exploring relationships among the words used. It is therefore inferred that as long as the pupils fail to grasp the relationships among key biological terms under discussion, they will always have problems in conceptualising what is being taught. Failure to understand the language associated with the biological terms gives rise to failure to grasp the biological concepts (Young, 1999).

Biology uses difficult vocabulary which is not only vast but also technical. Bennett (2003) observes that technical vocabulary associated with biological concepts has proved to be responsible for reducing the readability and understandability of the biological text which very often results in poor conceptualisation. It has been observed that there is common understanding among researchers that such concepts as genetics, meiosis and mitosis are rich in terminologies, yet not all of the terms are necessary for adequate understanding. This situation makes pupils become disinterested in the concepts and unwilling to memorise facts. Knippels (2002) holds the same views as Bennett(2003) that even the teachers and authors of curriculum materials do not always use terms in biology (especially in genetics) consistently and explicitly. This scenario accounts for the confusion that causes very poor absorption of biological ideas. However, it would be argued here that the failure on the part of the teachers and authors to use the biological terms consistently would not necessarily

lead to the failure on the part of the pupils to grasp the biological concepts. What would lead to the failure by pupils to understand the biological concepts is their failure to master and comprehend the vocabulary that is vital to understanding.

2.2 Specialist vocabulary of Biology

Barnes (1969) as cited by Bennett (2003) highlights the failure on the part of the teachers to explain to the pupils what Bennett refers to as 'specialist vocabulary' prior to actual learning. This probably implies that the inability of the teachers to explain 'specialist vocabulary' surrounding biological concepts is a clear manifestation of their inadequate understanding of the difficult topics such as genetics and DNA synthesis. It is easy to see the implication in the authors' statement that if teachers have a vague idea of what they want to teach, how much more shall the pupils fail to understand the same concepts? (Bahar and Polart, 2007) as cited by Ogunkola and Samuel (2011) point out that the many difficult terms and symbols used in the teaching of sciences are so new that they cannot be linked to the pupils' cognitive structures. The authors seem to emphasize the point that pupils' ability to comprehend some biology concepts is virtually blocked by the fact that they have had no experience with the new terms.

This is also well explained by the theoretical frame work used in this study, that the construction of ideas and meaning of what pupils learn largely depends upon their prior knowledge and environment they are operating in.

In a study conducted by Cassels and Johnstone (1985) to explore pupils' understanding of the 95 words judged to be the most troublesome in science lessons, it was discovered that many words were poorly understood by pupils. Looking at this, one might then ask, how the pupils would comprehend the concepts in biology if the vocabulary used is not understood. This is one factor which results in poor pupils' performance in biology (Johnston 1985 in Bennett, 2003).

One other factor related to language barrier in learning biology is 'science literacy' which Ramsden (1997) and Collins (2001) say pupils find not only difficult but also boring. Writing in biology and other sciences exerts additional linguistic demands on pupils by requiring them to express themselves more coherently, and that this is compounded by the conventional use of impersonal language in reporting. But teachers can easily go round this obstacle by allowing pupils to communicate in their

own style. If the pupils, as Britton *et al*. (1975) observe, are allowed to use language in more informal ways, their understanding of difficult concepts would be enhanced.

2.3 Pupils' attitude

Pupils are likely to have less interest in topics that are perceived difficult than in the ordinary topics. In such biological concepts as inheritance, mitosis , meiosis and other genetics-related concepts which have to do with all levels of biological organisation, pupils will only adequately understand the concepts if they engage in 'to-and-fro' thinking between molecular, cellular, organism and population levels. This to-and-fro act of thinking results in poor motivation and in a tendency to give up (Knippels, 2002; Johnstone, 1991).

Pupils do not necessarily have a negative predisposition towards biology, but their attempt to interact with difficult biological concepts is what causes their indifference and eventual loss of interest (Knippels, 2002; Osborne *et al*., 2003).This argument is similar to the findings that Bevins *et al.* (2005) suggested in their study of UK secondary school pupils' perceptions of science education that their apparent lack of interest in the field accounted for their low performance.

The scholars have also shown that there is a significant relationship between study habits and pupils' interest in biology. The pupils that perceived some topics as difficult had very little or no interest in studying such topics, and if they ever studied them they normally employed poor study habits. Consequently, pupils failed to comprehend the concepts involved and their performance remained poor (Ogunkola & Samuel, 2011).

2.4 Mathematical background

The topics such as genetics that pupils find difficult to learn have mathematical aspects. For instance pupils are required to calculate probability questions in genetics so much that if their mathematical background is inadequate they soon find genetics a hard concept. It has been further observed that pupils who perform poorly in mathematics often also do so when solving genetics problems and indeed in other biological concepts that are mathematical in nature (Knippels, 2002; Osborne *et al.*, 2003).

Mullich (2009) has expressed a similar idea to that of Knippels (2002) as he says that fluency in mathematics is needed to understand science, and lays emphasis on the fact

that learning Mathematics effectively before a pupil learns the topics in biology which are mathematical in nature would be a helpful step, and would help pupils understand the biological concepts with much ease. This statement gives a clear impression that if pupils are not well equipped with enough mathematics, they may face challenges when it comes to learning biological topics that are mathematical in nature. This is why the pupils' mathematical background should be sound enough.

2.5 Gender effect

It is interesting to note that pupils' learning difficulties can be influenced by one's gender. Tekkya *et al.* (2001) showed that there were more girls than boys who perceived more biological concepts as difficult to learn. This goes without saying that perceptions of pupils are influenced by their gender. The reason why more boys than girls perceive biological concepts as easy is attributed to socialisation factors and classroom experiences. Boys are seen as more competitive, more confident, and more willing to have a go at something as opposed to low esteem and passive dependant behavior among girls (Shamai, 1996; Tinklin *et al*., 2001).

However, other scholars such as Mavrikaki *et al.* (2012) have suggested in their study that gender does not seem to affect pupils' overall views about difficult topics in biology. This means that scholars are not agreed on which sex has positive views about the difficult topics in biology.

2.6 Lack of practical work and necessary resources

Inadequate or lack of practical work during biology lessons could be a stumbling block to pupils insofar as understanding new biological concepts is concerned. Practical work brings reality into the classroom and serves as a link between real life and theory, a situation that greatly aids pupils' understanding of the abstract terms. Experiments promote relevant basic skills and competences that pupils need in order to comprehend complex concepts. It is equally observed that scarcity of appropriate equipment is yet another setback. Much as the pupils and their teachers would want to engage in practical work as a way of simplifying the concepts that pupils would otherwise find incomprehensible, some schools just have no relevant resources that teachers need to teach the challenging topics in biology. Some scholars have argued that even though resources for teaching practical work could be available, some pupils are simply poor in performing scientific experiments; their practical skills are quite

poor especially with regard to handling of instruments or apparatus and making correct observations which, in essence, affects the interplay of experiments, observations and theoretical inferences (Young, 1994; Woodley, 2009).

2.7 Teachers' indifference towards relevant practical work in biology

Coupled with lack of classroom practical work in biology is the teachers' indifference towards laboratory activities associated with the topics perceived as difficult. It was also observed that there is general understanding among the researchers and scholars that failure to use laboratory activities on the part of the teacher makes it rather difficult for the pupils to grasp difficult biological concepts (Onyegegbu, 2001). This is supported by Woodley (2009) who argues that good quality practical work engages pupils and helps them develop relevant skills to understand difficult concepts.

2.8 Teachers' academic qualification

Research conducted by David *et al*. (2012) suggested that teachers play an important role of an implementer in the classroom. Teachers are recognised as critical factors in the delivery of quality education, and this is why there is a need for improvement in the level of abilities in teachers for them to effectively teach sciences in our schools. The results indicated that if some topics in science were difficult to pupils, it might be the fault of those who present them badly. If the teacher does not have the suitable qualification to offer biology to the grade level she or he is teaching, their difficulties would spill over to the pupils. It is difficult for the pupils to grasp the concepts that the teacher fails to understand. Poorly qualified teachers are very likely to transmit wrong descriptions of observations, misconceptions, misinformation and misapplication of content taught and scientific terminologies.

2.9 Conclusion

Literature showed that there are several gaps that cause the pupils to fail to understand some topics in biology. These gaps include: language and vocabulary used, pupils' mathematical background, pupils' attitude, teachers' qualification and lack of quality practical work. This study is intended to bridge some of these gaps.

CHAPTER THREE METHODOLOGY

3.0 Introduction

This chapter introduces the methodology that was employed in the study. This included the research design, data collection procedures and instruments, and data analysis. The methodology used was designed in such a manner that it would provide answers to the research questions.

3.1 Research Design

The study was a survey and mainly qualitative and was based on semi-structured questionnaires. It sought to interpret the information gathered to capture the respondents' views in order to explain pupils' learning difficulties in biology. Nevertheless, the study also employed some quantitative elements in the design.

3.2Data Collection

This section describes the target population in this study as well as sample size used and the sampling techniques employed.

3.2.1Target Population

All the high school biology teachers, all high school senior biology pupils and Heads of Department (HODs) of Natural Sciences in Kasama and Mungwi constituted the population. Kasama district is strategically located as it has both rural and urban high schools. It has about 11 high schools which include Government, Grant-Aided (Mission) and Private schools. Mungwi district has only two high schools, one Government and the other Grant-Aided.

3.2.2Sample Size

The sample for the study was drawn from 11 high schools in the study area namely: Kasama and Mungwi districts, in the Northern Province. The sample included 19 high school teachers of biology and 11 HODs of Natural Sciences Department. 451 pupils answered the questionnaire and 66 pupils were orally interviewed.

3.2.3 Sampling Techniques

Samples were chosen on a non-probability basis premised on the understanding that all the high schools were involved and that only biology teachers in the high schools were to be targeted and that some of the high schools had only two members in the biology section. Therefore random sampling could not be employed and hence purposive sampling was used. This is in line with Ghosh (2006) who says that convenience or purposive sampling can be used when administrative or other limitations make it difficult for the researcher to randomly select samples. Cohen and Morris (2008) support this approach and argue that researchers can hand pick the cases to be included in the sample on the basis of their judgment of typicality or possession of a particular characteristic being sought. In this way, they will build up a sample that satisfies their specific needs. The same technique was used to hand pick a sample of fifty senior pupils at each school to answer the questionnaires as some high schools only had one senior biology class.

Six senior pupils (3 females and 3 males in co-education schools) were randomly picked from among the fifty pupils who had filled in the questionnaires. This was done by picking every 13th student from each of the girls' - boys' class list.

3.2.4 Pilot Testing

A pilot refers to a trial-run used to test a process in order to detect weaknesses or flaws before full implementation. Pre-testing a questionnaire is critical to its success as it plays a role in enhancing reliability, validity and practicability of the questionnaire. Cohen and Morris (2008) as well as Wilson and McLean (1994) observed that piloting a questionnaire gains feedback on the validity and operationalisation of the questionnaire items. Hence, piloting helps eliminate forms of ambiguity in wording, checks the ability of the target audience to respond, checks amount of time required to complete the questionnaire and whether the questionnaire is too short or too long, too easy or too difficult. In this study the pilot was carried out on 20 subjects (10 biology teachers and 10 biology pupils) drawn from Kasama district.

3.2.5 Data Collection Instruments

The following instruments were employed to collect data:

3.2.5.1 Questionnaires

These were of three types, one for teachers, another for (HODs) of Natural Sciences and the other for pupils. The questionnaires for the teachers sought to elicit information on their knowledge of pupils' learning difficulties in biology. The questionnaires for the HODs sought to elicit information on the school profile in terms of performance in biology examinations, and the pupils' questionnaire helped elicit information on their learning difficulties in biology as well as on the topics in biology that are perceived as difficult.

3.2.5.2 Interview Schedules

Interviews were conducted with teachers and with pupils respectively as follow-ups to help fill in gaps or clarify any matters from questionnaires. This was done soon after the questionnaires had been filled in. The oral interviews were recorded in form of video clips.

3.2.6 Data Collection Procedures

The data collection exercise was undertaken over a period of one month (30 working days). The actual procedure began with questionnaires being distributed by the researcher to teachers, pupils and HODs. Interviews were conducted soon after the respondents had filled in their respective questionnaires. Some respondents were still followed-up even days after their being interviewed to clarify some inconsistencies arising from the questionnaires. A questionnaire was given to each HOD to get information on the school profile in terms of performance in biology examinations, the teachers' and pupils' questionnaires sought to elicit information on the teaching and learning difficulties in biology with respect to the topics perceived as difficult.

3.3 Data analysis

This study, by its nature, was mainly qualitative and as Sidhu (2003) observes, when the researcher gathers data by participant observation, interviews and analysing documentary materials, qualitative analysis may be ideal. However, this does not in

any way suggest that numeric measures were never used or included (Sidhu, 2003). Since this study was mainly qualitative, data analysis (particularly preprocessing) began during the data collection stage. The researcher also at this stage ensured that the data were internally consistent. For example, the researcher made follow-ups on informants to clarify some contradictions and gaps in the questionnaires or interviews. Data preparation was then done and this included organizing and explaining data to make sense of it in terms of participants' understanding of the situations, noting patterns, themes and categories (Cohen and Morris, 2008). Quantitative data captured in this study was analysed by making use of software, Excel. This analysis made use of descriptive statistics which involved; frequency tables, charts and percentages. Cohen and Morris (2008) recommend this and stated that numeric data analysis can easily be performed using software packages such as SPSS, Minitab or Excel. These software packages apply statistical formulae and carry out the needed computations. At the final stage the researcher sought to make interpretations of the questionnaire and interview responses.

3.4 Reflections on Ethical issues

In order to uphold and abide by research ethics, a number of considerations were taken into account. To start with, this study claims to have value as it is expected, at the end of it all, to contribute to the body of academic knowledge, more so that very little of such studies has ever been undertaken before in Zambia. The researcher got permission from school authorities upon visiting that school, and explained to the administration the value of the research and the procedures that would be followed. The researcher also assured the administration that the participation by staff and pupils would be voluntary, and that the informed consent forms would be given to the respondents to sign before taking part in the study. In order to promote and enhance confidentiality, respondents' names were not written on the questionnaires. Respondents remained anonymous, and were assured that the data obtained from them would not be disclosed to any other person. The administering of questionnaires and interviews was done outside class time so that the disruption of the school routine was as minimal as possible. Thus, the respect for the research site was guaranteed. Finally, the researcher took full responsibility for the conduct of the study and its ensuing consequences.

CHAPTER FOUR: RESULTS

4.0 Introduction

This chapter presents findings on the topics in biology perceived as difficult for high school pupils to learn in 11 high schools of Kasama and Mungwi districts of the Northern Province of Zambia.

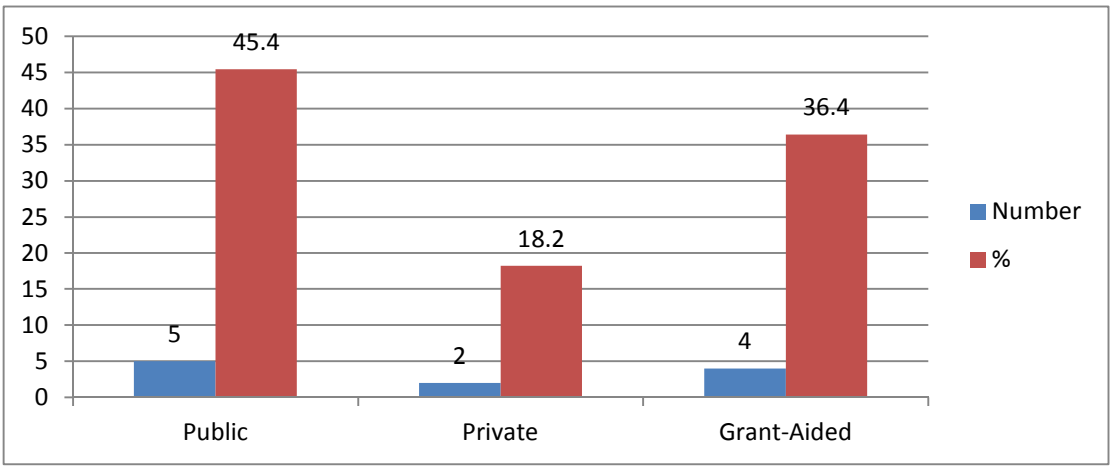
4.1 School profiles

The data collected on school profiles relevant to this study included: school type; performance in biology, by school, for the past three years; number of teachers in the biology section by school and gender; and teachers' demographics, experience, qualifications and teaching load. Other data included pupils' numbers, age, gender, grade level, favourite subject (s), and performance.

4.1.1 School type

The data were collected from different types of high school. These included Public, Private and Grant-Aided high schools as indicated in Figure 4.1

Figure 4.1 School type



Source: Field data, 2012

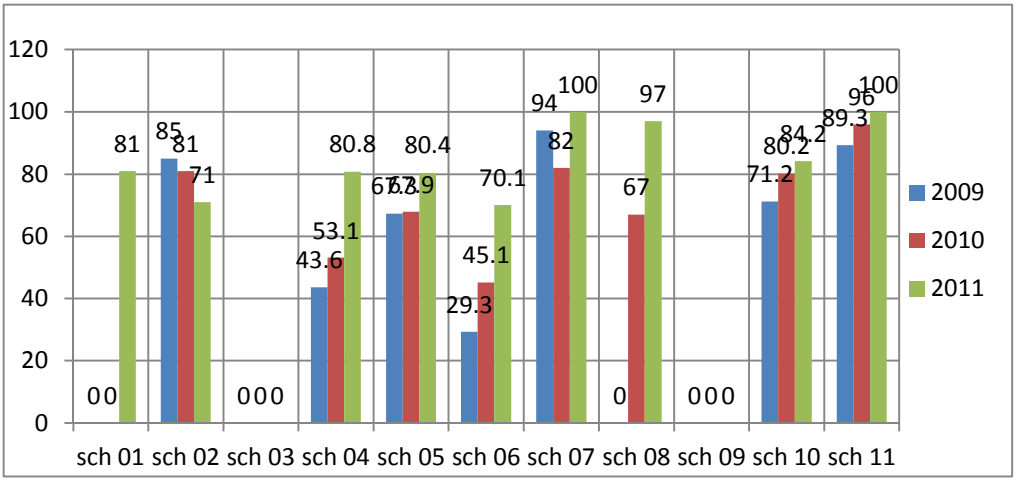
Figure 4.1 shows that, of the 11 high schools sampled, five (45.4%) were public or Government, four (36.4%) were Grant-Aided and two (18.2%) were private. The number of private high schools included in the study appears small because they were very few private high schools in the study area and actually almost all of them were included in the study. The purpose of including different types of school was to

establish whether or not pupils perceived the same topics as being most difficult irrespective of the type of school they were learning at.

4.1.2 Performance in biology examinations by school for the past three years

Data were collected about the performance of all the 11 target schools in biology examinations over the past three years in order to see the trends in pupils' performance in biology examinations amid their learning difficulties in topics perceived to be difficult. The data obtained were analysed and presented in Table 4.1 and Figure 4.1.

Figure.4.2 Overall performance by school over three (3) years



Source: Field data, 2012

Table 4.1 and Figure 4.2 show that in 2009 some schools had pass rates as high as 80% or slightly better but others had as low as 30.2%. In 2010 the performance of almost all schools dropped below 80% pass .The HODs attributed the drop in the pass percentage to a number of factors which included over-enrolment and few qualified biology teachers i.e. understaffing in the biology section. In 2011 there was, generally, an increase in the performance and almost all schools scored above 80% pass rate.

Table 4.1 Performance by school in biology examinations over three (3) years

(Key: P= passed; F= failed; T= total number of candidates)

School code	**gender**	**Number of candidates**			2009		2010		2011	
		2009	2010	2011	P	F	P	F	P	F
01	Female	-	-	-	-	-	-	-	11	01
	Male	-	-	-	-	-	-	-	5	3
02	Female	25	30	14	20	5	25	5	9	5
	Male	11	13	10	9	2	10	3	8	2
04	Female	-	-	-	-	-	-	-	-	-
	Male	-	-	647	-	-	-	-	523	124
05	Female	342	386	512	230	112	252	134	411	101
	Male	-	-	-	-	-	-	-	-	-
06	Female	130	124	235	30	100	49	75	143	92
	Male	165	200	246	58	107	97	103	194	52
07	Female	36	56	61	34	02	51	05	61	00
	Male	-	-	-	-	-	-	-	-	-
08	Female	-	06	6	-	-	5	01	06	00
	Male	-	12	10	-	-	11	01	10	00
10	Female	-	-	38	-	-	-	-	21	17
	Male	28	394	399	200	81	316	78	347	52
11	Female	47	45	48	42	05	43	02	48	00
	Male	-	-	-	-	-	-	-	-	-

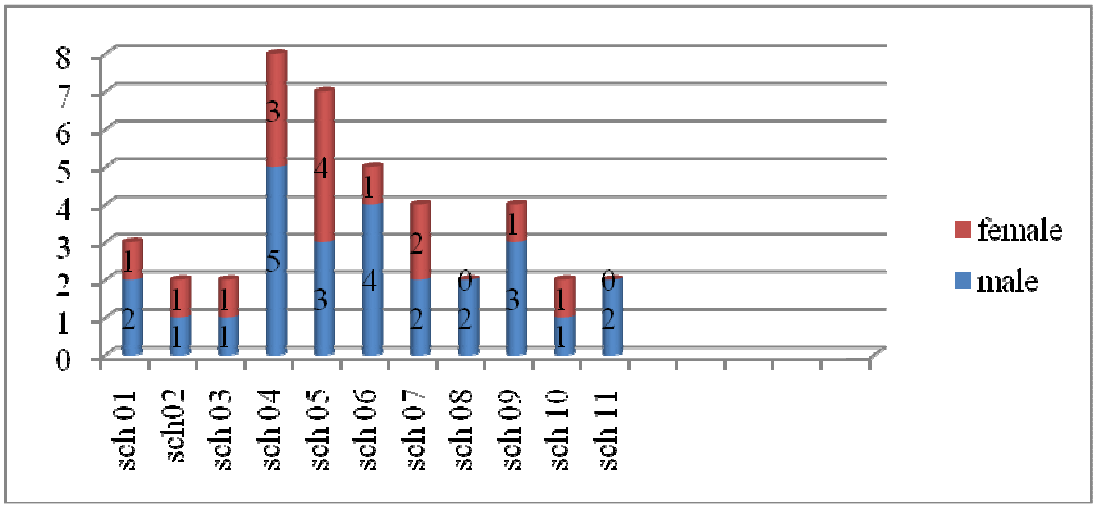
(Source: Examinations Council of Zambia Grade 12 Final Examinations results register 2009-2011). There are no data for schools 03 and 09.

The increase in the pass percentage was explained by HODs as being a result of reduction in enrolment levels in some schools, slight improvement in the staffing levels in some schools, motivating hardworking pupils by way of giving token of appreciation as well as monitoring and observation of biology teachers' lessons that schools embarked upon. Schools coded 03 and 09 have had no candidates between 2009 and 2011. School coded 01 only had candidates in 2011. School coded 08 did not have candidates in 2009. The table clearly shows that the performance in biology was generally average.

4.1.3 Number of teachers in biology section by school and gender

The study sought information on the number of teachers in the biology section at each school. The purpose of establishing the number of teachers in biology section at each school was to examine any relationship between pupils' learning difficulties in biology and staffing levels. The data obtained from the field regarding the staffing levels in the biology section were analysed and presented in Figure 4.3

Figure 4.3 Number of teachers in biology section by school and gender



Source: Field data, 2012

Figure 4.3 shows that the schools generally had more male than female biology teachers**.** The figure indicates that out of 41 teachers (total number of biology teachers) in the study area only 15 (3.7%) were female giving the ratio of female to male biology teachers of 1:1.7 This suggested that there were twice as many male as

female biology teachers. This may be attributed to the fact that fewer females opt to study natural sciences than the male counterparts during their university training.

4.1.4 Teachers' demographics

The researcher collected data on teachers' demographics from HODs as reflected in the School staff records.

4.1.4.1 Teachers' gender and age

The study sought the distribution according to the gender of teachers in order to find out the representation of both sexes (female or male) in the study. The study also determined the relationship between teachers' age and pupils' performance in biology. Data obtained from the field regarding teachers' gender and age were analysed and presented in Table 4.2.

Table 4.2 Information on teachers' gender and age

		Frequency	%
Gender	Female	3	15.8
	Male	16	84.2
Age	21-24	-	-
	25-29	10	52.6
	30-34	4	21.1
	35 or older	5	26.3

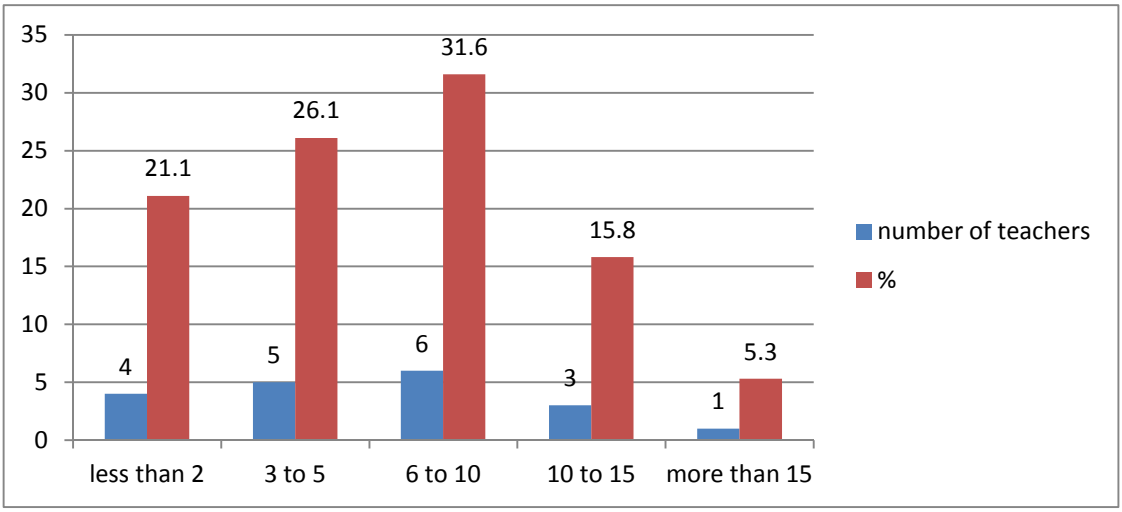
Source: Field data, 2012.

Table 4.2 shows that a total of 19 biology teachers participated in the study out of which three (15.8%) were female and 16 (84.2%) were male. It is clear that there were more male than female teachers in the biology sections in the natural sciences departments. The table also reveals that ten (52.6%) which is the majority, were aged between 24 and 29 years .It further shows that five (26.3%) were aged 35 or older, and four (21.1%) were aged between 30 and 34 years. This agrees with Figure 4.4 which indicates that the majority (31.6%) of the biology teachers had taught biology for less than 10 years compared to only 5.3% of teachers who had taught biology for more than 15 years.

4.1.4.2 Teachers' experience

The study sought information on the teachers' experience as this was deemed to have a bearing on the pupils' performance in biology. The data obtained on this were presented in Figure 4.4.

Figure 4.4 Teachers' years of experience



Source: Field data, 2012.

Figure 4.4 indicates that, of the 19 biology teachers involved in this study four (21.1%) had only taught biology for less than 2years, five (26.1%) had taught for 3 to 5 years. The majority (31.6%) of the biology teachers had taught biology for 6 to 10 years. Only three (15.8%) teachers had taught for 10 to 15years.It is interesting to note that of the 19 teachers of biology under study only one (5.3%) had taught for more than 15 years. The figure reveals that 15 out of 19 biology teachers had not taught biology for more than 10 years.

4.1.4.3 Teachers' qualifications by school and gender

The study sought information on teachers' qualifications in order to see the relationship between the pupils' learning difficulties and the teachers' qualifications. The data obtained were analysed and represented in Table 4.3 and in Figure 4.5

Table 4.3 Teachers' qualifications by school and gender

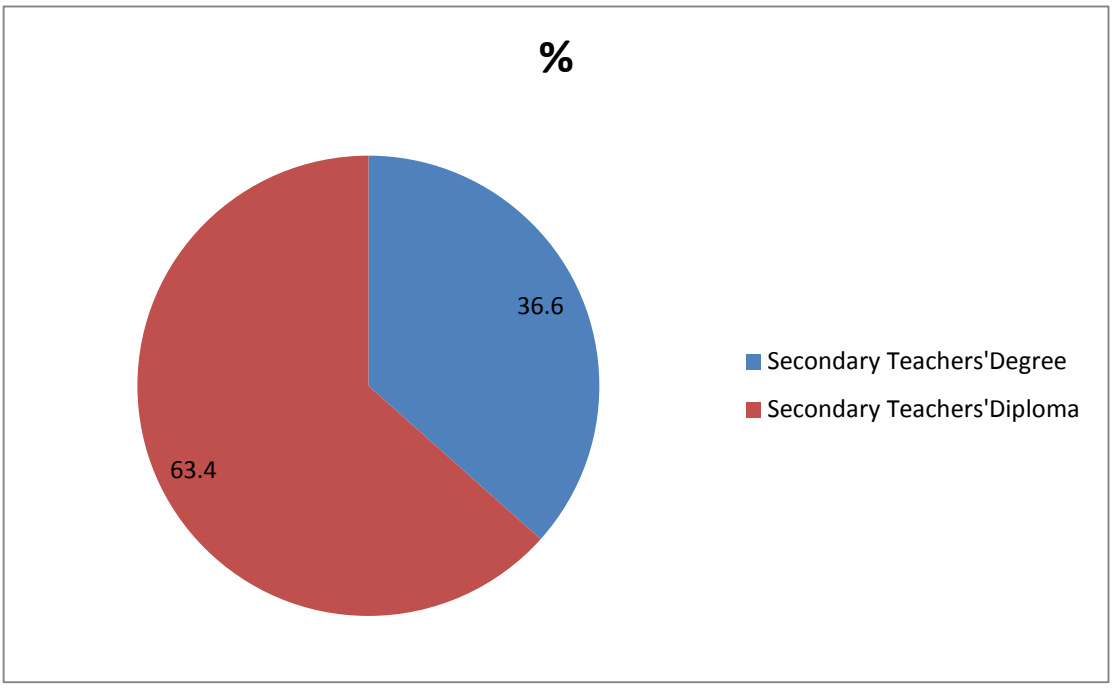
School code	Gender	Qualification		
		Diploma	Bachelors' degree	Masters' degree
01	Male	02	-	-
	Female	01	-	-
02	Male	01	-	-
	Female	01	-	-
03	Male	01	-	-
	Female	01	-	-
04	Male	-	05	-
	Female	03	-	-
05	Male	05	03	-
	Female	04	-	-
06	Male	01	03	-
	Female	01	-	-
07	Male	03	-	-
	Female	04	01	-
08	Male	-	-	-
	Female	02	-	-
09	Male	01	-	-
	Female	02	01	-
10	Male	01	02	-
	Female	01	-	-
11	Male	-	-	-
	female	02	-	-

(Source: School Staff Records, 2012)

The findings in Table 4.3 show that there was not a single teacher of biology with a masters' degree in all the schools under study. Table 4.2 also shows that out of 26 male biology teachers 13 (50%) held a secondary teachers' degree. However, out of 15 female biology teachers only two (1.3%) held secondary teachers' degree. Of the 41 biology teachers, 26 were secondary teachers' diploma holders. This means that

the majority of biology teachers (63.4%) had not upgraded themselves, though they still taught senior classes.

Figure 4.5 Summary of Teachers' qualification



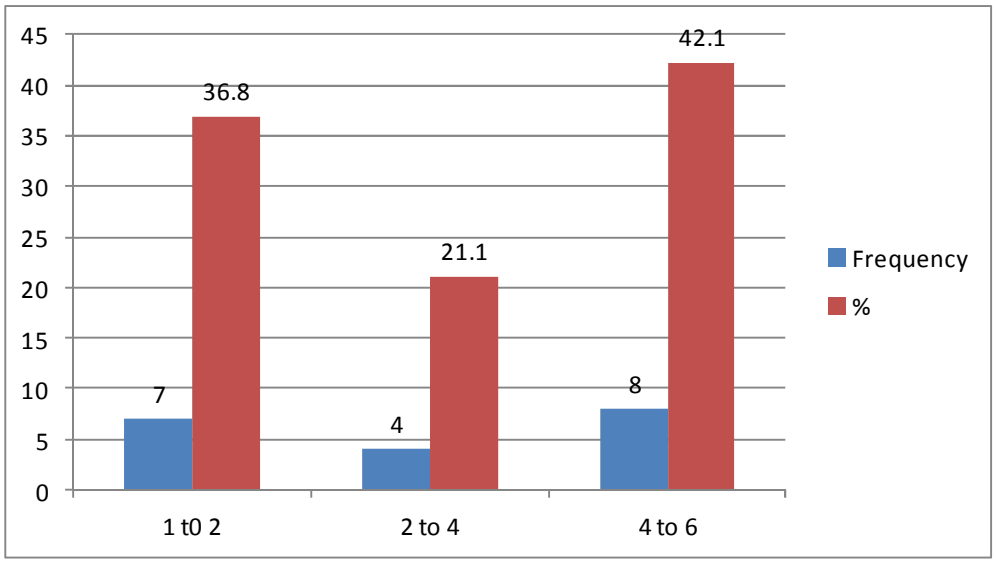
Source: Field data, 2012.

Figure 4.5 shows that the majority (63.4%) of the biology teachers were diploma holders, and a very small proportion of them had a secondary teachers' degree. It is very clear from the findings that although 63.4% of the respondents taught biology to senior pupils, they do not qualify to do so. This is because under the current Zambian education regulation with respect to qualifications, only teachers with a secondary teachers' degree officially qualify to handle senior pupils (grades 10-12) in high schools.

4.1.4.4. Biology teachers' teaching load

The information about the teaching loads of the biology teachers was sought as it was assumed that this could have a relationship with the pupils' performance in biology. Data were obtained from the field and statistically analysed. The results were as summarised in Figure 4.6.

Figure 4.6 Biology teachers' teaching load (number of classes)



Source: Field data, 2012.

According to Figure 4.6, a total of 19 biology teachers gave responses about their teaching load. The results indicated that eight (42.1%) of the biology teachers taught between 4 to 6 classes while four (21.1%) had between 2 and 4 biology classes. Only seven (36.8%) of the biology teachers had one or two classes, and these were not as burdened as the rest. The high teaching loads indicated could be attributed to over enrolment in some schools as seen in Table 4.4 below which indicated that schools coded 04 and 11 had a total enrolment of 1,720 and 1,200 senior pupils respectively. In schools where teachers were handling only one or two classes the enrolment was very low. For instance, school 08 had only ten senior pupils and school 09 had 29 (Table 4.4). This trend was noticed in Grant-Aided and Private schools.

4.1.5 Pupils' profile

The study sought information on the pupils' gender, age and grade level. The data collected also included the pupils' favourite science subjects and their performance in biology.

4.1.5.1 Number of senior pupils, their gender and age-range by school

The study sought information on the distribution of senior pupils in terms of number, gender and age-range in each school under study. The data obtained were analysed and presented in Tables 4.4 and 4.5.

Table 4.4 Number of senior pupils, gender and age-range by school

School code	**Number of senior pupils**			**Age- range**
	Male	female	Total	
01	58	75	133	14-19
02	11	17	28	14-24
03	147	79	226	16-23
04	1,720	-	1,720	16-19
05	-	1,200	1,200	16-21
06	210	122	332	14-22
07	-	250	250	15-18
08	07	03	10	15-18
09	27	02	29	20-30
10	1192	08	1,200	14-22
11	-	192	192	14-18
Total	**3372**	**1948**	**5,320**	

(Source: School registers for 2012)

Schools coded 04, 05, 07 and 11 are single-sex schools. Table 4.4 shows that there were more boys in schools than girls. The table indicates that the ratio of the number of boys (3372) to the number of girls (1948) was 1:1.7 (approximately 1:2) meaning there were almost twice as many boys as girls. Some schools (08 and 09) had as few as 2 and 3 girls respectively.

Table 4.5 Pupils' gender, age and grade level

		Frequency	%
Gender	Female	203	45.0
	Male	248	55.0
Age	14-18	253	56.1
	18-22	184	40.8
	22 or older	14	3.1
Grade level	11	81	18.0
	12	370	82.0

Source: Field data, 2012

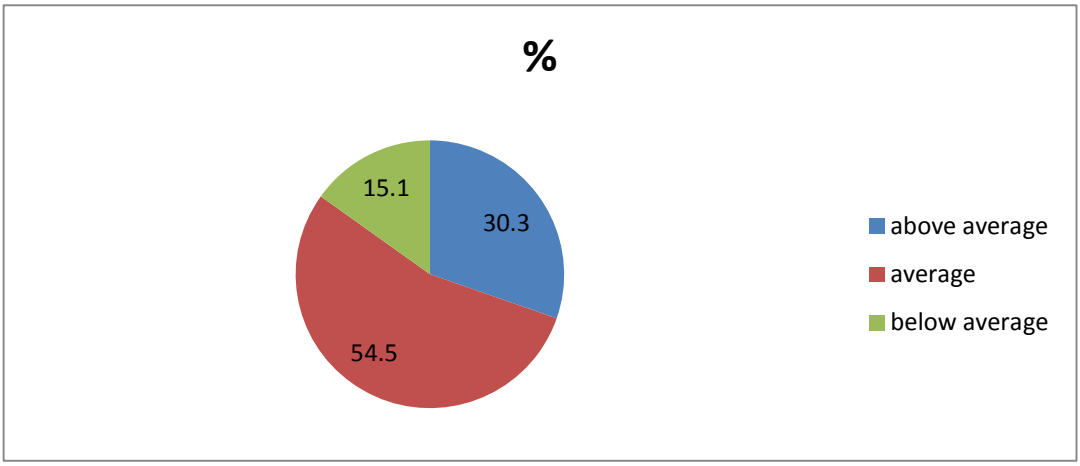
Table 4.5 shows that the total number of pupils who took part in this study was 451. Out of this number, 203(45%) were female and 248(55%) were male, giving the ratio of approximately 1:1. This means that there was almost equal gender representation in the study sample. The table also indicates that, of 451 pupils 253(56.1%) were aged between 14 and 18 years, 184(40.8%) were aged between 18 and 22, and 14 (3.1%) were aged 22 or older. The findings clearly showed that the majority of the pupils fell under the age bracket of 14 to18 years old, and that there was a relatively small proportion of adult pupils in the schools under study. That is, the teenage pupils were almost twice as many as the adult pupils. Eighty one out of 451(18.0%) pupils were in Grade11 and 370 (82.0%) were in Grade 12. The proportion of Grade 11s was smaller because the study mainly targeted Grade 12 pupils except where the school ran only up to Grade11. The rationale was that by Grade 12, pupils will have learned almost all the biology topics and therefore would be in a better position to ascertain the kind of topics that they found difficult to learn. It was usual to learn, in schools that only ran up to Grade11 that pupils would not tell their position on some topics because they were yet to cover such topics.

4.1.5.2 Pupils performance in biology

The information on the pupils' performance in biology was sought from the biology teachers and the pupils themselves in order to establish whether or not there was a

relationship between the perception of difficult topics in biology and the pupils' actual performance. The data obtained were presented in Figure 4.8 and Figure 4.12.

Figure 4.7 Pupils' responses about their performance in biology



Source: Field data, 2012

Figure 4.7 shows what the pupils said about their performance in biology. It indicates that more than half (54.5%) of the respondents said their performance was average while 15.1% said they were below average. A good proportion (30.3%) of the pupils said their performance was above average. But Figure 4.12 shows that the teachers indicated that performance of most pupils was average. This discrepancy could be attributed to the fact that teachers were looking at the greater picture of the performance of the whole class whereas the pupils were isolating their individual performances in biology measured against that of the whole class.

4.2 Pupils' responses

The study sought information on the biology topics perceived to be difficult from pupils in the high schools by use of questionnaires and interviews. The study also sought information on the pupils' favourite subjects. The data from 451 pupils were analysed and presented in Figures 4.8 – 4.10 and in Tables 4.6 - 4.11. Information was sought on the pupils' favourite science subject to try and establish their attitude towards biology. The data obtained were analysed and presented in Figure 4.8.

Figure 4.8 Pupils' responses about their favourite science subject

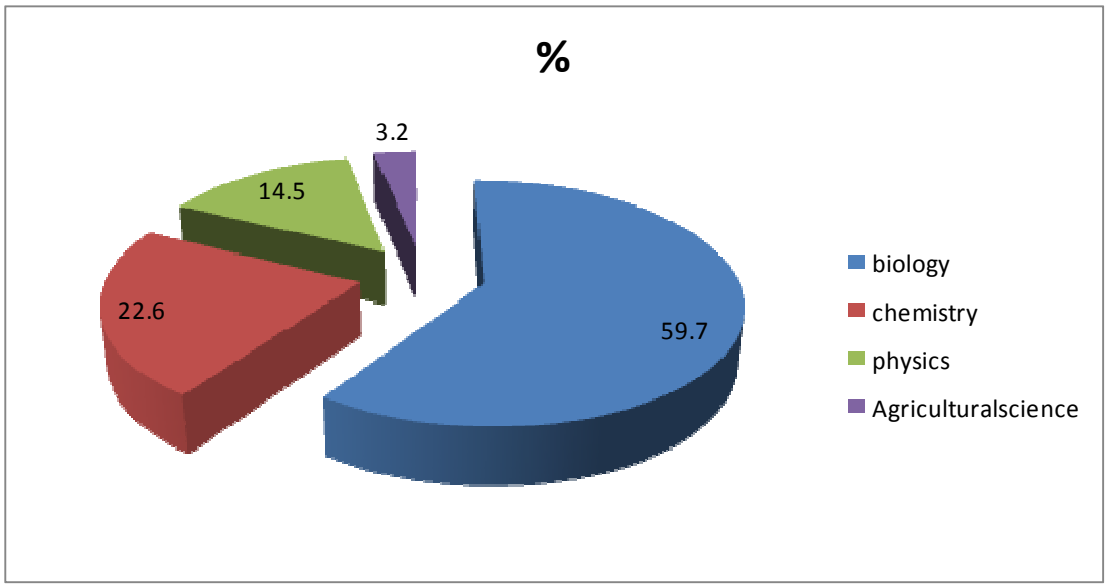
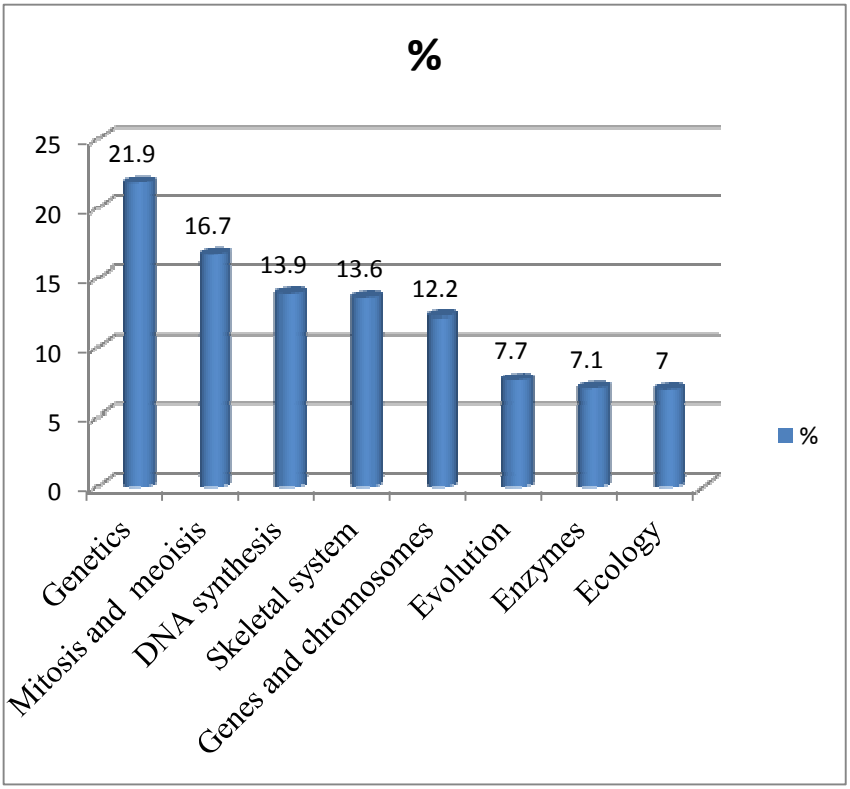


Figure 4.8 indicates that the majority(59.7%) of the pupils said their favourite science subject was biology, 22.6% of pupils said chemistry, 14.5% mentioned physics and a very small proportion (3.2%) of the respondents favoured agricultural science. What was interesting about the findings here was that, despite their learning difficulties and their average performance in biology the majority (59.7) of the pupils preferred biology to any other subject. Some of their reasons included the fact that learning biology was a pre-requite to their dream career and that biology was a real subject that affected their lives in many aspects such as medicine, food, reproductive health, hygiene to mention but a few.

4.2.1Topics in biology perceived to be difficult for pupils to learn

Data were collected from 451 pupils on the biology topics that they perceived to be difficult to learn, and these data were presented in Figure 4.9.

Figure 4.9 Topics in biology perceived to be difficult for pupils to learn

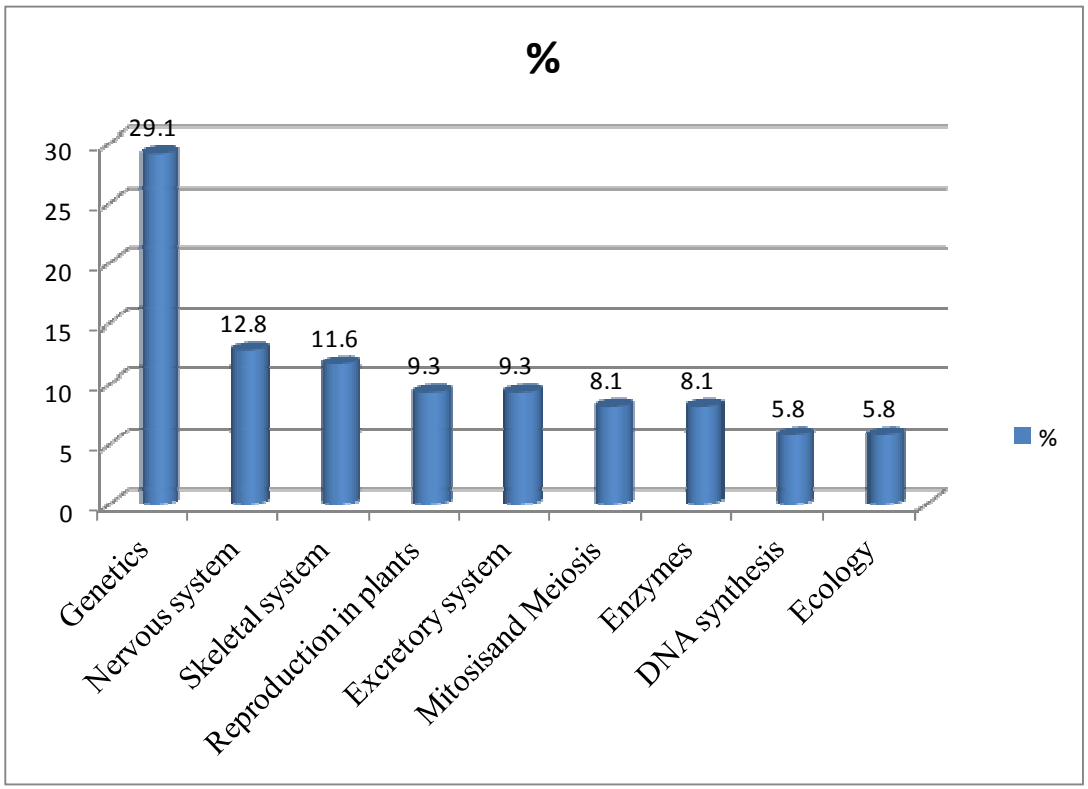


Source: Field data, 2012

The data shown in Figure 4.9 were obtained from the pupils who completed the questionnaires. Results indicated that 21.9% of the pupils said genetics was most difficult of the most difficult topics, followed by mitosis and meiosis (16.7%), DNA synthesis (13.9%), skeletal system (13.6%) and genes and chromosomes (12.2%). Ecology (7%) ranked last on the list of the topics pupils perceived as most difficult.

The follow-up interviews were conducted to seek data on topics in biology perceived to be difficult for pupils to learn. 66 pupils were interviewed and the data obtained were presented in Figure 4.10.

Figure 4.10 Topics pupils perceived as most difficult



Source: Field data, 2012.

Figure 4.10 shows the data collected from the pupils who were orally interviewed. Results indicated that majority (29.1%) of the pupils said that Genetics topped the list of topics that they perceived as most difficult, followed by nervous system (12.8%) and skeletal system (12.8%). The figure also indicates that DNA synthesis and Ecology ranked lowest and were represented by 5.8%. The findings were similar to those in Figure 4.9 which also ranked genetics as first.

4.2.2 Reasons why some biology topics were perceived to be so difficult

The study sought information from pupils in the target high schools on the reasons why some biology topics were perceived to be difficult. The data from 451 pupils on the reasons given and on the associated learning challenges were analysed and presented in Tables 4.6 and 4.7.

Table 4.6 Student's reasons' for the most difficult topics in biology

Topic	Reason	Frequency	%
Genetics	Poor teachers' explanation.	23	35.8
	Terms used complex.	62	
	Genetic diagrams difficult.	21	
	Calculations involved difficult.	6	
	Teacher too fast	4	
	It is too abstract	6	
	Too bulky	6	
Mitosis and meiosis	Cell division process complex.	8	16.2
	Poor teachers' explanation.	14	
	Terms used are complex.	25	
	Concepts are too similar.	11	
DNA synthesis	Terms used complex.	20	14.0
	Poor teacher explanation.	17	
	Too theoretical	8	
	Information not available.	5	
Skeletal system	Poor teachers' explanation.	12	20.4
	Names and terms complex.	41	
	Bulky.	10	
	No T/L resources used.	10	
Gene and chromosomes	Terms complex.	22	8.9
	Poor teachers' explanation.	10	
Evolution, ecology and Enzymes	Poor teachers' explanation.	7	2.0
	Terms difficult.	10	2.8
TOTAL		**358**	**100**

The data in Table 4.6 were collected from questionnaires. The table shows that 128 (35.8%) pupils said genetics was difficult. They cited various reasons including poor teachers' explanation, names and terms used being complex, genetic diagrams and calculations involved being difficult. They also said teachers were too fast when teaching, and the topic was bulky. Another 58 (16.2%) said mitosis and meiosis was

difficult because of the difficult terms involved, poor teachers' explanation, cell division phases were difficult and especially that they are too similar. Results also indicate that 50% of pupils attributed the difficulty experienced in learning DNA synthesis to the fact that it was too theoretical, poor teachers' explanation and that suitable information on DNA was not available in the teaching materials in schools. The results showed that73 (20.4%) of pupils said skeletal system was difficult due to complex terms used, it was bulky and that lack of teaching and learning resources in schools compounded the situation. Thirty two (8.9%) of the pupils equally cited complex scientific names or terms, and poor teachers' explanation as reasons for the topic 'genes and chromosomes' being difficult. Ten (2.8%) said that poor teachers' explanation made the topic 'enzymes' difficult. A very small proportion (2%) of the pupils said that learning enzymes was difficult because of the difficult names or terms used. The results showed that the majority of the respondents cited difficult terms and poor teachers 'explanation as being the main hindrances.

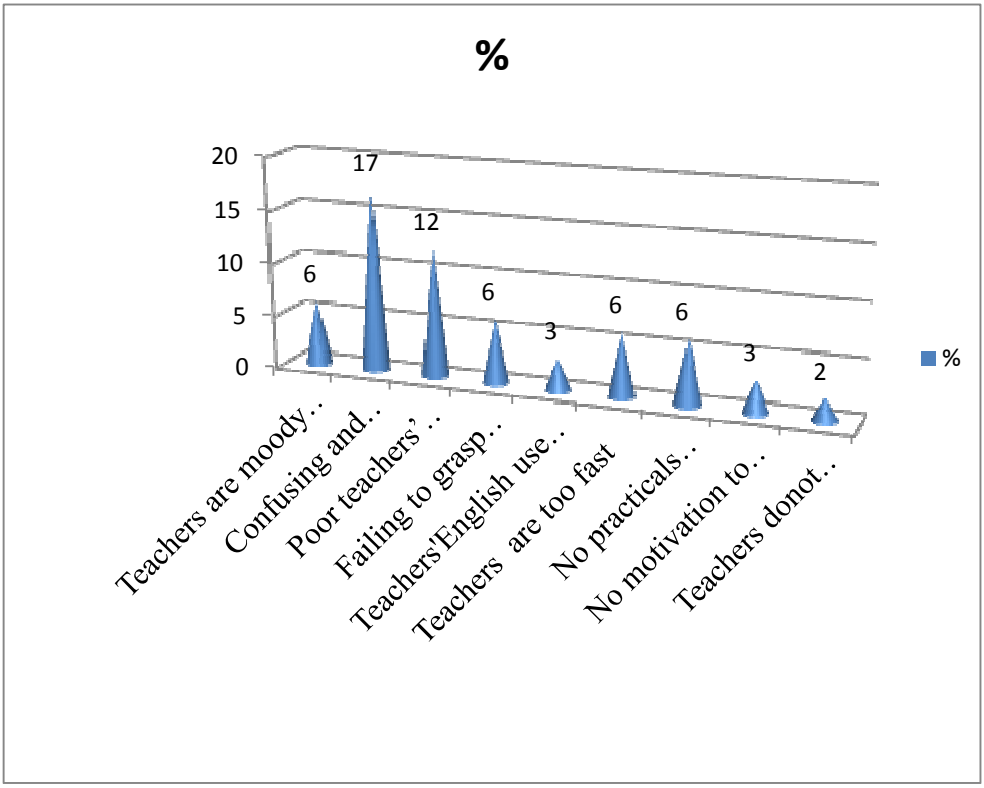
Table 4.7 Pupils' specific challenges when learning difficult topics in biology

Pupils' responses	Frequency	%
Teacher too fast	47	0.8
Lack of suitable text books	37	8.5
Topics too bulky	29	6.7
Complex terms or names used difficult to remember or spell	130	29.8
Unclear teachers' explanation	76	17.4
Harsh and moody teacher	43	9.9
Teachers' failure to use T/L aids	22	5.0
Unqualified teacher	9	2.1
No practical conducted	23	5.3
Little time allocated	10	2.3
Teacher failing to answer questions	10	2.3
Total	**436**	**100**

Source: Field data, 2012

The data in Table 4.7 which were obtained from questionnaires indicate that 130 (29.8%) pupils said that they found it difficult to learn the difficult topics because of the complex names and terms used. Seventy six (17.4%) pupils cited unclear or poor teachers' explanation, and 47 (10.8%) said teachers were too fast when teaching, another 43(9.9%) said that their learning was not easy because their teachers were too harsh and moody. The findings also showed that 37 (8.5%) respondents experienced challenges in learning difficult biology topics due to lack of appropriate text books in schools. A small proportion of 23 (5.3%) of pupils cited lack of practical laboratory activities and 22 (5.0%) pupils said that learning was done only theoretically due to lack of suitable learning resources.

Figure 4.11 Pupils' challenges when learning difficult topics in biology



Source: Field data, 2012.

The study sought information on the reasons why the topics were perceived to be difficult through follow-up interviews. Sixty six pupils were interviewed and the data obtained on the reasons and specific learning challenges were analysed and presented in Table 4.8 and Figure 4.11.

Table 4.8 Pupils' verbal reasons for the most difficult topics in biology

Topic	Reason	Frequency	%
Genetics	Terms used difficult	17	51.7
	Poor teachers' explanation	6	
	Complex calculations	1	
	It is bulky.	3	
	Complex genetic diagrams	2	
	Poor teachers' attitude to topics	2	
Nervous system	Poor teacher's explanation	2	6.7
	Names and terms used complex	2	
Skeletal system	Terms used complex	7	16.7
	Suitable books not available	3	
Reproduction in plants	Poor teacher's explanation	4	10
	Terms difficult	2	
Excretory system	Language and terms used complex	2	6.7
	Complex diagrams	2	
Mitosis and meiosis	Terms used complex	3	
	Too similar	2	8.3
Total		**60**	**100**

Source: Field data, 2012.

The data presented in Table 4.8 indicated that out of the sixty respondents 31 (51.7%) said genetics was tough. They gave various reasons such as complex terms, poor teachers' explanations, difficult calculations, bulkiness of the topic and even the teachers' negative attitude towards the pupils. Four (6.7%) pupils mentioned the nervous system and cited poor teachers' explanation and complex terms that characterize the topic as reasons for its being difficult. Ten (16.7%) respondents said the skeletal system was particularly difficult because of the complex terms. The absence of suitable reference books compounded the situation. Six (10.0%)

respondents mentioned reproduction and attributed its being difficult to poor teachers' explanation as well as the difficult terms used. The table also indicates that four (6.7%) respondents said the excretory system is difficult as it involved complex diagrams and complex names or terms. The table also shows that five (8.3%) pupils found mitosis and meiosis difficult because of the complex terms and the fact that the two were very similar especially regarding the cell division phases.

Figure 4.11 shows the data collected from the oral follow-up interviews. The figure indicates that the commonest challenge that respondents cited was confusing and complex terms represented by 17% followed by poor teachers' explanation (12%). It also shows that 6% of the pupils said that their teachers are usually moody and sulky-they easily lose their temper, another 6% of pupils cited failure to grasp the concepts involved as they were probably too difficult, others mentioned absence of laboratory work and that their teachers were too fast when teaching. A very small proportion (2%) of pupils mentioned teachers' failure to answer questions based on what they taught in class, and this leaves them in suspense as their doubts were not cleared. Some pupils, during the oral interview, observed that learning difficult topics could not have been this difficult if the schools had enough teaching and learning materials and their teachers were conducting practical work. This was evidenced in the words quoted from one of the respondents.

"In some topics in biology like in our school we do not have the labs so when we find topics that require Lab use, it becomes difficult to study" (student 25 [M, 03])

The pupils, during interviews, strongly spoke against unclear or what they called poor teachers' explanation and asserted that the learning challenges they were facing were largely due to the teachers' inability to explain, failure to use scientific terms as well as failing to give feedback. One student said: "The terms are difficult and the teacher does not use these terms. Our teacher is also moody. Our teacher assumes that you know, but I don't know. When he gives an assignment, he does not give feedback. I also feel very bad because he points at me and says that I will fail; why me?" (Student 1[F, 11]).

4.2.3 Possible practical teaching strategies to lessen pupils' learning difficulties

The findings on this theme were obtained from questionnaires and interviews.

The study sought information on the strategies that could be used to lessen the pupils' learning difficulties. As many as 451 pupils completed the questionnaire while 66 pupils were orally interviewed to give responses as to how the pupils' learning challenges would be lessened. The data obtained were analysed and presented in Table 4.9.

Table 4.9 Student's ideas about how best teachers could help them learn the difficult topics

Pupils' responses	Frequency	%
Teacher to research more and give notes	44	6.2
Teacher to revise complex topics	66	9.4
Give assignments/ homework to pupils	43	6.1
Clear teachers' explanation	105	14.9
Expose pupils to exam questions	65	9.2
Encourage group discussions	20	2.8
Teachers' positive attitude to pupils	42	6.0
Considering slow pupils	51	7.2
Teacher using T/L resources plus ICT	51	7.2
Motivate and encourage pupils	37	5.2
Conduct practicals	37	5.2
Remedial work	11	7.1
Use practical/ real examples	25	4.4
Allocate enough time to complex topics	31	4.4
Provide handouts e.g. pamphlets	29	4.1
Regular assessment	48	6.8
Total	**705**	**100**

Source: Field data, 2012.

Table 4.9 shows the findings from the questionnaires about the pupils' responses as to how best they would want to be helped to learn difficult topics with ease. A number of ideas were advanced but the majority 105(14.9%) mentioned clear teachers'

explanation, 65 (9.2%) said that there was need to expose the pupils to past examination papers so that they would be able to determine how to approach the difficult topics. Another 66 (9.4%) said it would be very helpful if the teachers began revising the difficult topics. The teachers needed to revise challenging topics so that the pupils could consolidate their understanding of difficult concepts. The results indicated that 51 (7.2%) mentioned the use of teaching and learning materials including the use of ICT in the classroom. Another 51 (7.2%) said that teachers needed to consider slow pupils and they should therefore adjust their style of teaching accordingly. Forty eight (6.8%) said that pupils would start performing well if the teachers assessed them more often than not so that the pupils would quickly work on their diagnosed deficiencies with respect to learning. The smallest proportion, 11 (7.1%) of the respondents cited remedial work, and that pupils would learn better those topics perceived as difficult if the teachers devised a system of administering remedial work to pupils.

Information on the strategies that could be used to lessen the pupils' learning difficulties was sought from the pupils through the oral follow-up interviews, 66 pupils were interviewed and the data obtained were presented in Table 4.10.

The findings in Table 4.10 which were obtained from the follow-up interviews show pupils' thoughts about how best the teachers could help them learn better the topics they perceived as difficult. The table indicates that the majority (23.7%) of the respondents mentioned use of teaching and learning resources including the use of ICT in the classroom. This finding coincided with the suggestion that the majority (27.8%) of the teachers put forward (Figure 4.20). This means that teaching and learning resources were particularly vital as they spoke for the teacher. About 13 percent (13.4%) said that conducting revisions by the teacher would lessen their challenges in learning difficult topics. The findings also show that 12.4% of the pupils said that clear and good teachers' explanation during lessons would be very helpful. Less than ten percent (8.2%) cited the frequent use of scientific terms by the teacher, another 8.2% mentioned regular assessment and that if the pupils were often assessed and given feedback they would diagnose their weaknesses early enough so that they could quickly unlearn the misconceptions established to improve their performance.

Table 4.10 Pupils' ideas about how best teachers could help them learn the difficult topics

Pupils' responses	Frequency	%
Motivation and encouragement	4	4.1
Teacher should show interest in the topics	4	4.1
Clear and good teachers' explanation	12	12.4
Practical examples	4	4.1
Friendly teacher	7	7.2
Allow asking questions	4	4.1
Teacher to use scientific terms often	8	8.2
Teacher to accommodate slow pupils	6	6.2
Teacher to use T/L resources plus ICT	23	23.7
Teacher to revise difficult topics	13	13.4
Regular assessment	8	8.2
Conduct practical in lessons	4	4.1
Total	**97**	**100**

Source: Field data, 2012.

Slightly over seven percent (7.2%) of the respondents said that they would learn better if the teachers became friendly because a friendly teacher was approachable and would therefore provide an opportunity for a student to ask where they were lagging behind. Some quotations from the pupils confirming this were as follows:

"The teacher should be accommodating especially when it comes to answering questions that pupils ask" (student 19 [F, 05].

"Our teachers do not allow us to ask a lot of questions so I feel shy and sometimes the teacher may think that I am being too much. When I ask questions, even my friends also say I am asking silly questions" (student 21 [F, 05]).

"I don't understand because the teacher does not explain. If you ask, the teacher will answer you something else" (student 4 [F, 11]).

“Teachers should be using proper charts as teaching and learning aids. They should also give us a lot of practical work not only notes” (student 48[F, 02]).

“Teachers should be researching before coming to teach. He should also be motivating, he says you guys will not pass” (student 3 [F, 11]).

“Some teachers just rush to finish the syllabus, they should be interested in teaching to make pupils understand the concepts” (student 5 [F, 11]).

“In this modern world technology can be of help in simplifying difficult topics. Things we cannot see should be presented on LCDs and by screens” (student 11[M, 04]).

The statements the pupils made during the oral interviews were explaining and highlighting the major challenges they faced in the classroom and they equally explained why pupils’ performance was not pleasing or satisfactory despite the pupils’ interest in biology. Majority of the pupils interviewed said biology was their favourite subject. The implication is that the teachers were not friendly and on this account failed to answer pupils’ questions.

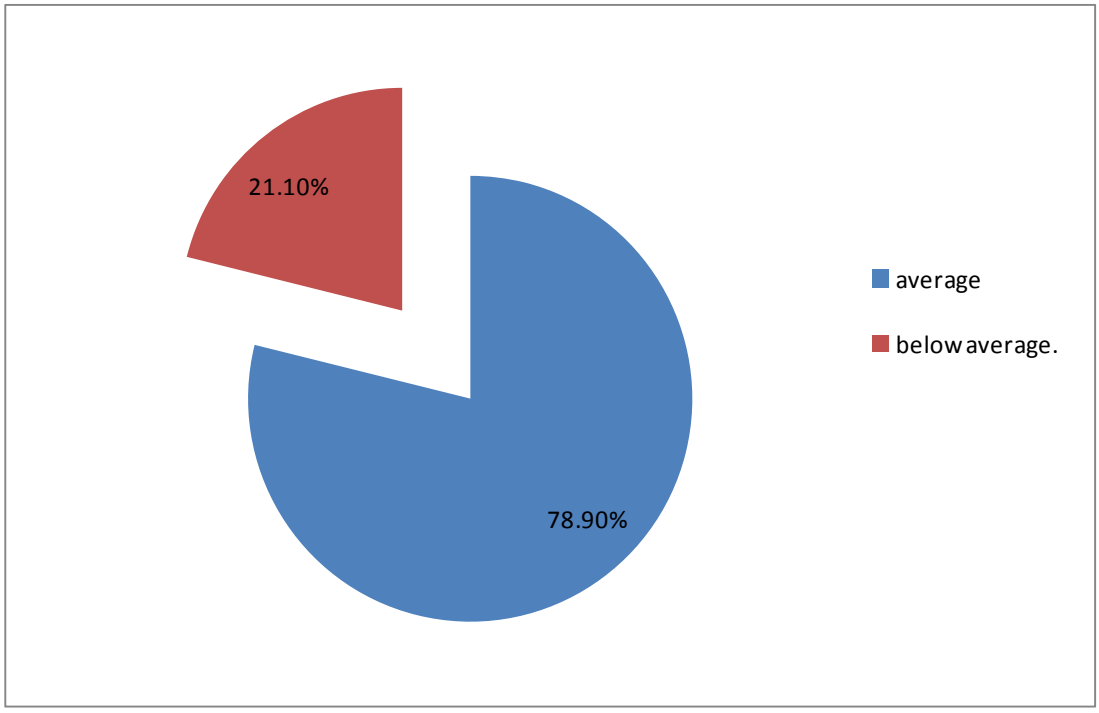
4.3 Teachers’ responses

Data were collected from biology teachers based on pupils’ average performance in biology, topics pupils perceive as most difficult as well as reasons why pupils find these topics difficult to learn.

4.3.1 Teachers’ responses about the pupils’ performance in biology.

The findings on this theme were based on 19 teachers who attended follow up interviews. The data obtained were presented in the Figure 4.12.

Figure 4.12 Teachers' responses about the performance of pupils in biology



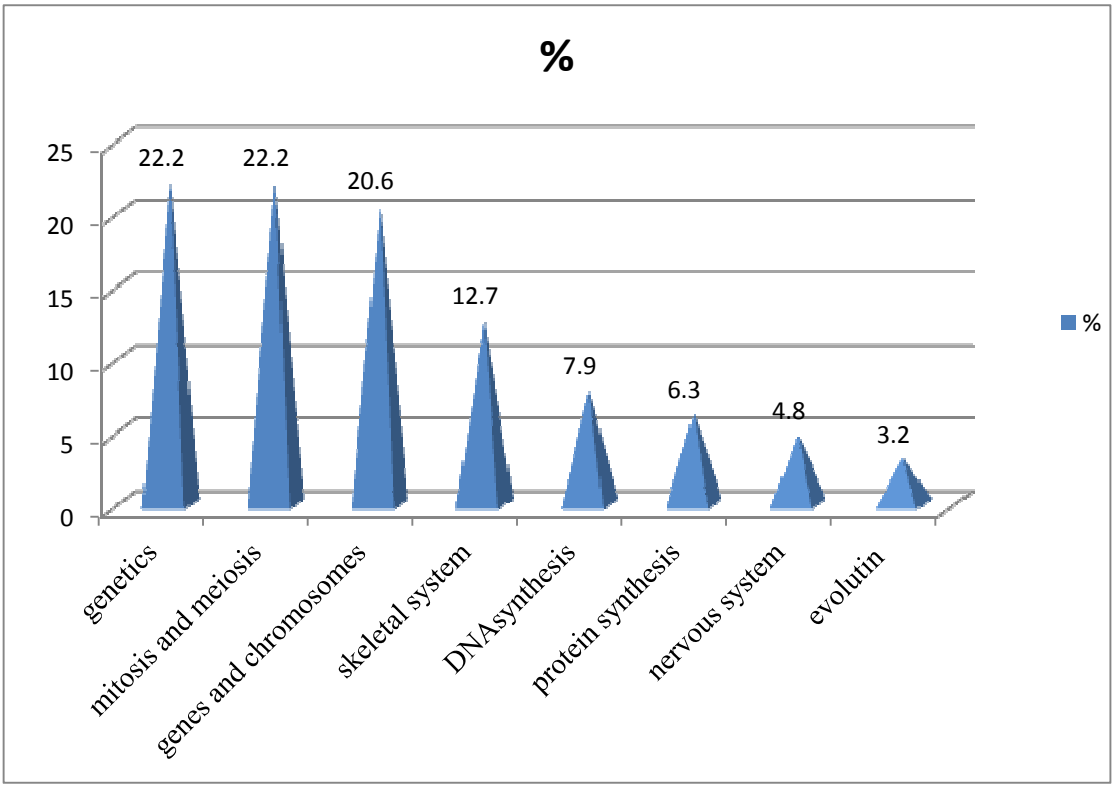
Source: Field data, 2012.

Figure 4.12 shows that the majority (78.9%) of biology teachers described the pupils' performance in biology as average. It also indicates that 21.1 % of the teachers considered their pupils' performance as being below average. No teachers described the pupils' performance in biology as being above average. This contrasted with the pupils' description of their performance in biology in Figure 4.8 which indicates that slightly more than half (54.5%) of the pupils under study said their performance was average and that 15.1% of the pupils described their performance as below average. Interestingly, About a third (30.3 %) of the pupils as indicated in Figure 4.8 described their performance in biology as above average.

4.3.2 Topics in biology perceived to be difficult for pupils to learn

The findings on this theme were obtained using the questionnaires and interviews. The study sought information on the topics perceived to be difficult from biology teachers in the high schools. 19 teachers completed the questionnaires and were also orally interviewed. The data collected were analysed and presented in Figures 4.13 and 4.14

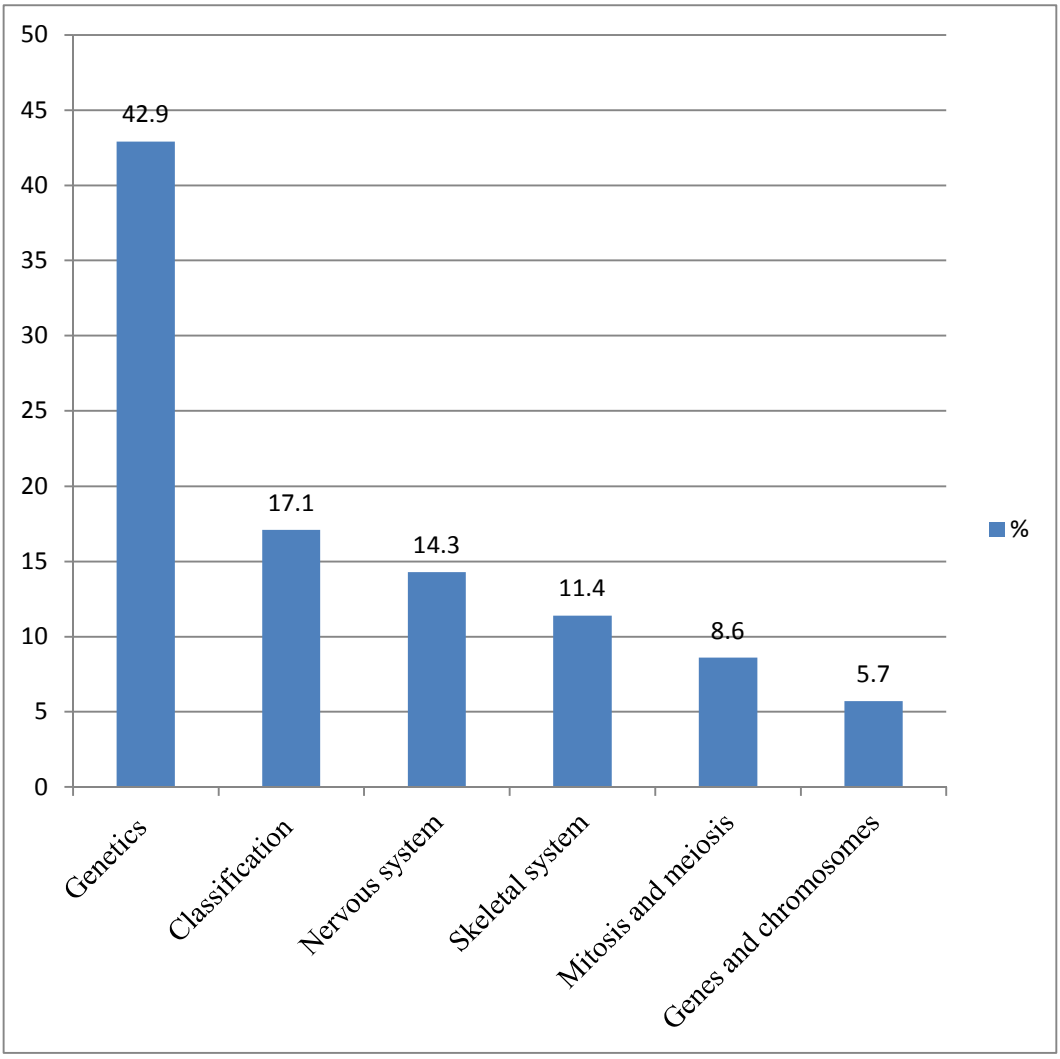
Figure 4.13 Topics in biology teachers thought pupils perceived as most difficult



Source: Field data, 2012.

Figure 4.13 which shows the data collected from questionnaires indicates that 22% of the respondents said that genetics is the most difficult topic; another 22% cited mitosis and meiosis, followed by 20.6% who said that genes and chromosomes was among topics that pupils perceived as most difficult in biology. The findings showed that a very small proportion of the respondents (3.2%) said evolution was one of the most difficult topics in biology. With respect to genetics, Figure 4.13 (teachers' responses) was consistent with Figure 4.9 (pupils' responses) in which genetics topped the list of the topics that both pupils and teachers perceived as the most difficult in biology. Nineteen biology teachers were interviewed to give responses about the topics the pupils perceived as most difficult to learn. The data obtained were analysed and presented in Figure 4.14.

Figure 4.14 Topics teachers thought their pupils perceived as most difficult



Source: field data, 2012.

The data presented in Figure 4.14 were obtained from oral follow-up interviews. It is clear that almost half (42.9%) of the respondents indicated that genetics topped the list of the topics pupils perceived as most difficult. The findings also showed that 17.1% of teachers of biology mentioned classification. A very small proportion (5.7%) of respondents mentioned genes and chromosomes as indicated in Figure 4.14. The respondents were emphatic when they admitted that such topics as genetics and classification were really difficult for pupils to learn and that they themselves sometimes found the topics difficult as evidenced by some excerpts below.

“Classification and genetics are difficult because even (we) teachers are not comfortable. These topics are wide and language or terms used are intimidating” (Teacher 1 [M, 11]).

“Some topics such as skeletal system have so many confusing names that sometimes pupils swap them, for example in bones, humerus and tibia are swapped. And then in genetics there is need for pupils to have some good mathematical background”. (Teacher 17[M, 06]).

4.3.3 Reasons why the topics were perceived to be so difficult

The study sought information on the reasons why the topics were perceived to be difficult from biology teachers. Nineteen biology teachers completed the questionnaires and attended the follow-up interviews. They gave responses on the reasons why the topics were perceived as difficult as well as the challenges teachers faced when teaching. The data were analysed and presented in Tables 4.11 and Figures 4.15 – 4.17.

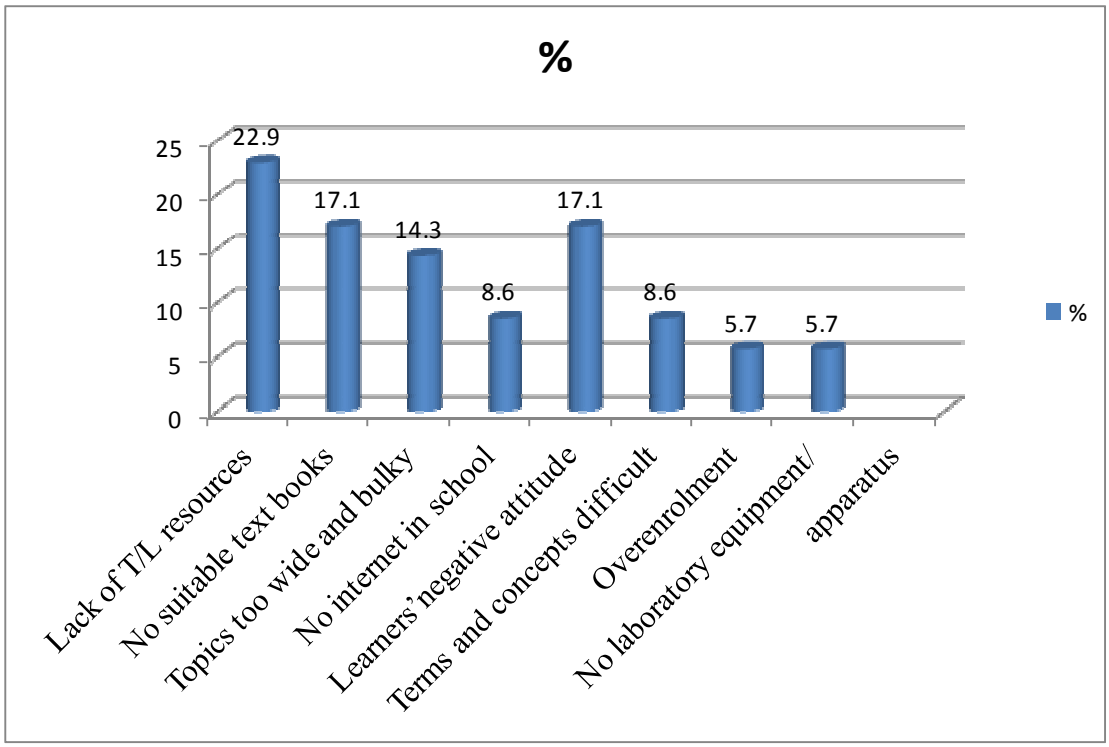
The data in Table 4.11 which were collected from questionnaires show that 16 (27.5%) respondents said mitosis and meiosis were difficult especially that there were no suitable teaching and learning materials in schools, the concepts involved were too similar and complex and cell division phases were difficult. Ten respondents (25%) said genetics was difficult because there were no suitable text books, no models used, names or terms used were complex and the topic was too abstract. The table also indicates that 5 respondents (12.5%) mentioned genes and chromosomes and said the topic was too theoretical. The smallest proportion (2.5%) of respondents cited nervous system and evolution and gave reasons as complex terms and the fact that the topics were too bulky.

Table 4.11 Teachers' reasons for the topics pupils perceive as most difficult

Topic	Reason	Frequency	%
Genetics	No models in school No suitable text books Terms are too technical and complex Too abstract	3 1 2 4	25
Mitosis and meiosis	Lack of T/L resources. Concepts too similar. Terms used are complex. Phases of cell division complex. Too theoretical	1 3 2 3 2	27.5
Genes and chromosomes	Too theoretical Application of concepts difficult	4 1	12.5
Skeletal system	Lack of teaching and learning resources Complex names /functions	2 2	10
Protein synthesis	Complex terms	2	5
Nervous system Evolution	Terms used are difficult Too bulky	1 1	2.5 2.5
Total		**40**	**100**

Source: Field data, 2012.

Figure 4.15 challenges Teachers face when teaching topics perceived as most difficult

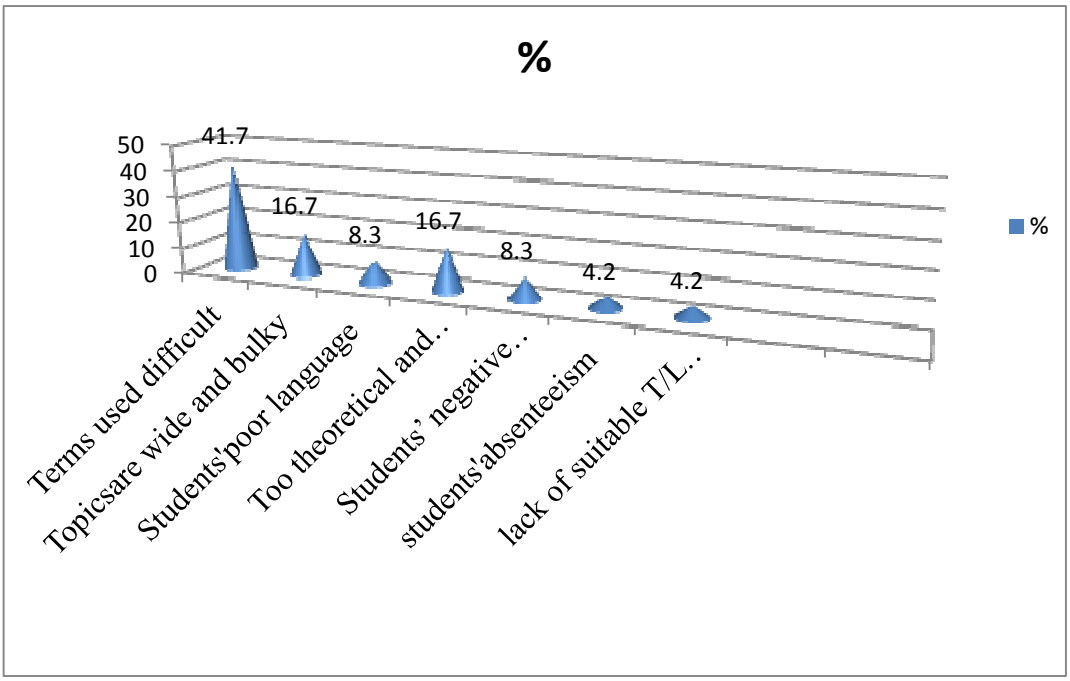


Source: Field data, 2012.

Figure 4.15 shows data obtained from the questionnaires and indicates that majority (22.9%) of biology teachers said that lack of suitable teaching and learning resources is the greatest challenge that they ever faced when teaching difficult topics in biology. Some teachers (17.1%) cited lack of text books for reference, another17.1% said pupils had a negative attitude towards topics perceived as difficult and this made teaching difficult as well. A small proportion (5.7%) of teachers explained that challenges they were facing were as a result of over-enrolment and lack of laboratory equipment and suitable apparatus.

The study sought information on the reasons why topics were perceived to be difficult from biology teachers through follow-up interviews. Nineteen biology teachers were orally interviewed. They gave responses on the reasons why topics were perceived as difficult as well as the challenges they experienced when teaching. The data were analysed and presented in Figures 4.16 and 4.17.

Figure 4.16 Teachers' reasons for the topics in biology pupils perceived as most difficult

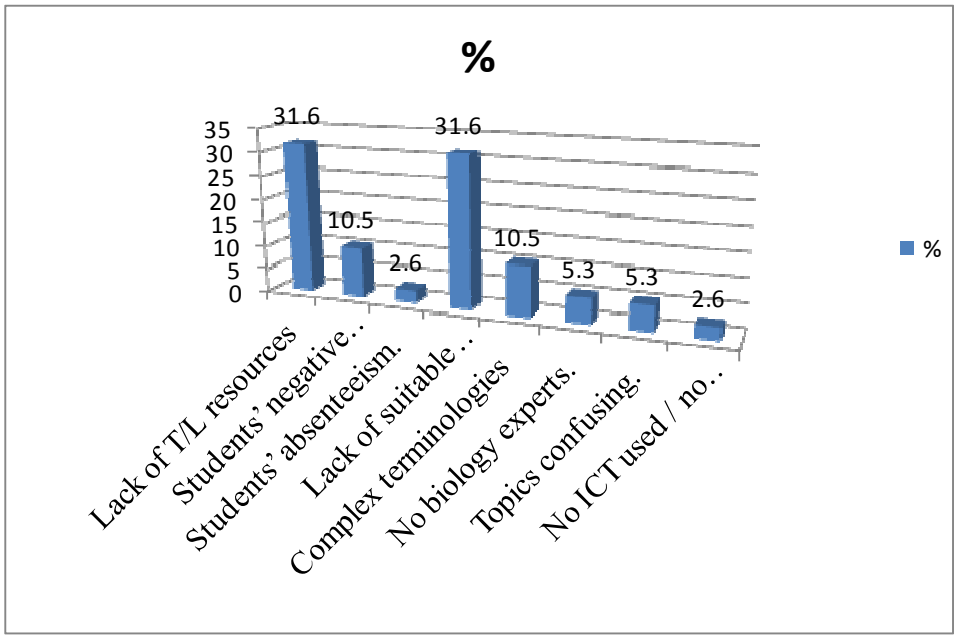


Source: Field data, 2012.

The findings in Figure 4.16 were collected from the oral follow-up interviews. The figure showed that most respondents (41.7%) cited difficult terms as one of the reasons pupils found some biology topics difficult. Just fewer than 20 (16.7%) said topics were too wide and bulky. It also shows that very few teachers (8.3%) mentioned pupils' poor vocabulary as a hindrance to effective communication as well as pupils' negative attitude towards the topics. A small proportion (4.2%) of respondents said that pupils' absenteeism and lack of suitable teaching and learning resources were seen to contribute to poor conception of difficult topics. Some teachers attributed pupils' negative attitude towards the topics perceived as most difficult to the fact that they began to learn those topics with preconceived ideas that the topics were difficult. Possibly this is what they were told by others. One teacher was quoted as below.

"Sometimes pupils do not perform well because they come to school with preconceived ideas that genetics is difficult. This is already a barrier" (Teacher 15[F, 10]).

Figure 4.17 Teachers' challenges when teaching topics in biology perceived as difficult



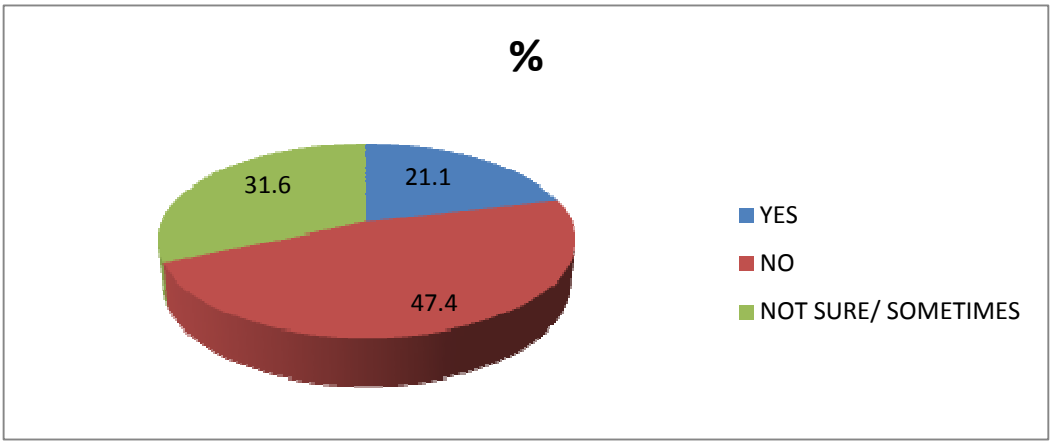
Source: Field data, 2012.

The data in Figure 4.17 obtained from the follow-up interviews indicate the various challenges that biology teachers faced when teaching the topics that pupils found difficult to learn. About thirty seven percent (36.6%) of the biology teachers cited lack of suitable teaching resources and lack of suitable text books and other related materials from which relevant information about challenging topics could be retrieved. About ten percent (10.5%) of teachers cited the negative attitude of pupils towards those topics they perceived as difficult as well as complex biological terms which were difficult to pronounce and recall. The findings also suggested that 5.3% of the respondents cited lack of properly qualified biology teachers, meaning teachers that had studied biology at least up to degree level. This was consistent with results in Figure 4.5 which show that majority (63.4%) of biology teachers were only diploma holders. Figure 4.17 also shows that a small proportion (2.6%) of biology teachers said that absence of internet and failure to integrate ICT into the classroom made it difficult to teach the topics which were difficult.

4.3.4 Effect of gender difference on pupils' perception of learning difficulties

The findings on this theme were obtained from the biology teachers through interviews. The study sought information on the effect of gender difference on pupils' perception of learning difficulties from the biology teachers. Nineteen teachers completed the questionnaires and were orally interviewed to give the responses. The data obtained were presented in Figure 4.18

Figure 4.18 Teachers' opinions about the effect of gender difference on pupils' perception of learning difficulties



Source: Field data, 2012.

The data in Figure 4.18 which were obtained from oral interviews indicate that 31.6% of the teachers stated that they were not sure whether or not male and female pupils perceived the same difficult topics alike; some of them said sometimes. Almost half (47.4%) of the biology teachers said the male and female pupils did not perceive the difficult topics the same way.

Some respondents, during the interview stressed that girls perceived the difficult topics in biology as being manageable while their male counterparts perceived the same topics as difficult and sometimes girls even performed better than boys did. One biology teacher said: 'Girls have more interest in biology and have fewer difficulties" (teacher 5, [M, 09]). However, the teachers seemed to have opposing views about the effect of gender on perception of difficult topics because, during the oral interview some teachers said boys always performed better. One respondent is quoted below:

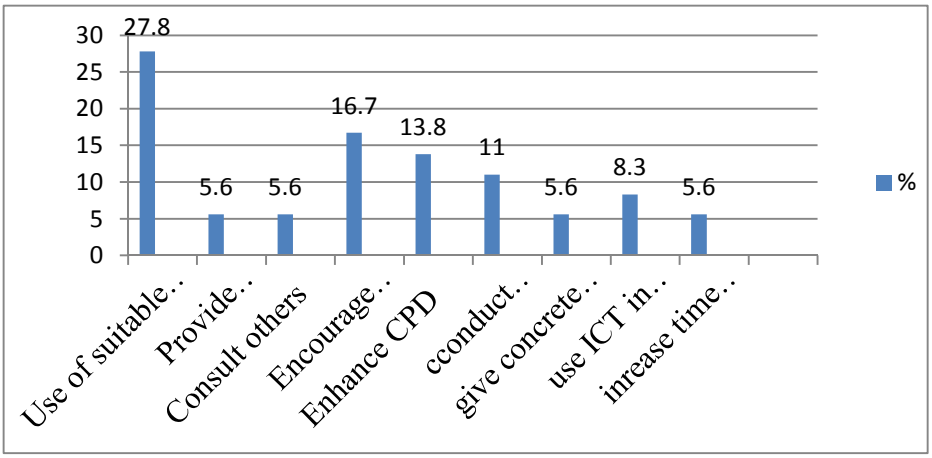
"Boys perceive difficult topics differently, the boys understand quicker than girls. This is attributed to lack of motivation among girls themselves" (Teacher 17 [M, 6]).

The findings in Figure 4.18 also show that 21.1% of the respondents said that both male and female pupils perceived the same difficult topics alike.

4.3.5 Possible practical teaching strategies to lessen pupils' learning difficulties

The findings on this theme were obtained from questionnaires and interviews. The study sought information on the strategies that could be used to lessen the pupils' learning difficulties. Nineteen teachers completed the questionnaire and were then orally interviewed to give responses as to how the pupils' learning challenges would be lessened. The data obtained were analysed and presented in Figure 4.19 and 4.20.

Figure 4.19 Teachers' suggested strategies to lessen pupils' difficulties

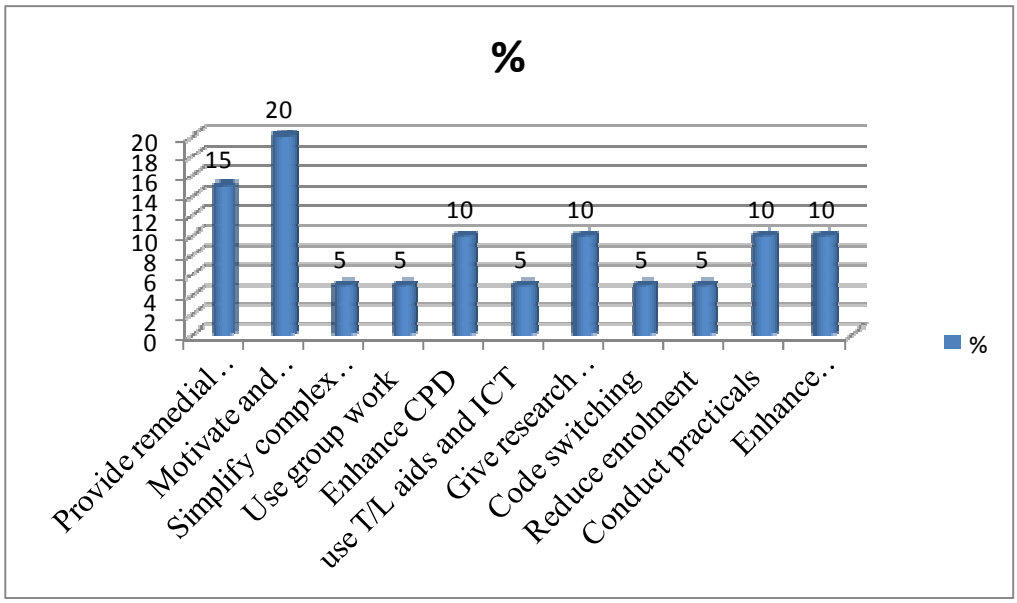


Source: Field data, 2012.

The data presented in Figure 4.19 which were obtained from the questionnaire show that the majority (27.8%) of the respondents said providing teachers with learning resources would help lessen the challenges the biology teachers face when teaching difficult topics in biology. Less than 20 per cent (16.7%) said encouraging research among pupils would be helpful. A small proportion (5.6%) of biology teachers cited increasing time allocation, meaning that the difficult topics should be allocated enough time so that they were adequately handled rather than just rushing through as was the case sometimes.

The study sought information on the strategies that could be used to lessen the pupils' learning difficulties from biology teachers through follow-up interviews. Nineteen teachers were orally interviewed to give responses as to how the pupils' learning challenges would be lessened. The data obtained were analysed and presented in Figure 4.20.

Figure 4.20 Teachers' suggested strategies to lessen pupils' learning difficulties



Source: Field data, 2012.

Figure 4.20 which shows the data collected from the oral interviews clearly show that the majority (20%) of the respondents said challenges would be minimised when teaching difficult topics if pupils were motivated and encouraged. The strategy to teach pupils in a way that would lead to their being motivated to learn better came up very often during the oral interviews with the biology teachers, and they emphasised the fact that there is need to motivate pupils in various practical ways including teaching with interest. One respondent said:

"If you have interest it is easy to build interest in the children. So we need to teach with interest, it is the way we present these difficult topics" (Teacher 14 [F, 07]).

A good proportion (15%) of the respondents said that providing remedial work would greatly help address the challenges. Ten of the biology teachers cited enhanced Continuing Professional Development (CPD) activities, giving research work or homework to pupils, improvisation and conducting practical work so that the pupils could have a concrete understanding of what they learned. It also indicates that a small proportion (5%) of teachers mentioned reducing the class size (pupil: teacher ratio) to reasonable, using ICT and other learning materials, making use of group work, and code switching in which case the teachers would be using English and a local language side by side to enhance pupils' understanding.

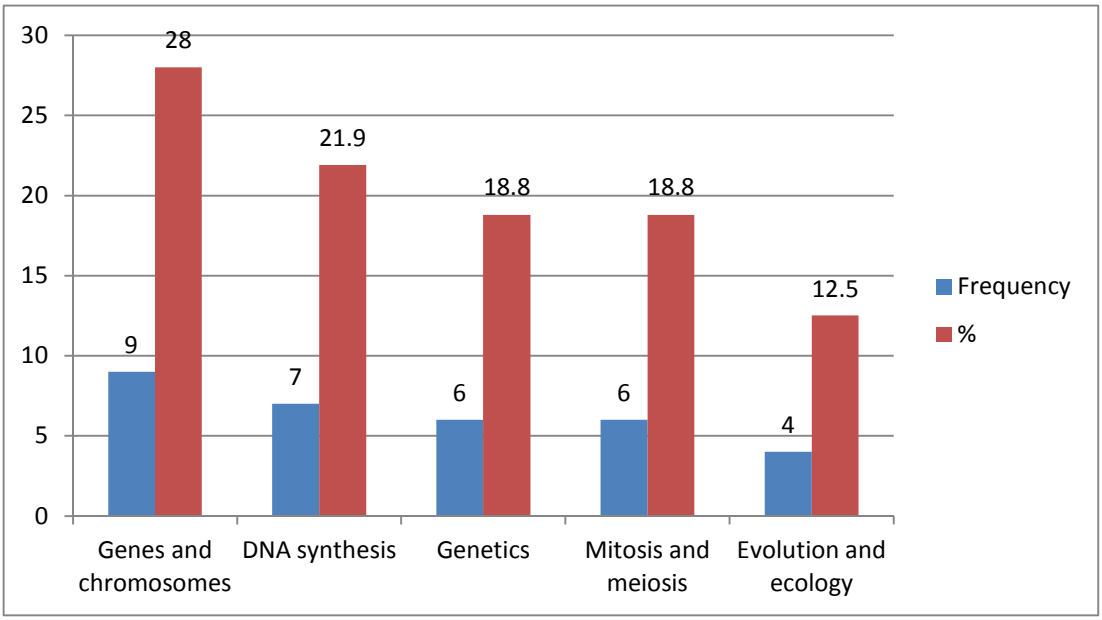
4.4 Heads of Departments' (HODs') responses

The researcher obtained data based on pupils learning difficulties from 11 HODs.

4.4.1 Topics in biology perceived to be difficult for pupils to learn

The findings on this theme were obtained from HODs using the questionnaire. The study sought information on the topics perceived to be difficult from HODs in the high schools. The data from 11 HODs were analysed and presented in Figure 4.21.

Figure 4.21 Topics that HODs think pupils perceive as most difficult



Source: Field data, 2012.

Figure 4.21 which shows the data collected from HODs indicates that the majority (28%) of HODs said that the topic, genes and chromosomes, was the most difficult

followed by DNA synthesis (21.9%). Figure 4.21 also shows that evolution (cited by 12.5% of the HODs) ranked last on the list of the most difficult topics.

4.4.2 Reasons why the topics were perceived to be so difficult

The study sought information on the reasons why the topics were perceived to be difficult from HODs. The information was sought from the HODs through the questionnaire. The data from 11 HODs who completed the questionnaire were analysed and presented in Table 4.12.

Table 4.12 HODs' reasons for the topics in biology pupils perceived as most difficult

Topic	Reason	Frequency	%
Genes and chromosomes	Complex terminologies.	8	29.6
DNA synthesis	Concept of bases is complex, too abstract and too theoretical	3	11.1
Genetics	Complex terms used. Too theoretical. Genetical diagrams difficult. Too long and bulky	2 2 1 3	29.6
Mitosis and meiosis	Complex terms used Too theoretical. Stages of cell division too similar and complex	1 2 2	18.5
Evolution and ecology	Too bulky Too theoretical	2 1	11.1
Total		**27**	**100**

Source: Field data, 2012.

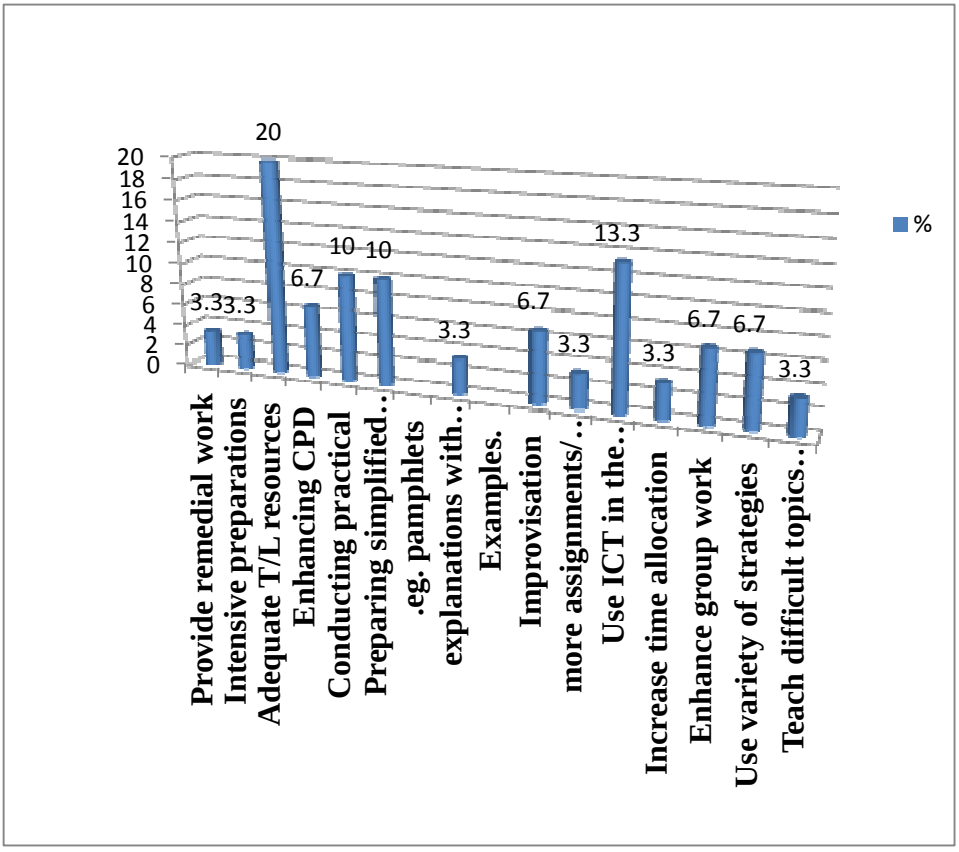
Table 4.12 indicates that eight HODs (29.6%) said that genes and chromosomes was the most difficult as this topic was characterised by very complex terminologies. The implication is that the difficult terms associated with this topic seemed to hinder or weaken the pupils' ability to grasp concepts. Another eight respondents (29.6%) said

genetics is difficult and cited reasons such as the complex terms used, genetics diagrams which are difficult to understand and that the topic is just too long. Five respondents (18.5%) mentioned mitosis and meiosis and said that the topic involved a lot of complex names or terms, it is too theoretical and cell division phases in mitosis and meiosis were too similar, implying that they tend to be confusing. The findings equally show that three (11.1%) said that Evolution and Ecology were bulky and highly theoretical.

4.4.3 Possible practical teaching strategies to lessen pupils' learning difficulties

The findings on this theme were obtained from a questionnaire. The study sought information on the strategies that could be used to lessen the pupils' learning difficulties. Eleven HODs completed the questionnaire to give responses as to how the pupils' learning challenges would be lessened. The data obtained were analysed and presented in Figure 4.22 below.

Figure 4.22 HODs' suggested strategies to lessen pupils' learning difficulties



Source: Field data, 2012.

Figure 4.22 shows that among the interventions that teachers would embark upon to lessen pupils' challenges as suggested by HODs; use of teaching and learning resources was cited by 20% of respondents who said this would most effectively help the pupils learn the most difficult topics in biology. It also indicates that use of ICT in the classroom (cited by 13.3%) would be almost as effective. The findings also show that explanations with practical examples, home work, increasing time allocation to the difficult topics and teaching such topics early enough, remedial work and teachers' intensive preparation (cited by 3%) would help the pupils to some extent.

CHAPTER FIVE: DISCUSSION

5.0 Introduction

This study sought to establish the topics in biology perceived as difficult for high school pupils to learn. The study employed questionnaires and follow-up interviews. Results established that Mendelian genetics, mitosis and meiosis, genes and chromosomes, DNA synthesis, skeletal system and evolution were the most difficult topics in biology. Below is a discussion of the specific findings.

5.1. Topics in biology high school pupils perceived to be difficult

The study has indicated that there were many difficult topics that pupils perceived as difficult to learn, and that the topics that HODs and biology teachers referred to as most difficult topics for the pupils to learn were basically the same as those that pupils themselves described as most difficult for them to learn. The HODs cited genes and chromosomes, DNA synthesis, Mendelian genetics, mitosis and meiosis and evolution as indicated in Figure 4.21. Teachers said the most difficult topics were Mendelian genetics, mitosis, genes and chromosomes, skeletal system, DNA synthesis, nervous system and evolution as shown in Figure 4.13 and Figure 4.14. The pupils referred to genetics, mitosis, DNA synthesis, skeletal system, genes and chromosomes, evolution enzymes and ecology as the most difficult topics.

The study has also suggested that the most difficult topics as described by all categories of respondents were genetics, DNA, genes and chromosomes, mitosis and meiosis, evolution and skeletal system. According to the findings the most difficult topics were ranked in the descending order of degree of difficulty based on their

average percentage score from HODs', teachers' and pupils' questionnaires, and teachers and pupils' interviews as follows: Genetics 27.0%, mitosis and meiosis 14.9%, genes and chromosomes 13.3%, DNA 9.9%, skeletal system 9.9% and evolution 4.7%. Therefore, the study established that the topics perceived as most difficult in order of descending degree of difficulty were as follows: Mendelian genetics, mitosis and meiosis, genes and chromosomes, DNA synthesis, skeletal system and evolution.

The study also has indicated that there were two other topics that the biology teachers thought pupils found difficult to learn, namely: classification and protein synthesis but the findings from the pupils' responses showed that pupils did not have problems with these topics. The pupils, instead, stated enzymes, ecology, nervous system, excretory system and reproduction in plants as the topics in which they experienced relatively few learning difficulties.

5.2 Reasons why the topics were perceived to be so difficult

The study has suggested that the challenges or difficulties pupils faced when learning topics they perceived as difficult were attributable to various factors. The findings indicated that the difficult topics were characterised by complex scientific terms and language that created a barrier so that pupils' understanding was restricted if not distorted. The fact that pupils were put off by the specialist vocabulary meant that there would be communication breakdown leading to failure to grasp concepts on the part of the pupils. This situation arose if the teacher did not help the pupils conceptualize the terms associated with that particular topic. The study also suggested that there were some teachers who failed to use the associated terms simply because they too were not comfortable with the vocabulary in question. The implication is that the inability of the teachers to explain 'specialist vocabulary' surrounding biological concepts was an indication of their inadequacies (Bennett, 2002).

The study indicated that due to the abstract nature of the difficult topics and the fact that they were taught theoretically, pupils found getting the concepts a big challenge. It was clear from this study that teachers of biology did not conduct practical work to enhance and concretise pupils' understanding. However, the biology teachers and HODs claimed that although they were willing to conduct practical work, the schools

lacked suitable laboratory equipment or apparatus and the necessary materials. This means that the teachers seemed to admit that had it not been for the paucity of the laboratory equipment and materials the learning challenges would not have been what they are today. On the contrary, the findings showed that it was not the lack of laboratory equipment or apparatus that caused the failure to conduct practical work on the part of the teachers in all cases but the fact that some teachers are incompetent with regard to conducting practical work. Some teachers lacked necessary practical skills to conduct meaningful practical work. The findings are consistent with the thoughts of the scholars Young (1994) and Woodley (2009) who explain that some teachers fail to conduct practical work because they are quite clumsy and awkward at performing experiments and their practical skills are so poor that they normally make wrong observations and inferences. Such teachers consequently get frustrated and begin to shun practical work a situation that accounts for pupils' poor performance in biology.

Furthermore, the study also has suggested that some teachers expressed incompetence when it comes to improvisation. The failure to improvise could be attributed to inadequate teaching experience of some teachers. The findings in Figure 4.4 have shown that almost half of the biology teachers had only taught biology for the period of between 1 to 5 years and so they were very likely to lack improvisational skills.

The study suggested that the pupils also attributed their failure to learn the difficult topics effectively to what they termed poor teachers' explanation in the course of teaching and learning. The failure on the part of the teacher to explain clearly the necessary concepts to the pupils only goes to explain the depth of incompetence possibly as a result of one teaching a grade they were not qualified to handle or their poor or negative attitude towards their work. Teachers' negative attitude towards work would nurture in the teacher the propensity to evade study and research, hence failing to allow pupils to ask questions and getting sulky as a defense mechanism. The effects of this scenario are far reaching indeed. Firstly, formative assessment in the classroom would be at stake, but the teacher must realise that formative assessment is as important as the learning process itself and that questioning and giving feedback in terms of answering the questions is an *ingredient* of formative assessment. The findings agree with Brook hart (2006) and Boston (2002) who explain that formative

assessment seeks to identify and ascertain the gap between what the learner knows currently and the desired goal for him or her to reach. This provides an opportunity for both the teacher and the learner to adjust learning in relation to the goals. This means that without formative assessment, the pupils' performance could not improve.

The findings indicated that 63.4% of all teachers of biology in the study site handled the senior classes for which they were not qualified because they were diploma holders .The minimum qualification for one to handle a senior class is secondary teachers' degree. But, owing to inadequate number of graduate teachers, schools usually made use of diploma holders to fill up the gap.It is difficult for the pupils to grasp the concepts that the teacher failed to understand. The findings were in agreement with David *et al*. (2012) who argue that the extent to which the teacher understands and explains a topic largely depends upon his / her academic qualification .Poorly qualified teachers will naturally find it difficult to clarify complex concepts, and if it is difficult for the teacher to grasp complex concepts one would not expect the pupils to understand the concepts. Under these circumstances it would really be difficult for the pupils to construct knowledge and correct meaning of what is being learned. The correctness and accuracy of the information the pupils receive are a function of a suitably qualified teacher .Otherwise, if teachers do not have suitable qualification they are likely to transmit wrong descriptions of observations, misconceptions, misinformation, and they are bound to misapply or misinterpret the content taught and scientific terminologies.

This study has shown that poor pupils' mathematical skills were one of the reasons some pupils found topics that involved some calculations difficult. The findings in this study suggested that teachers explained poor pupils' performance in the topics perceived as most difficult such as genetics in terms of pupils' failure to apply their mathematical skills. This deficit on the part of the pupils was well acknowledged by the pupils themselves, and it really accounted for their learning challenges.

The study showed that topics that involved calculations such as probability in genetics were not popular among pupils who, at the same time, do not perform well in Mathematics. The concepts involved may not necessarily be complex but the failure on the part of the pupils to solve the mathematical aspect of the concepts is what made

pupils perceive such topics as difficult. The findings were consistent with what Knippels (2002) and Osborne (2003) independently observe. They argue that pupils who perform poorly in mathematics often also do so when solving genetics problems and indeed in other biological concepts that were mathematical in nature.

The study has further established that Natural Sciences Departments in high schools lacked adequate suitable teaching and learning resources to teach the difficult topics. In addition to this, the high schools lacked other essential facilities such as computer laboratories and internet connectivity which both teachers and pupils would use for their research and study. Nonetheless, this scenario should not be viewed as a good excuse to fail to incorporate or integrate ICT in the classroom. There is this misnomer that teachers would only use ICT in the classroom if they had computers and had access to internet. Teachers have to realise that use of DVD/CD players, radios, video cassette recorder, TV sets and decoders was a very effective and efficient way of integrating ICT in the classroom .For instance, a biology teacher would play a DVD/CD to show the process or phases of mitosis and meiosis or food relationships among organisms in ecology or transcription in DNA and so on, in order that pupils may learn in a more life-like situation as this would help them conceptualise more effectively.

5.3 Effect of gender difference on pupils' perception of learning difficulties

The study has established that gender difference had an impact on the pupils' perception of learning difficulties as evidenced in Figure 4.18 which clearly indicates that almost half (47.4%) of the teachers had noticed such an effect of gender on the pupils' perception.

The study further suggested that some teachers of biology thought that the topics that boys found difficult to learn, girls found them easy to learn while others felt that it was the other way round, and argued that boys perceived the difficult topics as being fairly manageable. They further argued that the boys understood the topics faster and were more likely to endure and work on the difficult topics until they grasp the concept than the girls would. This thought is supported by Tekkya *et al.* (2001) who showed that there were more girls than boys who perceived more biological concepts as difficult to learn. This means that teachers of biology acknowledged the fact that

gender has an effect on the pupils' perception of learning difficulties but they were not completely agreed on which gender *per se* has a better or a more positive perception of learning difficulties. This is in agreement with Mavrikaki *et al.* (2012) who argued in the study they conducted that gender does not seem to affect pupils' overall views about difficult topics in biology.

5.4 Possible practical teaching strategies to lessen pupils' learning difficulties

The study established that a variety of teaching and learning strategies needed to be employed if the biology teachers had to lessen the pupils' learning difficulties in relation to difficult topics. The study suggested that there was need for the biology teachers to develop and promote a culture of preparing adequately, as this would help them strictly think about appropriate methods of delivery and consider, in very specific terms, the kind of teaching and learning resources that would address the learning needs of their pupils. The study also suggested that teachers of biology needed to use the teaching and learning resources including ICT if they had to attain good pupils' performance in the challenging topics, and that they had to improvise where the needed materials were not available. This would help their pupils concretise their understanding. Young(1994) and Woodley (2009) back this thought and argue that the poor pupils' performance in biology with respect to difficult topics is as a result of some schools not having relevant teaching and learning resources that teachers need to teach the challenging topics .

The study established that, to effectively go round the pupils' learning challenges posed by the difficult topics, teachers of biology needed to conduct practical activities. Practical work is not only motivating but it also brings reality into the classroom and serves as a bridge between real life and theory, a situation that immensely enhances pupils' understanding of abstract terms. Failure to use laboratory activities on the part of the teacher as Onyegegbu (2001) explained made it rather difficult for pupils to grasp difficult biological concepts.

The study has also established that teachers would help their pupils understand difficult topics if they began to incorporate into their lesson plans remedial work which should be administered to slow pupils shortly after each normal lesson. This would be an effective way to take care of slow pupils so that they grasped concepts

that they could otherwise have failed to comprehend had the teacher just ignored them. However, the teacher should explain the purpose of administering remedial work to slow pupils so that pupils do not view it as punishment since it would demand that they remain in class a little longer than usual. The study has established that in addition to remedial work, most teachers of biology expressed desire to plan for revision work. This is very helpful to pupils as it provides pupils with another opportunity to learn the same difficult topics so that their understanding of these topics is a lot better now than ever before. However, this could prove to be a daunting task on the part of teachers especially in schools where there was over enrolment and teachers were already overworked.

The findings suggested that in order to improve learning and performance in relation to the difficult topics, teachers needed to administer assignments, homework or any other research work to get the pupils engaged so that they began to understand things before hand. Marking assignments or homework could be challenging in schools where the enrolment levels are exceedingly high, but this is a *necessary evil* if the intention of teachers of biology was to go round the challenges that pupils face when learning those difficult topics. This, in the final analysis, would increase time that biology teachers needed to deal with the difficult topics as the pupils will have been exposed to the same topic on more than one occasion.

The findings showed that one of the principal reasons the pupils experienced learning challenges when learning difficult topics was that topics were characterised by complex terms or vocabulary. To navigate round this, the teacher could help the pupils by citing practical or concrete examples to illustrate the concepts. Use of concrete examples tended to enhance understanding because they were akin to the pupils' immediate environment. The findings agree with Bemmett (2002) who highlights the effect of the failure on the part of teachers to explain to pupils what he refers to as 'specialist vocabulary' prior to actual learning. He explains that the teachers' inability to simplify the associated complex terms would negatively affect pupils' ability to grasp the concepts. This is further supported by Ogunkola & Samuel (2011) who point out that many difficult terms and symbols used in teaching of the sciences were so new that they needed to be clearly explained if they had to be linked

to the pupils' cognitive structures. Failure to which there, certainly, would be poor understanding of biological concepts on the part of the pupils.

The study showed that there was need for teachers to embark on regular formative assessment through administering research and home work to easily diagnose the pupils' weaknesses in good time with a view to redressing the situation. Formative assessment which occurs as an integral part of teaching and learning process provides a wide spectrum of opportunities to assess how pupils are learning so that the information thus collected could then be used to make necessary adaptations and adjustments with a view to improving pupils' achievement. The findings were supported by Black & William (1998), Boston (2002) and Baroud (2007) who strongly advise that there is no better alternative to formative assessment if the intention is to improve the pupils' performance.

The study has also suggested that teachers of biology would teach the difficult topics in biology effectively if they enhanced Continuing Professional Development (CPD) which provided a professional platform for the teachers to share and exchange intellectual and professional ideas on how best to teach the topics that the pupils perceived to be difficult. This collaboration between or among teachers was vital as it sharpened their pedagogical skills and it made them teach biology topics in a more meaningful way.

CHAPTER SIX: SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

The study has established the topics that high school pupils found difficult to learn. According to the findings, the most difficult topics ranked in the descending order of degree of difficulty were Mendelian genetics, mitosis and meiosis, genes and chromosomes, DNA synthesis, skeletal system and evolution.

The study also suggested the reasons why the topics were so difficult to learn. The findings showed that there were many reasons why pupils experienced challenges in learning difficult topics. These included the fact that topics were characterised by complex terms; teachers of biology were not conducting practical laboratory work but taught just theoretically, paucity of teaching and learning resources including lack of suitable text books and failure by teachers to use ICT in the classroom. Some teachers failed to handle difficult topics as evidenced by their poor explanation of concepts, and that they did not possess right qualifications to handle senior classes. Some of them were quite inexperienced with respect to teaching biology, and that departments in Natural Sciences in high schools were understaffed.

The study also established that some pupils faced learning challenges because of their poor mathematical background and so they could not cope with topics in biology that were mathematical in nature. The findings also showed that over enrolment existing in high schools had led to teachers handling too many large classes which deprived the teachers of an opportunity to administer remedial work and attend to individual pupils' learning needs.

The study suggested that gender difference had an impact on the pupils' perception of learning difficulties, and the teachers of biology acknowledged the fact that gender had an effect on pupils' perception of learning difficulties but they were not completely agreed on which gender, per se, had a better or a more positive perception of learning difficulties as this was dependent upon the pupils' orientation, disposition, context and school environment.

The study also suggested that a variety of teaching strategies would help pupils learn with ease those topics they perceived as most difficult. These included the teachers inculcating in themselves a culture to prepare their lesson adequately, use of adequate teaching and learning resources which involves well researched and simplified handouts, incorporating ICT in the classroom, promoting active student-centred teaching strategies and employing effective communication skills characterised by clear explanations and reference to real-life practical examples. The study also showed that biology teachers would go round the pupils' learning challenges through motivating their pupils, administering remedial work to the slow pupils, revising the difficult topics, giving assignments or research work (homework) based on the challenging topics to pupils prior to classroom learning so that pupils are adequately exposed to the difficult topics. The findings suggested that conducting formative assessment more often than not and viewing this pedagogical practice as an integral part of every learning experience would significantly lessen the learning difficulties.

6.2 Conclusion

The results of the study have established that the most difficult biology topics in the 'O' level biology syllabus that pupils found difficult to learn included: Mendelian genetics, mitosis and meiosis, genes and chromosomes, DNA synthesis, skeletal system and Evolution.

The study has shown that pupils found the aforesaid topics difficult to learn due to a number of reasons which, among many others, include: poor teachers' explanations which made it difficult for the pupils to grasp the concepts under discussion, the topics were characterised by complex terms which were difficult to read and recall. Some of the topics perceived as difficult were mathematical in nature and so they proved to be challenging to pupils with poor mathematical background. There was also significant lack of teaching and learning resources including ICT facilities for use by both teachers and pupils in high schools. It was further established that teachers of biology did not conduct practical work when teaching difficult topics, and formative assessment in biology was rarely conducted while feedback to pupils was normally delayed.

The study established that gender difference had an impact on pupils' perception of difficult topics. The boys and girls did not perceive the difficult topics the same way. The biology teachers, however, were not agreed on whether or not it was the girls or boys that had a positive perception of the difficult topics in biology. Depending on the nature of the pupils' learning environment or orientation, the girls performed better in topics boys found difficult to learn and *vice versa* .

Notwithstanding the learning challenges that the pupils experienced in biology, the study showed that use of effective strategies could greatly lessen the learning difficulties. These strategies included: teachers needed to provide remedial work for slow pupils, CPD should be promoted and enhanced in high schools to facilitate professional and intellectual exchange of ideas among teachers, teachers needed to engage their pupils in research work and practical activities, and teachers needed to use appropriate teaching and learning resources including ICT. There was also a need for teachers to intensify improvisation where there is paucity of learning and teaching resources. High schools and teachers have the capacity to lessen pupils' learning challenges by resolving to implement suitable teaching and learning strategies.

6.3 Recommendations

In view of the findings presented and discussed in this study, it is recommended that:

(i) There should be rigorous regular monitoring of the teaching of biology in both public high schools by the local school authorities as well as by external authorities who may include the Senior Education Standards Officers (SESO), District Education Standards Officers (DESO), and Education Standards Officers (ESO) so that the teachers of biology intensify their lesson preparations and improvisation.

(ii) The schools should renovate their biology laboratories, and Government through grants should restock these laboratories in terms of necessary equipment or apparatus, chemicals, and models and other required teaching and learning materials to ensure effective teaching of biology in schools.

(iii) The Government should employ more graduate teachers of biology and post them to all high schools across the country as these would not find teaching difficult topics that challenging.

(iv) The Government should facilitate the upgrading of biology teachers with low qualifications by sponsoring them for further studies.

(v) The Government should establish modern computer laboratories and effective internet connectivity at all public high schools in order to promote ICT and integration of ICT in the classroom.

(vi) There is a need for the high schools to support and strengthen school- based CPD, which would provide teachers of biology with an opportunity to interact and exchange ideas based on the best pedagogical practices with respect to teaching biology.

(vii) Schools should strive to marshal their local resources in addition to government grants in order to procure adequate biology text books or reference books for use by pupils and teachers.

6.4 Recommendations for Further Research

There were issues that emerged from this study which would necessitate further research. Below are some suggestions for further research.

(i) An investigation into the impact of the teachers' qualification on the effective teaching of biology.

(ii) The extent to which teachers of biology formatively assess their lessons.

(iii) The impact of gender difference on the perception of learning difficulties in biology.

(iv) A comparative study of boys' and girls' performance in biology.

(vii) Extension of the scope of the study to include other districts in the Northern and other Provinces of Zambia.

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List of appendices

Appendix I: Consent form

UNIVERSITY OF ZAMBIA

SCHOOL OF EDUCATION

DEPARTMENT OF MATHEMATICS AND SCIENCE EDUCATION

CONSENT FORM

Dear respondent,

My name is Moses Musonda. I am a student pursuing a postgraduate course, Master of Education in Science Education, at the above mentioned institution. I am doing my research which is a purely academic activity whose main aim is to identify the topics pupils perceive as most difficult in biology, and to highlight possible strategies teachers could use to address the learning challenges. You have been chosen to participate in this study by way of voluntarily providing information. Should you accept to participate in this study, you are required to sign on this document on the slot provided below. Before appending your signature on this form, ensure that you fully understand the nature of this activity. You are therefore, encouraged to ask any question on anything not clear to you.

Note that you are free to withdraw from this study at any time if you so wish, but it is our desire that you participate in this study from the beginning up to the end.

Thank you for accepting to participate in this study.

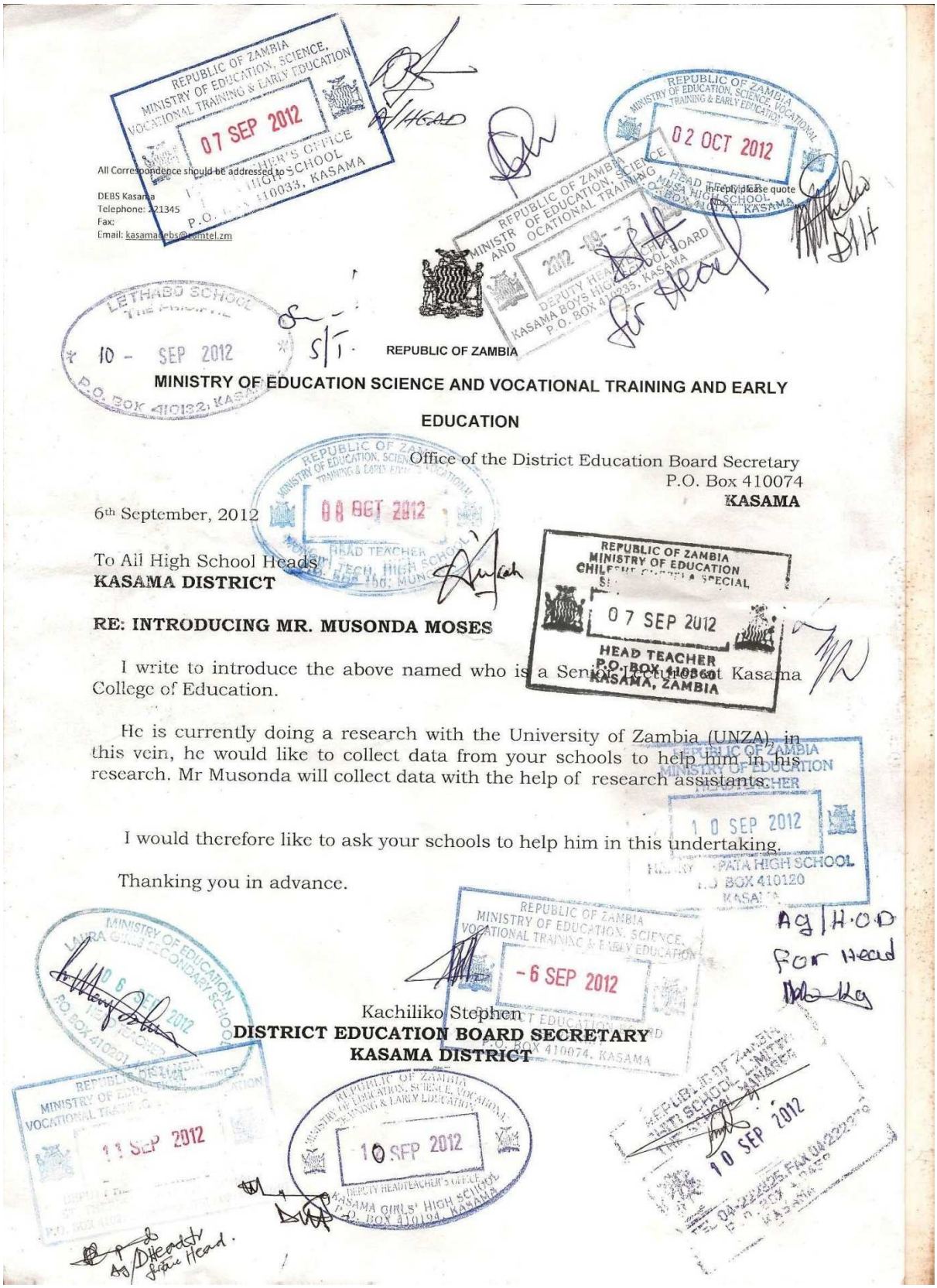
Respondent‘s name……

Phone: number: …….

Signature……..

Date ……..

Appendix II: Research Permission letter



REPUBLIC OF ZAMBIA

MINISTRY OF EDUCATION SCIENCE AND VOCATIONAL TRAINING AND EARLY EDUCATION

Office of the District Education Board Secretary
P.O. Box 410074
KASAMA

6th September, 2012

To All High School Heads
KASAMA DISTRICT

RE: INTRODUCING MR. MUSONDA MOSES

I write to introduce the above named who is a Senior Lecturer at Kasama College of Education.

He is currently doing a research with the University of Zambia (UNZA), in this vein, he would like to collect data from your schools to help him in his research. Mr Musonda will collect data with the help of research assistants.

I would therefore like to ask your schools to help him in this undertaking.

Thanking you in advance.

Kachiliko Stephen
DISTRICT EDUCATION BOARD SECRETARY
KASAMA DISTRICT

Appendix III: Questionnaire for Head of Natural Sciences Department.

Dear Sir/Madam,

Thank you for your permission to conduct a study in your department. This questionnaire is designed to help the researcher understand your school profile and to assess the performance of your pupils in the subject of Biology. The data collected will help the researcher compile a report which is a requirement for him to complete his programme of study. You are assured that the information you provide will be treated with greatest confidentiality it deserves, and is purely for academic purposes.

Thank you for accepting to complete this questionnaire.

Date: ……

Section A: **Personal Details**

1. Name of School:

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2. Name of HOD:

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   (NB: You need not write down your name if you feel uncomfortable)

Section B: Pupils' Profile

1. How many senior pupils are in your school? ……..
2. Classify the number of your pupils by gender

Boys		Girls	

3. What is the age-range of the senior pupils in your school?

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Section C: Teachers' Profile

1. How many Biology teachers do you have in this school?

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Males		Females	

2. Classify your teachers by their qualifications.

Qualifications	**Gender**	
	Males	**Females**
Diploma		
1st Degree		
Masters Degree		
Other (specify)……		
TOTALS		

Section D: School performance in Grade 12 biology examinations

Gender	No. of candidates who sat			2009		2010		2011	
	2009	2010	2011	Passed	Failed	passed	failed	passed	failed
Female									
Male									

Overall pass %

2009 =

2010 =

2011 =

2. Give reasons why the school performed in this way in biology in the three different years

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Section E: Difficult topics in biology.

(a). tick **as many as possible** the topics your pupils find difficult to learn in '**O' level**. You may include other topics that do not appear on the given list.

Topic	**Tick-difficult for**	
	boys	girls
Mendelian Genetics		
Genes and chromosomes		
Mitosis and meiosis		
Nervous system		
Protein synthesis		
DNA synthesis		
Excretory system		
Homeostasis		
Photosynthesis		
Enzymes		
Transport of materials		
Ecology		
Cell and organelles		
Evolution		
Skeletal system		
Reproduction		
Classification		
Sensory organs		
Endocrine system		

(b) Explain what makes the topics you have ticked in (a) above so difficult.

Topic	**Difficult aspect of topic**	**Reason**

(c) Suggest interventions you would suggest that your teachers use to lessen pupils' learning difficulties in these topics.

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Appendix IV: Questionnaire for biology teachers

Dear Respondent,

This questionnaire is designed to collect data on the pupils' learning difficulties in biology in high schools in Zambia. The data collected will help the researcher compile a report which is a requirement for him to complete his programme of study. You are also assured that the information you supply will be treated with the greatest confidentiality it deserves, and that it is meant for only academic purposes.

Thank you for accepting to complete this questionnaire.

Part A: personal details.

1. Gender

Male		Female	

2. Age. (Please tick)

21 to 24 ☐

25 to 29 ☐

30 to 34 ☐

35 or older ☐

3. Type of Teacher Training received (please tick)

a).Secondary teachers' diploma ☐

b).Secondary Teachers'degree ☐

c).Other (specify……..) ☐

4. How long have you been teaching?

a).Less than 2 years ☐

b).3 to 5 years ☐

c).6 to 10 years ☐

d).10 to 15 ☐

e).More than 15 ☐

PART B: Teachers' Knowledge of pupils' learning difficulties in biology.

(a). Tick as many as possible the topics your pupils find difficult to learn as per '**O' level** biology syllabus. You may include other topics that do not appear on the given list.

Topic	**Tick-difficult for**	
	Boys	girls
Mendelian Genetics		
Genes and chromosomes		
Mitosis and meiosis		
Nervous system		
Protein synthesis		
DNA synthesis		
Excretory system		
homeostasis		
Photosynthesis		
Enzymes		
Transport of materials		
Ecology		

Cell and organelles		
Evolution		
Skeletal system		
Reproduction		
classification		
Sensory organs		
Endocrine system		

(b) Explain what makes the topics you have ticked in (a) above so difficult.

Topic	Difficult aspect of topic	Reason

(c) What challenges do you face when teaching the topics perceived difficult by pupils?

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(d) Suggest interventions you would use to lessen pupils' difficulties in these topics.

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Appendix V: Questionnaire for pupils.

Dear Respondent,

This questionnaire is designed to collect data on the pupils' learning difficulties in biology in high schools in Zambia. The data collected will help the researcher compile a report which is a requirement for him to complete his programme of study. You are also assured that the information you supply will be treated with the greatest confidentiality it deserves, and that it is meant for only academic purposes.

Thank you for accepting to complete this questionnaire.

Part A: personal details.

1. Gender [please Tick (√)]

Male		Female	

2. Age. [Please Tick (√)]

14 to 18 ☐

18 to 22 ☐

22 or older ☐

3. Grade level (please tick)

a. Grade 11 ☐

b. Grade12 ☐

PART B: Topics pupils consider difficult in biology.

(a). Tick as many as possible the biology topics you find difficult to learn . You may include other topics that do not appear on the given list

Topic	**Please Tick(√)**
Mendelian Genetics	
Genes and chromosomes	
Mitosis and meiosis	
Nervous system	
Protein synthesis	
DNA synthesis	
Excretory system	
Homeostasis	
Photosynthesis	
Enzymes	
Transport of materials	
Ecology	
Cell and organelles	
Evolution	
Skeletal system	
Reproduction	
Classification	
Sensory organs	
Endocrine system	

(b) Explain what makes the topics you have ticked **(√)** in (a) above so difficult.

Topic	Difficult aspect of topic	Reason

(c) What challenges do you face when learning these difficult topics?

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(d) Suggest ways you would want your teacher to help you learn better these difficult topics.

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Appendix VI: Interview schedule for biology teachers.

- How many biology classes do you teach?
- What is the performance of your pupils in biology like?
- What topics in biology do your pupils find difficult to learn?
- In your opinion, what makes these topics so difficult?
- Do the boys and girls perceive the same topics alike?
- Do you face any challenges when teaching the topics pupils perceive as difficult?
- If the answer to the above question is yes, specify these challenges.
- How would you go round the challenges you have stated in order to help your pupils learn these difficult topics in biology.

Appendix VII: Interview schedule for pupils.

- What is your favourite science subject? Why?
- How would you describe your performance in biology?
- Which topics in biology do you find difficult to learn?
- What makes these topics so difficult?
- What specific challenges do you face when learning these difficult topics in biology?
- How would you like your teachers to help you learn better these difficult topics in biology?