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# Investigation of Appropriateness of Teaching and Learning Methods of Biology Subject that Address Environmental Degradation in Karonga District Malawi – A Case Study

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## ABSTRACT

*The purpose of this study was on to investigate the appropriateness of the methods of teaching and learning Biology that address environmental degradation Case study of Karonga district. A quantitative method was used in this study. Sixty secondary school teachers were selected from 40 secondary schools in Northern Education Division in the Ministry of Education in Malawi as research participants. Schools and participants were selected through convenience and purposive sampling techniques respectively.  In this study, data was collected through interviews, questionnaire and document analysis. Data analysis was done thematically and using statistics. The study found out that the teaching and learning methods in Biology would  not  address environmental degradation.*

## Introduction

Biology education is important in the issues of Environmental degradation as it plays a foundational role in the process of addressing the issues of Sustainable Development (United Nations Educational, Scientific and Cultural Organisation (UNESCO), 2017). This encourages many countries worldwide to integrate environmental degradation in their Biology Education. Kipgokei (2016) explains that various countries in the world have designed their Biology curriculum to impact knowledge and skills for environmental issues.  For example, in Germany issues of environmental degradation and climate change are not left out in Biology education (Seguin, 2015). This means that Biology education deals with human and environment relations and is critically important, particularly given the current environmental and social problems such as environmental degradation. The Biology curriculum in Ireland has been developed to cover aspects of human environments and environmental awareness and care (Government of Ireland, 1999), while in Britain the British Biology curriculum puts emphasis on the development of skills needed to carry out Biological inquiry and fieldwork (Clifford, 2013). Biological education can enable learners address issues of the environment and it is important for those students who take Biology subject to be enlightened on environmental degradation. This portrays that Biology subject will enable and equip them with knowledge and skills which address issues of environmental degradation. This is in agreement with Malawi Institute of Education (2014), which points out that the Biology curriculum in Malawi has been developed to cover aspects of human environments and environmental awareness and care. This means that students are given the chance to develop important Biological concepts and skills. Therefore, some teaching methods in Biology which do not allow learners to acquire transformative skills, must be discouraged since these contribute very little to the learning process concerned with environmental degradation.  Hence, this study examined the feasibility of the Biology content and teaching and learning

## RESEARCH METHODOLOGY.

A research paradigm is the set of common beliefs and agreements shared between scientists about how problems should be understood and addressed. The research will use a pragmatic paradigm in this study. Mittwede (2012) defines a pragmatic paradigm as a world view that focusses on what works rather than what might be considered absolutely and objectively true or real. This paradigm advocates the use of mixed methods in research to explain a solution to a research problem. Tashakkori and Teddlie (2003) emphasise that there cannot be one way to solve one problem, but a mixture of approaches can better help solve the problem and find the truth. Pragmatic paradigm gave freedom to the researcher to use any procedure or method associated with qualitative or quantitative research. This is in agreement with Creswell (2014) who explains that pragmatic paradigm does not commit to one system of reality or philosophy. The researcher applied this paradigm because the study needed mixed methods when collecting data. Quantitative paradigm was used and questionnaires used five point likert scale to measure variables and the numerical values were assigned to the responses which were structured according to the objectives of the study.

Quantitative research is an approach for testing objective theories by examining the relationship among variables (Creswell, 2014). This approach simply measures or counts attributes through answering the "how many" questions. Data is interpreted numerically for easy analysis and the researcher used Computer excel software package for the interpretation of data using tables, a graph and a pie chart.

The researcher got a sample from the target of secondary schools in the study with a target sample of secondary school Biology teachers in the Northern Education Division. A sample of sixty (60) Biology teachers was obtained from a target population of eighty five Biology teachers. To come up with a sample of sixty Biology teachers, the researcher used purposive sampling whereby two Biology teachers were selected from each of the fifty sampled secondary schools.

The researcher used purposive sampling to make sure that each school had one teacher from junior section and another one from senior section. Purposive sampling involves selecting participants based on the researcher's judgement about certain characteristics being sought to meet the objectives of the study (Cohen, Mario & Mourisson, 2007). Out of 50 Secondary school that is, 25 public secondary Schools that is , Conventional and Community Day secondary schools (CDSSs) and 15 private secondary schools only 40 secondary school in Karonga where the research study was conducted, forty (40) schools were sampled for this study using a statistical formula for calculating sample size in known population taking into consideration the p-value of 0.5, level of confidence 90%, and a margin of error of 10% (Creswell, 2014). The researcher used purposive sampling in the selection of specific schools where the study was conducted per district, because it gave chance to both private and public secondary school to take part in the study.

Sample size refers to the number of participant or observation included in the study. Sixty Biology teachers out of 80 b Biology secondary school teachers were selected randomly across Karonga District to be part of the sample. These teachers were chosen regardless of the sex. According Tayie, (2005) explains that for degree of precision 25 and 45 percent can be accepted for wider population so the sample is in line with what is recommended.

The study was carried out in forty secondary schools within Northern Education Division (NED) in the Northern Region of Malawi. The study took place in secondary schools found in Karonga. Only Biology teachers took part in the research since the purpose of the study was to assess teaching and learning methods for secondary school biology subject content as an approach to addressing environmental degradation in Malawi. Case study of Karonga district. The researcher chose that Biological area for the study because there is an alarming rate increase of environmental degradation due to an increase of infrastructure, destruction of

Karonga cultivate cotton plantation, rice and cassava farming activities. Hence, by conducting the research in this study location, it helps Biology teachers in secondary schools to find solutions or mitigation measures for Environmental Degradation when delivering lessons related to environmental issues.

The data collected was both secondary and primary. The secondary data was portrayed when syllabi of biology of both junior and senior was collected to analyse success criterion. The primary data was when questionnaire was employed for data collection

## Quantitative Data Collection Instrument

### Document Analysis

O'Leary (2014) defines document analysis as a systematic procedure for reviewing or evaluating documents either printed or electronic material. This indicates that in document analysis various procedures are involved in analysing and the interpretation of data of a particular study. Mogalakwe (2006) explains that document analysis involves the study of documents relevant to the research topic. That means document analysis as a form of quantitative research uses a systematic procedure to analyse documentary evidence and answer specific research questions. The researcher used document analysis to assess how the success criteria in secondary school Biology syllabi are framed to address environmental degradation in Malawi, hence helped to draw upon many sources of information in corroboration with the use of different data sources and methods. This is in agreement with Bowen (2009) who supports the use of document analysis that it helps in the triangulation of data, hence research credibility.

Questionnaire is another data collection instrument which was used in the research study. According to Kothari (2004), questionnaires are the most widely used instruments for obtaining information from individuals. Questionnaire is a tool designed for the collection of qualitative data widely used in the construction research (Silverman, 1998). This data collecting instrument is good for the collection of standardised data and making generalisations. Close ended questions were used in the questionnaire to target numerical data such as methods of teaching selected topics and rate of assessment of learners' fieldwork. Questionnaires provided responses quickly and the

### Data Analysis

Data analysis, according to Mwituria (2012), is the process of looking at and summarising data with the intent to extract useful information and develop conclusions. The data collection of this research study was organised according to the objectives of the study. Qualitative Data Analysis was done by identifying the main themes. Ranjit (2005) emphasizes that Qualitative research employs interpreted and naturalistic approach to the world, seeking to compile a detailed account of the phenomena in its natural setting, and makes a comprehensive interpretation of human experiences from the perspectives of the participants. Qualitative data analysis was done by first editing the responses from the participants, which was analysed using descriptive statistics, discussed and finally, conclusions were drawn. For example, qualitative data that was collected through interviews was analysed by the researcher by transcribing verbal responses following the order of interview schedule. The audio interview was played repeatedly to maintain accuracy as Cohen, Mario and Mourisson (2007) elaborate, that for the researcher to transcribe the right information and maintain accuracy, there is need to replay the audio interview repeatedly. Qualitative data was also analysed by using NVIVO which is one of the computer assisted qualities data analysis software. Wickham

and Woods (2005) assert that NVIVO software allows for qualitative inquiry beyond coding, sorting and retrieval of data, and it integrates coding with quantitative linking, shaping and modelling. This means that NVIVO assists qualitative researchers in managing their data.

Quantitative data is defined as the value of data in the form of numbers where each data sets unique numerical value associated with it (Daniel, 2010). This means that the data or information can be used for mathematical calculations. Quantitative data for this research would be analysed using quantitative data analysis software such as Microsoft Excel, Microsoft Access and SPSS. Data was prepared, validated to find out if it was collected using set standards. Later, it was edited and coded. In quantitative research study, the researcher analysed the data from the questionnaire using SPSS computer software to produce tables and find percentages of respondents who answered various questions (Creswell, 2014). Both qualitative and quantitative were done

## PRESENTATION OF THE RESULTS

Below is the presentation of the results from quantitative data:

**Demographic data of respondents**

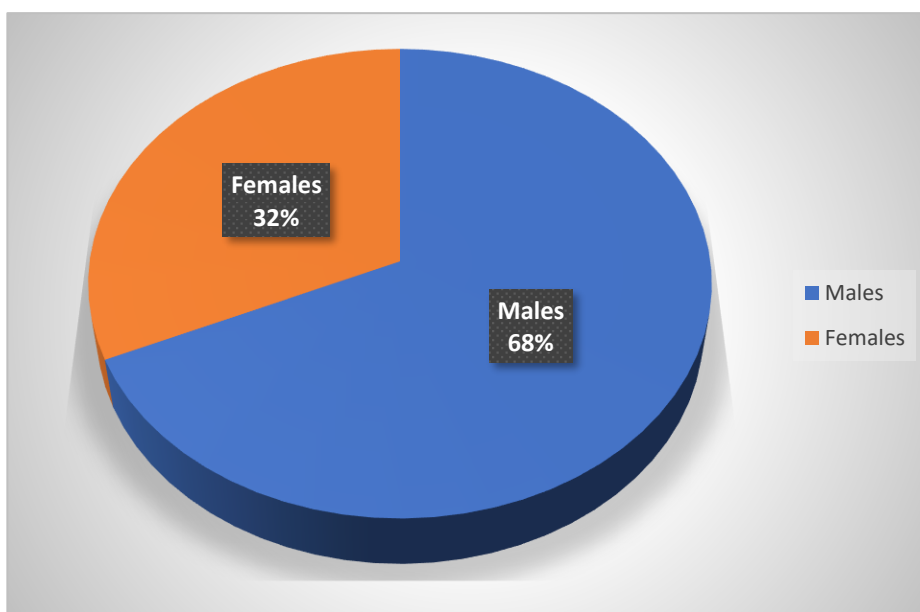. Distribution of teacher respondents by gender



*Figure 1 Distribution of teacher respondents by gender*

Data on gender of respondents showed that 19 Biology teachers representing (32%) were females and 41 Biology teachers representing (68%) were males as shown in the Figure 1 above. The findings indicated that more than half of the respondents were males while the females were below half of the respondents, indicating that in the Karonga, there are very few female Biology teachers. The percentage of females is smaller compared to percentage of males because in most of secondary schools in the Northern Education Division, there were no Biology female teachers. This disparity would have an effect on the responses as the gender ratio was included in order to gain a perspective on the general understanding of Environmental Education by males and females who participated in the study.

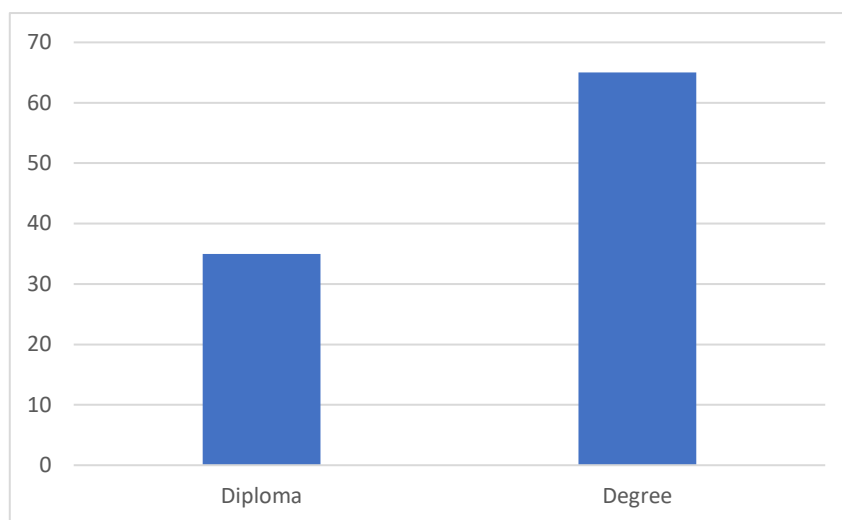*4.1.0.1 Highest qualification for respondents*



*Figure 2 Percentage of highest qualification for respondents*

The results of Biology teachers' qualifications in Figure 2 above indicates that 35 Biology teachers had diplomas, representing (35%), while 65Biology teachers had Bachelor of education, representing (60%). Hence, all respondents had the required qualification to teach Biology subject in secondary schools.

**Investigating the appropriateness of the methods of teaching and learning Biology selected topics that can address environmental degradation in Malawi**

*Table 1: The Methods of teaching and learning Biology for the topic of Ecosystem*

| | | Agree | | Not Sure | | Disagree | | | |
|---|---|---|---|---|---|---|---|---|---|
| Item | Selected teaching methods | *f* | *%* | *f* | *%* | *f* | *%* | *Total (f)* | Total *(%)* |
| 1 | Field work | 42 | 70 | 6 | 10 | 12 | 20 | 60 | 100 |
| 2 | Case study | 40 | 67 | 15 | 25 | 5 | 8 | 60 | 100 |
| 3 | ICT e.g videos | 15 | 25 | 10 | 17 | 35 | 58 | 60 | 100 |
| 4 | Inviting a specialist | 12 | 20 | 18 | 30 | 30 | 50 | 60 | 100 |
| 5 | Explaining | 55 | 92 | 3 | 5 | 2 | 3 | 60 | 100 |
| | **Average percentage (%)** | | **55** | | **17** | | **28** | **60** | **100** |

Table 3 shows the selected teaching methods for the topic of Ecosystem from both Junior and Senior Secondary Biology syllabi using purposive sampling technique. Data from the table above indicate that most of the Biology teachers (92%), in secondary school used explanation method in teaching the topic of ecosystem. The average of 55% of Biology teachers used the methods of teaching the topics related to environmental degradation such as ecosystem, Plant diversity ,Organisms and their environment

*Table 2: The Methods of teaching and learning Biology for the topic of Climate change*

| | | Agree | | Not Sure | | Disagree | | | |
|---|---|---|---|---|---|---|---|---|---|
| Item | Selected teaching methods | *f* | *%* | *f* | *%* | *F* | *%* | *Total (f)* | Total *(%)* |
| 1 | Field work | 48 | 80 | 2 | 3 | 10 | 17 | 60 | 100 |
| 2 | Case study | 12 | 20 | 26 | 43 | 22 | 37 | 60 | 100 |
| 3 | ICT e.g videos | 10 | 17 | 10 | 17 | 40 | 67 | 60 | 100 |
| 4 | Inviting a specialist | 15 | 25 | 20 | 33 | 25 | 42 | 60 | 100 |
| 5 | Explaining | 56 | 93 | 2 | 3 | 2 | 3 | 60 | 100 |
| | **Average percentage (%)** | | **47** | | **20** | | **33** | **60** | **100** |

*Key: f=Frequency; % = percent*

Table 4 indicates the selected teaching methods for the topic of Climatic Change from Senior Secondary school Biology syllabus and Senior secondary school syllabus respectively, using purposive sampling technique. Data from table 4 above shows that most of the Biology teachers (93%) used explanation method more than any other method in teaching the topic Climate. About 47% of Biology teachers in secondary schools used the teaching methods that can address environmental degradation Including in Junior secondary and other related topics like: Plant diversity , Organisms and their environment.

*Table 3:Summary of teaching methods for the selected topics (Ecosystem and climate change)*

| Item | Selected teaching methods | Topic Ecosystem | Topic Climate change | Average % |
|------|---------------------------|-----------------|----------------------|-----------|
| 1 | Fieldwork | 70% | 80% | 75% |
| 2 | Case study | 67% | 20% | 44% |
| 3 | ICT eg Videos | 25% | 17% | 21% |
| 4 | Inviting specialist | 20% | 25% | 23% |
| 5 | Explaining | 92% | 93% | 93% |

The data in Table 5shows that when teaching Ecosystem topic, 70% of Biology teachers used fieldwork, 67% used case study, 25% used ICT, 20% used a specialist and 92% used explanatory method. For Climate Change 80% of Biology teachers used fieldwork method, 20% used case study, 17% used ICT, while 25% used a specialist, and 93% used explanatory method.

An average of 75% of Biology teachers used fieldwork, 44% used case study, 21% used ICT, 23% used a specialist, and 93% used explanatory method when teaching the selected topics of ecosystem, wildlife and wetlands which are related to environmental degradation. An average of 53.5% of Biology teachers used teaching and learning methods that address environmental degradation when teaching the following topics: Ecosystem, Wild life and wetlands, which are related to environmental degradation.  However, most of the teachers used explanatory method in teaching the topics indicated in Table 5 above. This indicates that if most of the Biology teachers used explanatory method in teaching the topics related to environmental degradation, it would be difficult to address environmental degradation since explanatory method does not create critical thinking in learners.

## DISCUSSION AND RESULTS

**Investigating the appropriateness of the methods of teaching and learning Biology selected topics that can address environmental degradation in Malawi**

The results in Table 5show more than half of Biology teachers (75%) conducted Fieldwork as a teaching method in Biology lessons relating to environmental degradation such as Ecosystem and climate change. This would lead to address environmental degradation. This concurs with what Mohammed (2016) found out in his research in Ethiopia, that 87.4% of

Biology teachers used Fieldwork. This is in agreement with Lotz-Sistka, Tshiningayamwe and Urenje (2017), who explain that fieldwork is very important in the teaching of Biology which assists in promoting SDGs, including environmental issues. For example, on the topic "*ecosystem*", it would be necessary for students to have visits to places with wetlands such as forest. Students would appreciate the beauty of vegetation, hence would engage themselves in finding and suggesting ways of conserving and protecting wetlands in Malawi. In this case, Biology as a subject would address environmental degradation.

In Table 6, about 44% of Biology teachers used case study in teaching Biology topics like

Ecosystem and climate change. This is different from what Kagoda (2016) discovered in Uganda whereby 67% of teachers in secondary schools used 'case study' in teaching Biology. The case study as a method of teaching and learning Biology in secondary schools plays a vital role in addressing environmental degradation. However, with the findings, most Biology teachers in Malawi do not use 'case study' as a method of teaching biology, especially the topics related to environmental degradation. This cannot assist learners to be involved in addressing environmental degradation. Gitau (2015) recommends case study method as a strategy of teaching Biology which involves problem-based learning and promotes the development of analytical skills in learners. This means that a case study in   Biology involves students in solving problems that may be similar to those they face in their daily lives.  For instance, one of the problems that children face is an increase of the degradation of the environment in their communities, and through case study method, problems of deforestation and pollution are likely to be solved positively by students. Lotz-Sistka and Ulenje (2017) add that case studies provide students with in-depth information about a particular issue in a particular context. Biology teachers in Malawi use case studies in the teaching of Biology, it would help learners share views and develop skills in analytical thinking, problem solving, group work and communication. Hence, addressing issues of environmental degradation.

 Item 3 in Table 6, 21% of the Biology teachers in secondary schools used Information and Communication Technology (ICT). This portrays that most of Biology teachers did not use ICT as a method of teaching topics related to environmental degradation. This contradicts with Asongu, Le Roux and Biekepe (2017), who explain that the use of ICT can reduce dependence on environmental resources in order to decrease environmental pollution. For instance, the use of hydro-electric power (HEP) generated from water discourages cutting down of trees. This can assist in addressing environmental

degradation by keeping the environment intact. Through technology, learners can acquire information about the sustainability of environment. The findings do not correspond with the recommendation by UNESCO (2017), which says that teachers should use teaching methods that allow learners engage in fieldwork in Biology, with the aim of addressing environmental degradation. It is good for Biology teachers to use ICT when teaching topics related to environmental degradation since it encourages learners to sustain it.

Item 4 in Table 5indicates that 23% of Biology teachers admitted that they invited specialists when teaching topics related to environmental degradation. This cannot assist in addressing environmental degradation. Environmental specialists have vast knowledge about environmental challenges, including environmental degradation. If most of the Biology teachers did not invite Environmental specialists, learners would not able to get first-hand information about environmental degradation. The findings are against Alvarez-Garcia, Sureda-Negree and ComasForgas (2015), who reported that secondary school Biology teachers in Canada involved Environmental Educationists to provide them with new knowledge about environmental issues. This helped them to discover new teaching methods that encouraged learners to have more practical activities within the environment, hence addressing environmental degradation.

In Table 6, the majority of teachers, 93% of Secondary School Biology teachers agreed that they used explanatory method in the teaching of Biology topics related to environmental degradation. This implies that most of the Biology teachers do not use teaching and learning methods that would help in addressing environmental degradation. For instance, if 93% of Biology teachers used explanations in teaching Biology topics related to environmental degradation, that means there is no creativity and critical thinking in learners as students get knowledge and memorise it without application or doing practice. In this case, learners are not transformed and would not learn by doing things, applying, exercising and practicing ideas. Hence, would not think about the environment or could interact with the environment in a negative manner.

Dermici, Kesler and Kaya (2015) observed that most Biology teachers do not use methods that enhance learners in addressing environmental degradation. Explanatory method of teaching Biology does not encourage learners to have transformative minds and critical thinking. It encourages rote learning. This is not supported by Transformative Learning Theory which explains that teaching should help learners change the values on how they view the world and interact with the environment (Sterling, 2011). If learners change values and have positive interaction with the environment, issues relating the environmental degradation are likely to be addressed. Gitau (2015) explains that that 'explanatory method' is largely a passive process and does not arouse learners' interest. This gives a clear picture that the method would not address environmental degradation because learners' thinking would not be transformed. United Nations Educational, Scientific and Cultural Organisation [UNESCO] (2017) recommends the use of teaching methods that would assist learners have more practice so that they would be fully transformed on how best they would interact with the environment. This would help in addressing environmental degradation.

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