



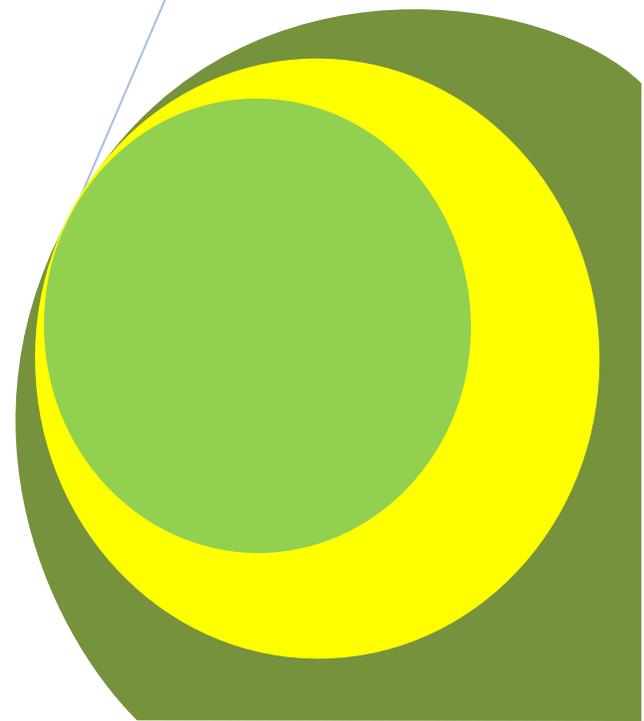
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The Effective Teaching and Learning of Biodiversity in Advanced Level National Biology Curriculum (9190), Masvingo Province, Zimbabwe

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Research Article

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ABSTRACT

The study presents findings on the effectiveness of the teaching and learning of the topic biodiversity a component of the Zimbabwean Advanced level Biology curriculum (9190) in Masvingo. The main goal of this study was to identify the methods employed by the teachers when teaching the topic Diversity of organisms and factors that affect their effectiveness in the teaching and learning of this component as well as establishing the challenges faced by 'A' level biology teachers during the teaching and learning of this topic. The data gathering procedures involved 'A' level biology lesson observations, document analysis of 'A' level biology teachers' schemes and records of work, past examination question papers from ZIMSEC and chief examination reports for the period 2003-2005. Questionnaires were administered to 'A' level biology teachers and students. The Zimbabwe School Examination Council (ZIMSEC) National Chief Examiner for Biology Curriculum 9190/2 was interviewed. The qualitative and quantitative methods of data analysis were employed. The results obtained indicated that the teaching and learning of biodiversity was not very effective. Findings from the lessons observed and the interviews carried out to the Heads of Science Departments showed that the majority of the strategies used in biodiversity teaching were not student-centred. Very few schools were found to involve field trips when teaching this topic. The study recommends that 'A' level biology teachers from each province establish 'A' level biology peer coaching teams to help each other on the diversity of organisation. Workshops on how to prepare fieldtrips as a teaching strategy should be organized and carried out.

Keywords: Effective teaching, Effective learning, Diversity of organisms and Biology Curriculum (9190).

INTRODUCTION AND BACKGROUND TO THE STUDY

The National Curriculum for Advanced Level Biology (9190) was first introduced to schools in Zimbabwe as a statutory requirement in 2002 and first examined in November 2003. One of the aspects of this Biology Curriculum (9190) which was new to many teachers was the inclusion of the diversity of organisms as a compulsory core-topic. Cohen and Manion (1994) assert that in order to understand exactly what happens to curricula when they are put into teachers' hands, researchers need to observe lessons, interview teachers and students as well as looking at the work done to piece together a complete description of the implementation process. Prior to the introduction of the 'A' level Biology (9190) the practice in the out phased biology curriculum (9266) was that the topic on biodiversity used to be taught as an option topic and students were to answer questions from two options of their choice which they would have studied. In Masvingo Province only two schools, Mashoko and St Antony's high schools were offering this option on biodiversity. (Masvingo Science Education In-Service Teacher Training, (SEITT) report 2000). The 'A' level Biology curriculum (9190) introduced in 2002 included the diversity of organisms as one of its 13 themes in the core-section, therefore this component was made compulsory to all students doing biology at this level. Thus all 'A' level biology teachers for the first time were made to teach it. Students would now study 13 compulsory core-topics and 4 option topics of which they were supposed to choose to study one option topic and candidates would answer questions set on that option. The option topics are

- Biotechnology
- Application of genetics
- Human Health and Disease
- Applied plant and animal science

Ornstein and Hunkins (2004) in his study, the teacher as a learner in curriculum implementation pointed out that a common thread running through the different symposium papers was the argument that (more) attention should be given to intentions of and practical problems faced by individual teachers in the implementation perspective urges us also to keep in mind that many factors influence the teacher's actual use of curriculum documents.

The key function of a teacher in the classroom is to facilitate the learning process, providing access to the intended curriculum. In the process of providing access to the curriculum, teachers make different types of decisions: selection of content, selection of methods, how to relate on interpersonal level and some of the more managerial type (Jaji, 1990).

Many Advanced level Biology teachers lack the background knowledge and understanding of biodiversity, which might limit their effectiveness in the teaching of this topic. The needs assessment survey done for 'A' level Biology teachers in Masvingo with the intention of planning for the SEITT Biology workshops has shown that many 'A' level Biology teachers have neither the adequate subject content on diversity of organisms nor the pedagogical knowledge required for its effective teaching and this might be having an impact on students' performance in this topic.

In Masvingo Province, currently there were 118 schools with 'A' level status out of which only 21 schools were offering Biology at 'A' level (Ministry of Education Sport and Culture, Masvingo 2005). These schools they ranged in category from government secondary schools, private to rural council schools. Teachers are of diverse experience and qualification backgrounds ranging from BEd Biology, BSc Honours Biology or Biochemistry (with or without Graduate Certificate in education). Licentiate degree in Education Biology from Cuba to MSc Education, Biology. All these factors might be influencing the effectiveness of biodiversity teaching.

Problem Situation

Many of the 'A' level biology teachers in Masvingo Province have either inadequate subject matter or they lack the pedagogical knowledge required in the effective teaching of the topic; Diversity of organisms, a compulsory subject area in the 'A' level Biology national curriculum (9190).

Significance of the study

Biodiversity is more than a biology topic but a concept that cuts across disciplinary boundaries, and it is an environmental issue. The 1992 Earth Summit in Rio de Janeiro defined biodiversity as: the variability among living organisms from all sources, including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems. All species provide some kind of function to an ecosystem. They can capture and store energy, produce organic material. Decompose organic materials help to cycle water and nutrients, control erosion or pests, and fix atmospheric gases. Biodiversity also has an important economic role for all humans; it provides pharmaceutical and cosmetic products. One of the important economic commodities that it supplies to human kind is medication. Wild plant species have been used for medicinal purposes since before the beginning of recorded history. For example *guinine* comes from cinchona tree and is used to treat malaria, *digitalis* from the foxglove plant and is used for chronic heart trouble and many others. From biodiversity we can get fibres for clothing and other industrial products from plant species such as oils, lubricants, perfumes, dyes, paper, waxes, rubber, resins and many others. It has an ethical role, as it is also part of many cultures and spiritual heritage. The diversity of organisms has a scientific role as it give scientists some clue as to how life evolved and will continue to evolve on earth. Today biodiversity is under threat, what has previously been caused by plate tectonics, volcanoes, meteors and other forces of nature is now being caused by the rapid destruction of habitats, depletion of resources and the ecological mixing of incompatible species all being troubling story which must be effectively told in powerful ways in schools, so that citizens who have a concern for the biological future can act with understanding. In Zimbabwe, curriculum developers having realized all the benefits of biodiversity to humankind have made this an essential topic of study for all 'A' level biology students compulsory. Given the importance of the diversity of organisms to humankind, this study contributes to the theoretical understanding of the component diversity of organisms in the national 'A' level biology curriculum (9190). This study also contributed to a student centred instructional approach in biodiversity teaching. The study also helps in advancing student achievement in 'A' level biology through the use of effective instructional strategies, which promote active learning. It will encourage the teaching of biodiversity in and out of the classroom in the local environment, to help teachers look for the potential in their own surroundings and relate these to the wider issues of biodiversity. It will assist in the planning, teaching strategies and assessment of biodiversity. It will also assist in the planning, teaching strategies and assessment of biodiversity. It will provide background data that might affect the effective teaching of biodiversity. What students learn is greatly influence by how they are taught. Effective science teachers engage in ongoing assessment of their teaching and student learning. In doing this, effective teachers use

multiple methods and systematically gather data about student understanding and ability. Analyze data, guide teaching and guide students in self-assessment. The study only dealt with effective teaching and learning of biodiversity in Masvingo, thus generalization may not be appropriate based on this small scale. In addition, the schools which the study focused on were so scattered in the province.

MATERIALS AND METHODS

The research design in this study was both analytical (qualitative) and descriptive (quantitative) through triangulation. It was quantitative because the questionnaires used resulted in quantifiably analysed data. Also the moment the study further looked at relationships between variables and then interpreted these relationships, gave information concerned about the qualitative aspects of the research. Fraser (1986) noted several reasons that justify the combination of qualitative and quantitative methods: the complementarities of qualitative observational data and quantitative classroom environmental data adds richness to the whole, the use of classroom environment questionnaire provides an important source of information concerning how teachers regard this class. Some of the data collected such as the teachers' academic and professional qualifications are documented such that whatever is given could be checked in the records.

The sampling procedure was based on the target group. In that regard the sample as chosen is based on preferred population, stratified purposive sample selection from the peri-urban, urban and rural High Schools offering the biology curriculum (9190). From each category of the schools, one school offering biology at 'A' level upper six were chosen for a lesson observation teaching biodiversity. There were 118 'A' level school in Masvingo province and of these, only 21 schools were offering biology at Advanced level in the seven districts of the province. (Ministry of Education, Sport and Culture, Masvingo region 2005).

Questionnaire

Questionnaire contents were read and examined by professional staff that evaluated clarity of the items. This was to ensure the use of appropriate vocabulary, sentence structure and that the questions were suitable for the intended level.

Twenty-one questionnaires for the 'A' level biology teachers were distributed to "A" level Biology teachers from the 21 schools in the province which were currently teaching the subject at this level, during the Science Education In-service Teacher Training Workshops. The teachers were kindly asked to leave the questionnaires at the Science and Mathematics Centre after completion and some of those who did not attend workshops were captured in their schools, making sure that those teachers already captured at the regional workshops were not allowed to respond the questionnaire again.

The questionnaires were analysed to determine the effectiveness of the teaching of biodiversity and expose the factors, which might be militating against effectiveness of the teaching and learning of the diversity of organisms in the 'A' level biology curriculum (9190). A questionnaire containing questions on the following categories was administered to collect data from the 'A' level biology practicing teachers:

Teaching context: Age, gender, questions to show if the school is in a rural, urban or peri-urban area.

Teachers' biodiversity backgrounds: questions to establish the specialization of the teacher and his/her biodiversity background.

Biodiversity teacher-perspective: questions on a range of biodiversity teaching issues including the teacher's confidence, enjoyment and their views of pupil interest and achievement and field work in lessons.

Biodiversity teaching: questions to establish teaching strategies commonly used, resources most commonly used, including textbooks, internet, INSET (professional development and support from colleagues).

A questionnaire to the 'A' level biology students was also administered after each of the three lesson observations done. This questionnaire for the students had only four aspects to test the validity of some of the response given by their teachers on biodiversity teaching activities, such as class discussions, presentations, group work and fieldwork. The questionnaires were immediately collected after the students had completed them.

Interview

The other data collection techniques used in this study was the interview for the Zimbabwe School Examination Chief Examiner for the 'A' level Biology Curriculum (9190). The interview is the most appropriate technique when

collecting data because it helps to gain access to what is inside a person's head,(Tuckman, 1972) Although the most ideal technique when collecting data is face- to- face interview, it has to be recognized that face- to- face interview have several problems. They are time consuming, they cost money and they limit the number of participants. The face- to- face interview was done to the ZIMSEC national chief examiner for the 'A' level Biology curriculum (9190). The interview was audio recorded and the data was qualitatively analysed. The rest of the data was gathered through document analysis of the 'A' level biology ZIMSEC examiner's reports for 2003-2007 and the ZIMSEC advanced level Biology Examination Syllabus for the years 2003-2007.

Biodiversity lesson observations

Observation technique as a method of collecting data was also applied in this study. A total of 3 lessons were observed. 1 biodiversity lesson observation from each of the 3 school categories; rural, peri-urban and urban school. Observation techniques as methods of collecting data have weaknesses for instance there is the human element whereby the observers may be subjective in their rating and assessment. A lesson observation instrument with the aspects on biodiversity teaching was used. The observation instrument was produced according to the strengthening of Mathematics and Science in Secondary Education (SMASSE) project in Kenya. The instrument has the following aspects, which also addressed the objectives of this study:

- Teaching procedure
- Fundamental Technique/Methodology
- Management

Data analysis

The interview data was analyzed qualitatively by first putting it into categories for analysis. The reread data was coded and this data generated by qualitative method was voluminous. The data was then interpreted by attaching significance to what was found, making sense of findings, offering explanations, drawing conclusions extrapolating, making inferences and considering meanings. The data gathered from biodiversity lesson observation was put into rating categories and a descriptive and qualitative analysis was done.

RESULTS

Table 1: Personal information as percentages of respondents (N=13)

Gender: Male	77%	Age/Yrs 20-25, 26-30, 31-35, 36-40, 41+	
Female	23%	%	7.7 23 23 39.6 7.7
Academic Qualifications	77%	Professional Qualification	
Bachelor of Science	23%	BEEd.	26.7%
		LicEd	33.0%
		GRADCE.	20.0%
		PG.DIPSCED.	6.7%
		No Professional Qualification	13.6%
'A' Level Biology Teaching Experience		Subjects Qualified to teach at 'A' Level	
Years	%	Subject	%
0-5	38.5%	Biology	77%
6-10	30.8%	Biology and Chemistry	15.4%
11-15	23.0%	Biology and Mathematics	7.6%
16+	7.7%		

It can be deduced from the results in table 1 above that not all Advanced level biology teachers were qualified to teach biology at this level and some lack the teaching experience which also impact negatively in their effective teaching. The table also indicated that there were some teachers who were new in this profession.

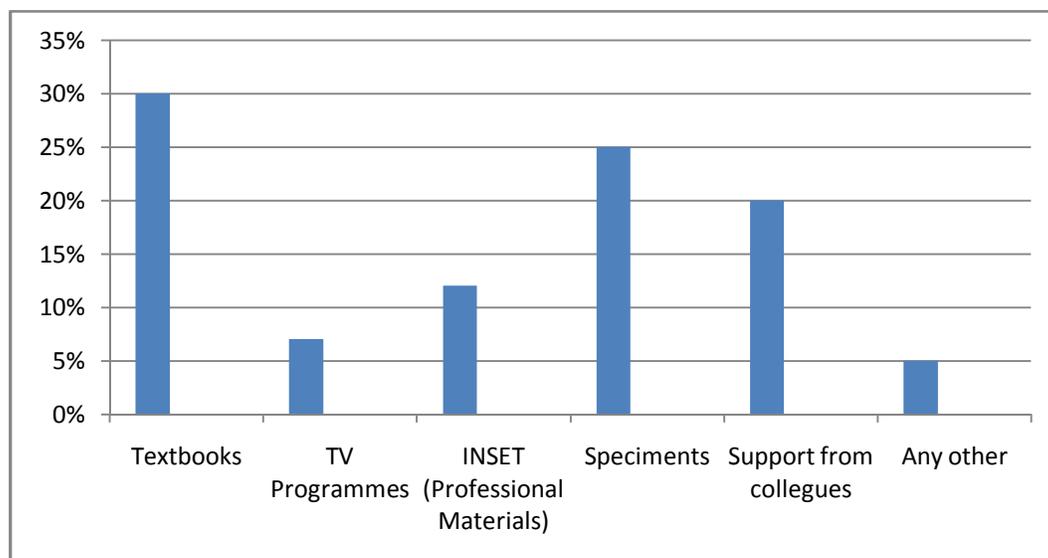


Fig 1: Most valuable areas of support used in 'A' level Biodiversity by teachers in Masvingo.

The data in figure 1 indicates that the majority of teachers used textbooks during teaching and most of the books used did not have teacher's guides to assist the teachers for effective teaching of the diversity of organisms. On any other support materials, it could be deduced that very few of the teachers who provided information used computers in their teaching.

Table 2: Responses of teachers on their views on 'A' Level Biodiversity Teaching in Masvingo Province

Area	Question	No. of Responses on a Likert Scale					Total No. of Responses
		High low	2	3	4	5	
Views on teaching	• What is your background knowledge of biodiversity in the National Biology curriculum (9190)	6 (42.2%) 38.5	1	1 (7.7%)	-	5 7.7%	13 100
	• How much do you enjoy teaching biodiversity?	11 (84%) 15.4%	- (0%)	-	-	2 0%	13 100
	• How confident do you feel in teaching Biodiversity in the 'A' level Biology Curriculum (9190)?	12 (92.3%) 7.7%	- 0%	-	-	1 0%	13 100
Effects on Pupils	• What do you feel is the level of interest and achievement of the pupils in biodiversity you teach?	4 4 (38.8%) 23%	3 23.1%	2 15.4%	-	0%	12 92.3%
Practical etc, content	• How much practical work is included in the biodiversity you teach in 'A' level biology?	5 30.8% 23.1%	3 23.1%	-	1 15.4%	3 23.1%	12 92.3%
	• How much biodiversity investigational and fieldwork is included in 'A' level biodiversity lessons?	5 30.8% 23.1%	3 23.1%	-	1 15.4%	3 23.1%	12 92.3%
Interest in more support	• When more support on biodiversity teaching is produced on the basis of this research, what would be your interest in obtaining this support?	12 92.3%	1 7.7%	-	-	-	13 100%

Teachers expressing their 'A' level biodiversity teaching most of them indicated that they had partial background knowledge of the diversity of organisms, very few indicated that they enjoyed teaching this component although the majority were not very confident as shown in table2 above.

Table 3: Frequency of Questions covering the theme diversity of organisms (2003-2004)

Year and Month	Paper Description and Number of Questions		
	Multiple choice (9190/1)N=40	Structured 9190/2	Practical (9190/4)
Nov 2003	3	2	2
Jun 2004	4	1	-
Nov 2004	4	3	-
Mean	3.7	2.0	0.7

Table3 above showed that the examination questions set on the diversity of organisms cover all the three compulsory papers except the option paper which also reflect that its percentage weight is very big, although in the practical paper questions on this component were not very popular as reflected by a mean of 0.7.

Table 4: Kingdom most enjoyed during the study of diversity of organisms

Kingdom	Frequency	Percentage
Prokaryotae	1	4.2
Proctista	2	8.3
Fungi	10	41.7
Plantae	2	8.3
Animalia	9	35.5
Total	24	100

The results from this table indicated that the majority of the students enjoyed the study of the kingdoms *fungi* and *animalia* respectively.

Table 5: Fieldwork activities carried out during the study of diversity of organisms

Fieldwork	Frequency	Percentage
Yes	7	29.2
No	17	70.8
Total	24	100

The results shown in table 5 above indicate that they have been very few fieldwork activities carried out when students study the diversity of organisms.

The majority of the teachers have very little background knowledge of biodiversity and do not enjoy teaching it as shown by the results in table2 and these teachers indicated that they needed more support to teach this component. The topic biodiversity is assessed contributing a great percentage to the students' terminal performance as shown in table3. Results from table 4 has shown that the Kingdoms most enjoyed by students during learning was the *fungi* followed by the *animalia*. Table 5 shows that very few teachers take their students to field trips. It is likely because some schools are in urban areas and many teacher would not be willing to be involved in the trouble of planning and taking the risk of taking students out for such a trip.

DISCUSSION

The results shown are also in agreement with Dorsey (1989) who found out that in a predominantly male professional establishment women also have a greater perception of being discriminated against the low number of female 'A' level biology teachers which may be due to the fact that the majority of science teachers in Zimbabwe are male with very few female science teachers available. This does not provide the girl students with sufficient role models to

build their occupational aspirations around. It is likely that some male Science teachers have a predominantly masculine view of science and appear to reinforce that attitude in the entire student. Teaching experience as shown in table 1 is very important in 'A' level Biology teaching.

The more teachers' experience, the more their children appear to learn (Chivore, 1994). It was noted that inexperienced teachers were not effective in organizing and running practicals on diversity of organising. This observation was also supported by Nyagura (1991) who found out that pupils taught by trained teacher obtained better results in their final examinations. One teacher indicated that they had no biodiversity background and were also not confident in their teaching of this component of the syllabus. These findings are also in accordance with what Jaji (1990) found, that teachers who lack the appropriate qualifications cannot be expected to implement the curriculum in the form it was intended especially when they lack sufficient academic qualifications to have in depth knowledge of the subject matter from the results in fig 1, it was shown that the most resources used by teachers were textbooks, therefore the teaching strategies commonly used were likely not to be student-centred and again there were very few textbooks in schools with biodiversity information. Commenting on the general performance 'A' level Biology students on the biodiversity question, the ZIMSEC 'A' level Biology chief examiner said that the questions on this topic were generally poorly done by many students and this according to his opinion, might be due to poor teaching methodologies which he thought were being employed by teachers when they, teach this topic. The chief examiner also indicated that this topic on diversity of organisms was too abstract if not taught with specimens, fieldwork activities and practical activities in the laboratory. During observation of lessons on diversity of organisms, it was found out that there was poor interpretation of the 'A' level biology syllabi by teachers, lack of well planned fieldwork and practical activities are likely contributing to poor performance by students in this component of the curriculum.

One of the revision lessons observed on *Cnidarians platyhelminthes* and *nematode* indicated that employing a student-centred approach help students to understand the content being taught and students were able to classify the organism studied despite their diversity. This was also in agreement with Ebenezer and Zoller (1993) that effective teaching and learning of Science take place when there is active teaching and active participation of students and when they relate science concepts to everyday life. Good Science teaching needs to encourage, invite, engage, excite, interrogate and challenge as was observed in this revision lesson.

The study's findings from lesson observation indicated that the majority of students from the urban schools were found not to be able to identify different types of fungi, plants and Animals as compared to students from rural schools. This is likely due to the fact that students from rural schools had an advantage of living in the natural environment with high species diversity. Ramey et al. (1996) also found out that the majority of the teachers who had always enjoyed science grew up in rural settings or where exploring their natural world was a common occurrence.

CONCLUSIONS FROM FINDINGS

Findings from documents analysed indicated that 'A' level biology teachers were not effectively teaching the component Diversity of organisms and that the students' performance was generally poor in this component although the Kingdom fungi was found to be familiar to many candidates. The students from urban schools showed that they were not having chances to go for field trips.

'A' Level biology students also have shown that they preferred that the biodiversity content, which were are being taught, be related to everyday life and be applicable to local situations for the learning to be effective. The study also found out that the majority of 'A' level biology teachers did not include fieldwork activity during their teaching of this topic and students indicated that they were never taken out for fieldwork activities when they studied the topic diversity of organisms. It was also found from the documents analysed that most of the fieldwork activities were not planned for.

The Kingdoms *Prokaryotae* and *Proctista* were found not to be very familiar to many candidates and it was likely due to the fact that 'A' Level biology teachers were not giving students more practical work to observe representatives of these phyla under the microscope. This was also in agreement with what Gwimbi (1997) found that in most cases, practical lessons were and did not immediately follow the theory lessons.

RECOMMENDATIONS

In the light of these findings, the following recommendations are made:

*For effective teaching of biodiversity, the teacher should get the learners involved as much as possible in activities that will enable them develop the needed process-skill

*Biology teachers should net-work, interact and share their experiences with one another through seminars and workshops organized by the Science Education In-service Teacher Training (SEITT) to discover better strategies of teaching the component diversity of organisms.

The following action is also suggested by this study that staff-development, training and retraining of teachers particularly about new information knowledge skills etc which hitherto they had not been expected to understand. Should be implemented as part of the Zimbabwean Ministry of the Education's policy.

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