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Assessing Secondary Teachers' Knowledge and Pedagogical Skills in Climate Change Education in Zambia: A Case Study of Masaiti District

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Abstract
Climate change is a critical global challenge that significantly impacts ecosystems, economies, and communities, particularly in developing countries like Zambia. In the Masaiti District, where over 60% of the population relies on agriculture, the effects of climate change are increasingly evident, necessitating effective climate change education. However, many teachers in this region are inadequately prepared to teach this vital subject, despite recognizing its importance. This study aimed to assess teachers' knowledge and pedagogical skills in climate change education across ten schools in Masaiti District. Employing a Quantitative approach, the research collected data over three months using structured questionnaires administered to 74 teachers, supplemented by interviews and focus group discussions. The quantitative data was analyzed using statistical software Stata. The findings revealed that a significant proportion of teachers (64%) lack a comprehensive understanding of national policies on climate change education, and many (50%) hold only diploma-level qualifications, potentially limiting their depth of content knowledge and pedagogical skills. Key challenges identified include a lack of resources (63%), limited curriculum time (37%), and insufficient training (30%), hindering the effective delivery of climate change education. To address these gaps, the study recommends strengthening policy dissemination, enhancing teacher capacity-building, optimizing curriculum and assessment, fostering collaboration and community engagement, and advocating for increased resource allocation. By implementing these recommendations, Masaiti District can empower educators and equip students with the necessary skills to address climate change challenges in Zambia, fostering environmental responsibility among future generations.

Keywords: Climate Change Education, Pedagogical Skills, Teacher Capacity-Building, Climate Change

1. Introduction

This study aims to assess the current state of climate change education in Masaiti District, focusing on teachers' knowledge, teaching methods, and the challenges they encounter in delivering climate change education. By understanding these factors, the research seeks to identify opportunities for enhancing climate change education in Zambia, ultimately contributing to the country's resilience against the impacts of climate change. Improving teacher training, developing comprehensive curricula, and providing necessary resources can empower educators to effectively engage students in climate action. This, in turn, fosters a generation that is informed and proactive in addressing the climate crisis, equipping them with the skills and knowledge to navigate the challenges posed by a changing climate. Through these efforts, Zambia can build a more sustainable future while ensuring that its youth are prepared to be responsible stewards of the environment.

1.1 Background Study

Climate change is a significant global issue impacting weather patterns, ecosystems, and social equality, primarily caused by human activities like burning fossil fuels and deforestation (IPCC, 2014) [19]. In Zambia, the effects include altered rainfall, severe droughts, and flooding, threatening agriculture and food security, with a potential 40% drop in maize production reported in 2024 (Zambia National Farmers Union, 2024). The economic consequences are severe, as agriculture contributes about 20% to the GDP, and climate change could push 1.5 million Zambians into poverty by 2030 (World Bank, 2021) [39]. The Zambian government is responding with measures like emergency food aid and improved water management, while education plays a crucial role in addressing climate change. However, many secondary school teachers lack the training and resources to

effectively teach this topic, highlighting the need for targeted training programs to enhance climate change education (Zambian Ministry of Education, 2021).

1.2 Statement of the problem

Climate change poses a significant challenge for secondary education in Zambia's Masaiti District, where many teachers lack the training and resources to effectively teach this critical subject. About 40% of teachers do not have formal qualifications in related subjects, and only 15% incorporate climate change topics into their lessons (Masaiti District Education Board, 2022; Zambia National Curriculum Framework, 2021). This results in students missing key concepts like the greenhouse effect and sustainable practices. The teaching methods used are often outdated, relying on rote learning rather than engaging approaches (ZIEM, 2020).

This study aims to assess teachers' knowledge and skills regarding climate change education, highlighting areas for improvement. The World Bank (2021) [39] warns that without action, climate change could push 1.5 million Zambians into poverty by 2030. To enhance education in this area, the study proposes comprehensive teacher training and better access to teaching materials, aiming to prepare teachers and equip students to address climate challenges effectively.

1.3 General Objective of the Study

To assess secondary school teachers' knowledge and pedagogical skills regarding climate change education in Masaiti District, Zambia, while identifying the challenges they face in effectively delivering this content.

1.3.1 Specific objective

1. Identify challenges and barriers secondary teachers face in the teaching of climate change in Masaiti District.

1.4 Significance of the Study

This study is important for improving climate change education in Zambia's Masaiti District by addressing teachers' knowledge gaps. Many teachers feel unprepared to teach climate topics, so the research will identify their specific needs and provide support. The study aims to enhance the quality of climate education, helping students understand environmental issues better and encouraging them to engage in activities like tree planting and recycling. The study has three main goals: Assess the current state of climate change education, evaluate the effectiveness of the Zambian Education Policy in promoting climate knowledge, and identify challenges faced by teachers. By addressing these challenges, the research aims to empower teachers and students to effectively tackle climate change. The findings will also inform policymakers about the state of climate education, guiding better policies and programs. Ultimately, this study seeks to create environmentally conscious individuals who advocate for sustainability, contributing to a more resilient future for Zambia.

1.5 Scope of the study

This study examines climate change education in Masaiti District, Zambia, focusing on curriculum integration, teaching methods, resources, and the knowledge and engagement of teachers while also gathering insights about the experiences and challenges in teaching climate-related topics, with findings that may inform broader climate change education efforts in the country.

2. Literature Review

2.1 Overview

This chapter reviews existing research on climate change education in Zambia, focusing on the Masaiti District. It highlights teachers' understanding of climate change and the challenges they face, such as lack of resources and training. The goal is to provide insights that can improve climate change education and better prepare students for environmental challenges.

2.2 Theoretical Framework

The study uses Pedagogical Content Knowledge (PCK) theory, which combines what teachers know about climate change with how they teach it (Shulman, 1986). The research aims to evaluate teachers' understanding of key climate concepts, their teaching methods, and the challenges they encounter. By improving teachers' PCK, the study hopes to enhance climate change education in Zambia.

2.3 Challenges and Barriers

Teachers face several challenges in teaching climate change, including lack of training, rigid curricula, student disengagement, and societal misconceptions (McCaffrey & Huff, 2004; Dawson & Carson, 2021). Collaborative efforts and professional development are needed to support teachers and improve climate education (Darling-Hammond *et al*., 2017) [11].

2.4 Personal Critique of Literature Review

The literature review highlights important issues but lacks specific examples and details about effective training programs and teaching methods. It could benefit from more focus on unique challenges faced by rural versus urban teachers (Chikozho *et al*., 2020) [8].

2.5 Research Gaps

There are gaps in understanding how cultural beliefs affect teaching methods and student engagement. More research is needed on effective training programs and how to incorporate local knowledge into climate education. Addressing these gaps will help improve climate change education and better equip teachers and students to tackle environmental challenges.

3. Research Methodology

3.1 Overview

This chapter outlines the methodology used to study climate change education in Masaiti District, including research design, sampling, data collection, and ethical considerations.

3.2 Research Design

The study used a quantitative research design, employing structured questionnaires to collect data on teachers' experiences and knowledge of climate change (Bryman, 2016) [5].

3.3 Description of the Study Area

Masaiti District has about 20 schools with 8,500 students

and 215 teachers. The local economy relies on agriculture and mining, both affected by climate change. Recent reports show declining crop yields due to changing weather patterns (Zambia Statistics Agency).

3.4 Target Population
The study focused on 74 teachers from five secondary schools teaching subjects related to climate change.

3.5 Sampling Design
A random sampling technique was used to ensure all teachers had an equal chance of being selected, avoiding bias (Trochim, 2006).

3.6 Sample Size
A sample of 74 teachers was chosen to represent diverse teaching experiences in climate change education (Creswell & Clark, 2007) [10].

3.7 Data Collection Methods
Data was collected using questionnaires through face-to-face interviews, focus group discussions, and key informant interviews to gather comprehensive information.

3.8 Data Collection Tools
Structured questionnaires were used to document responses from participants.

3.9 Data Analysis
Statistical software (STATA) was used to analyze the data, with visual representations to illustrate findings (StataCorp, 2021) [33].

3.10 Limitations of the Study
Challenges included costs for printing materials (Robson, 2011) [32] and potential participant reluctance to share honest opinions (McLeod, 2019).

3.11 Ethical Considerations
Ethical guidelines were followed, including obtaining informed consent and ensuring participant confidentiality (American Psychological Association, 2017; Beauchamp & Childress, 2013) [1, 3].

4. Presentation of Results and Discussions
4.1 overview
This study will present findings based on the objectives.
"To identify challenges and barriers secondary teachers face in the teaching of climate change in Masaiti District."

4.2 Presentation of results on background characteristics of the respondents
a) Gender of the respondents

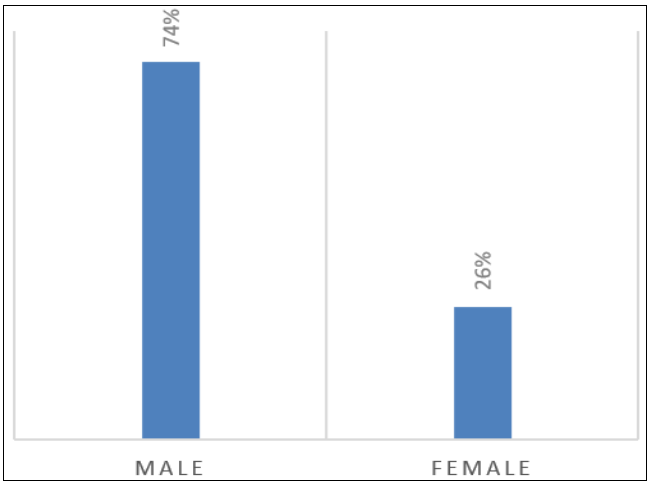

Fig 4.1.1: Gender of the respondents

Figure 4.1.1 presents the gender distribution of the respondents in this study. The data shows that 74%, which represents 37 of the participants, were male, while 26%, representing 13 participants, were female.

b) Qualification of respondents

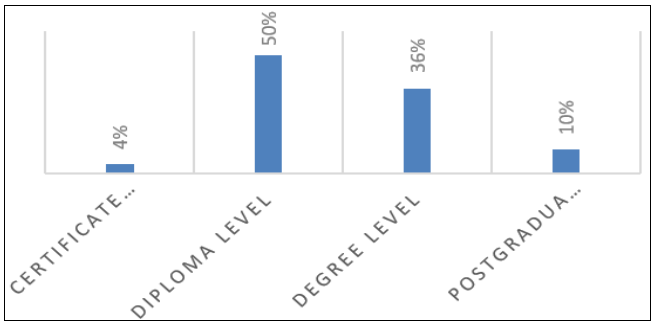

Fig 4.1.2: Academic Qualification of respondents

Figure 4.1.2 presents the academic qualifications of the respondents in this study. The data shows that the majority of the teachers (50%), representing 25 teachers, held a diploma-level qualification, followed by 18 with a degree-level qualification (36%). A smaller proportion of the teachers had a certificate-level qualification (4%), representing 2 teachers, and 5 (10%) held a postgraduate diploma.

4.3 Presentation of results for Teachers and key informants based on the objective; "To identify challenges and barriers secondary teachers face in the teaching of climate change in Masaiti District."

a) Challenges faced when teaching climate change

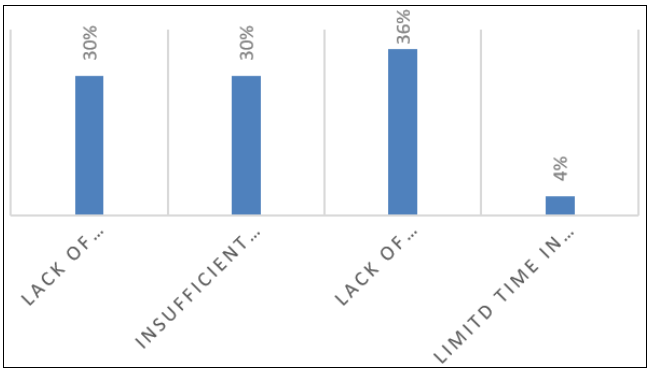

Fig 4.3.1: Challenges faced when teaching climate change

Figure 4.4.1 outlines the challenges faced by secondary school teachers in Masaiti District when teaching climate change. The data reveals that the most significant challenge is the "Lack of student interest and engagement," identified by 18 teachers (36%) of the respondents. The second most pressing challenge, reported by 15 teachers (30%), is the "Limited time in the curriculum." Additionally, 15 teachers (30%) cited "Insufficient training on climate change" as a significant challenge, while 2 teachers (4%) reported facing "Curriculum constraints that limit the teaching of climate change.

b) Rate of teaching resources availability

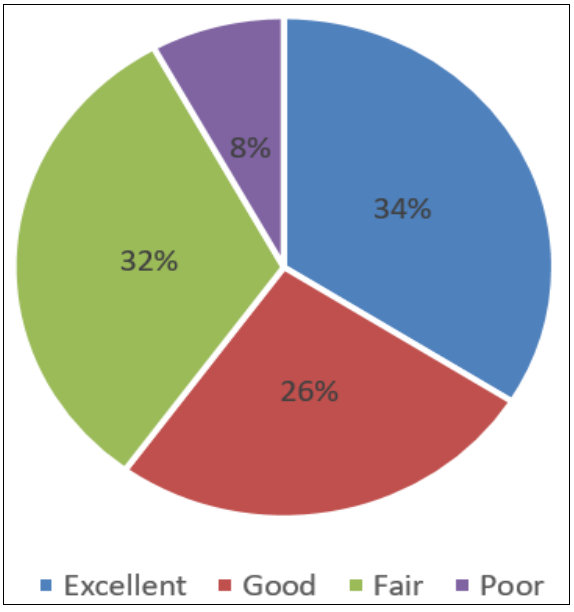

Fig 4.3.2: Rate of availability of teaching resources

The results show that the majority of respondents rate the availability of teaching resources as "Excellent," with 17 teachers (34%) indicating that resources are readily available. Additionally, 13 teachers (26%) rate the availability of resources as "Good," noting that there are some resources, but improvements are needed. Furthermore, 16 teachers (32%) consider the availability of resources to be "Fair," indicating that resources are limited and often outdated. Lastly, 4 teachers (8%) rate the availability of resources as "Poor," expressing that they struggle to find any relevant teaching materials.

c) Support to overcome climate change challenges

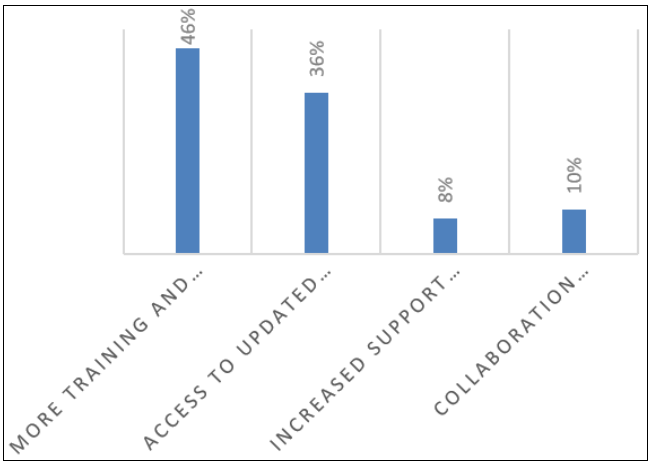

Fig 4.3.3: Support to overcome climate change challenges

The data reveals that the most sought-after form of support among secondary school teachers in Masaiti District is "More training and professional development," with 23 teachers (46%) indicating this as a priority. The second most desired form of support is "Access to updated teaching materials and resources," as indicated by 18 teachers (36%). Additionally, 4 teachers (8%) expressed a need for "Increased support from school administration," while 5 teachers (10%) indicated that "Collaboration with other teachers to share resources" would be beneficial in overcoming the challenges they face.

d) Perception of the role of local education authorities in implementing the climate change policy

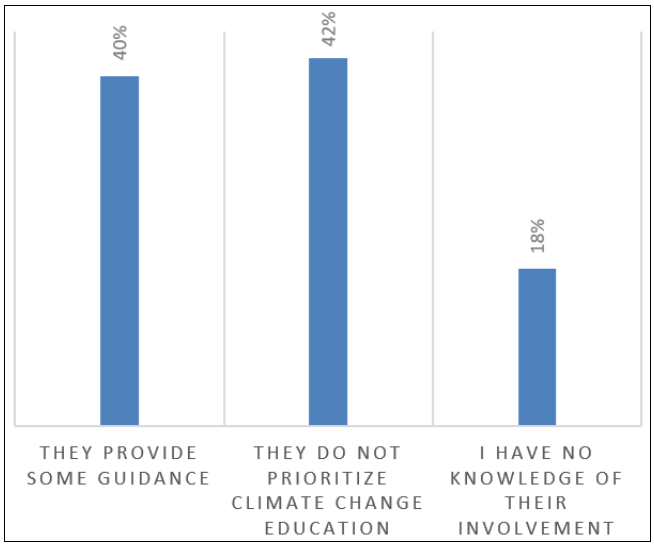

Fig 4.3.4: Perceptions of the Role of Local Education Authorities in Climate Change Policy Implementation

The data reveals that a significant proportion of teachers in Masaiti District believe that local authorities "provide some guidance" on climate change education, with 20 teachers (40%) indicating this perspective. 21 teachers (42%) indicate that local authorities "do not prioritize climate

change" in their policy implementation efforts. 9 teachers (18%) report that they have "no knowledge of [local authorities'] involvement" in climate change education.

4.4 Presentation of results for the key informants

a) Gender of the respondents

Fig 4.4.1: Gender of the respondents

What is your Gender	Freq.	Percent	Cum.
male	14	58.33%	58.33
female	10	41.67%	100.00
Total	**24**	**100.00**	

The data reveals a notable gender imbalance among the respondents, with 14 teachers (58.33%) identifying as male and 10 teachers (41.67%) identifying as female.

b) Highest academic level

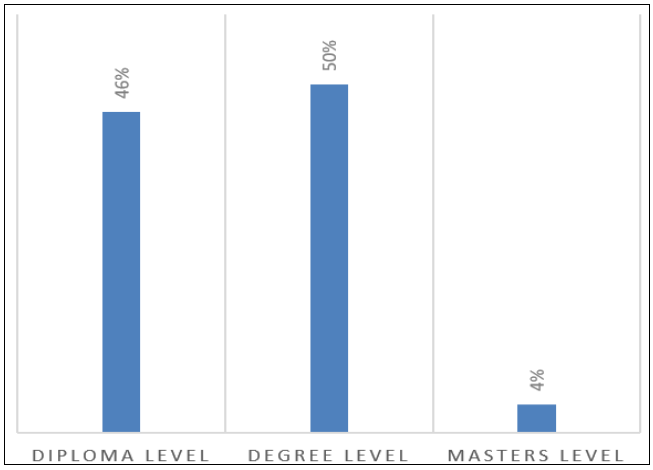

Fig 4.4.2: Highest academic level

Figure 4.4.2 illustrates the highest academic level attained by the respondents. The data reveals that the majority of the teachers hold a degree-level qualification, with 12 teachers (50%). This is closely followed by 11 teachers (46%) who hold a diploma-level qualification, 1 teacher (4%) with a postgraduate diploma, and none with a certificate-level qualification.

c) The strengths of current national policies on climate change

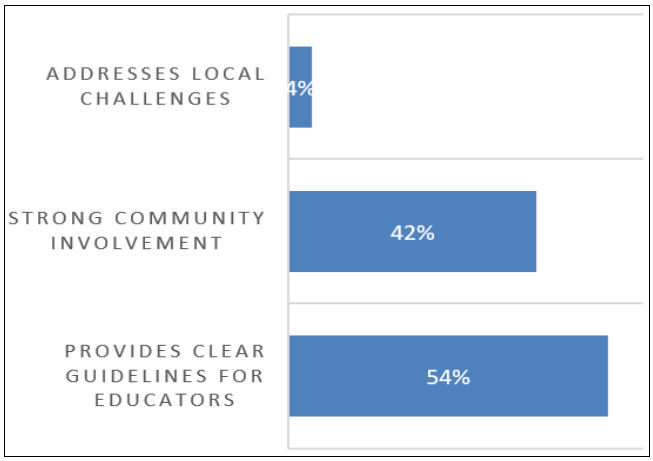

Fig 4.4.3: Strengths of current national policies on climate change

Figure 4.4.3 highlights the strengths of current national policies on climate change as perceived by the respondents. The data reveals that the most significant strength, identified by 13 teachers (54%), is that the policies "Provide clear guidelines for educators." This is followed by 10 teachers (42%) who believe that the policies demonstrate "Strong community involvement." Lastly, 1 teacher (4%) feels that the policies "Address local challenges."

d) Motivation to get involved in climate change education

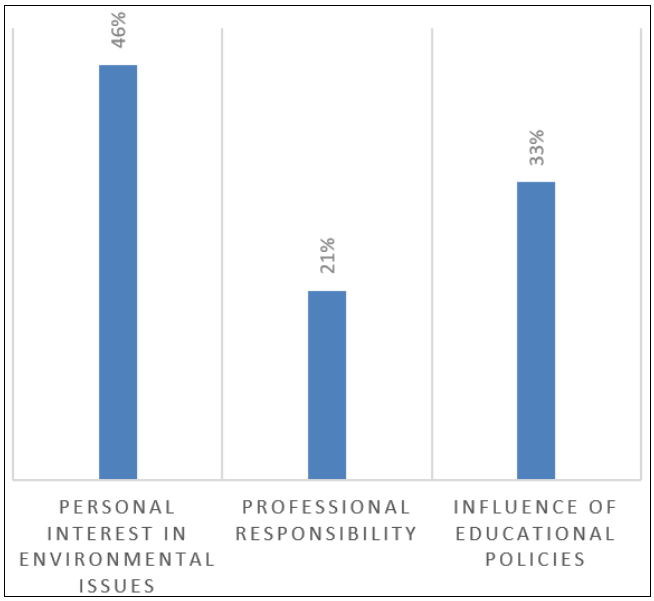

Fig 4.4.4: Motivation to get involved in climate change education

Figure 4.4.4 illustrates the motivations for getting involved in climate change education among the respondents. The data reveals that the primary motivation, reported by 11 teachers (46%), is their "Personal interest in environmental issues." This is followed by 8 teachers (33%) who cited "Professional responsibility" as a key motivating factor. Lastly, 5 teachers (21%) believe that the "Influence of educational policies" has been a significant driver for their involvement in climate change education.

e) Effective teaching methodologies for climate change

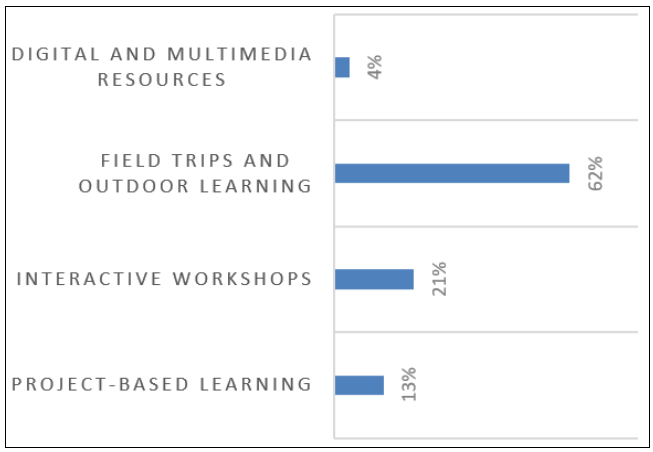

Fig 4.4.5: Effective Teaching Methodologies for Climate Change Education

Figure llustrates the effective teaching methodologies for climate change education as perceived by the respondents. The data reveals that the most favored approach is "Field trips and outdoor learning," with 15 teachers (62%) indicating this as an effective methodology. The second most preferred teaching methodology is "Interactive workshops," identified by 5 teachers (21%). 3 teachers (13%) believe that "Project-based learning" is an effective approach for climate change education, while 1 teacher (4%) highlighted "Digital and multimedia resources" as an effective teaching methodology.

Barriers in the adoption of these methodologies by educators

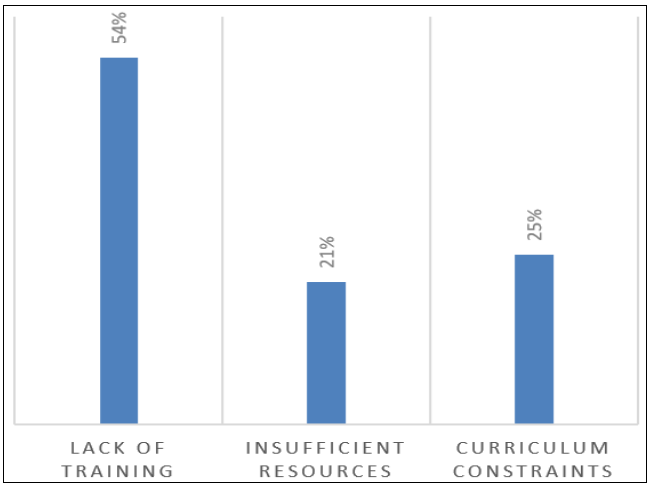

Fig 4.4.6: Barriers to Adopting Innovative Teaching Methodologies

Figure highlights the key barriers that secondary school teachers in Masaiti District face in adopting innovative teaching methodologies for climate change education. The data reveals that the most significant barrier, identified by 13 teachers (54%), is a "Lack of training." The second major barrier, reported by 6 teachers (25%), is "Curriculum constraints." Additionally, 5 teachers (21%) cited "Insufficient resources" as a barrier to adopting innovative teaching methodologies.

f) Significant challenges educators face when teaching climate

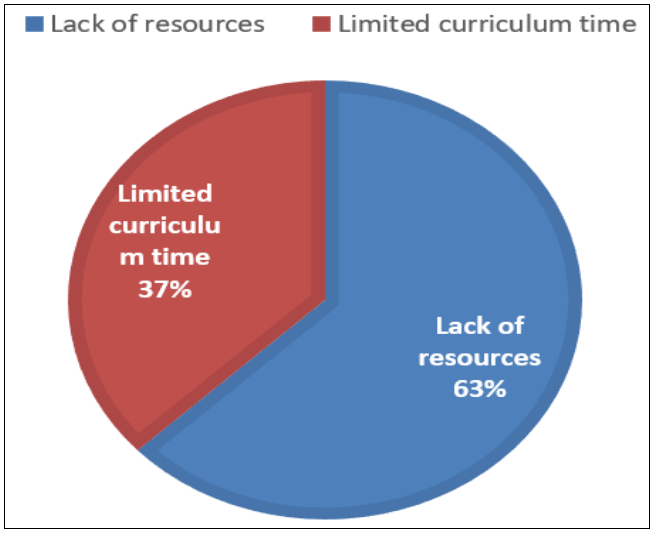

Fig 4.4.7: Significant Challenges Faced by Educators in Teaching Climate Change

Figure 4.4.7 illustrates the significant challenges faced by educators in teaching climate change. The data reveals that the primary challenge, reported by 15 teachers (63%), is a "Lack of resources." This finding aligns with earlier observations that the availability of teaching materials for climate change education is uneven, with some teachers rating it as "Excellent" and others as "Poor." The absence of appropriate resources can significantly hinder the effective delivery of climate change education. The second most significant challenge, identified by 9 teachers (37%), is "Limited curriculum time," suggesting that the current curriculum structure and time allocation may not allow for in-depth exploration of climate change-related topics.

g) Support needed to enhance climate change

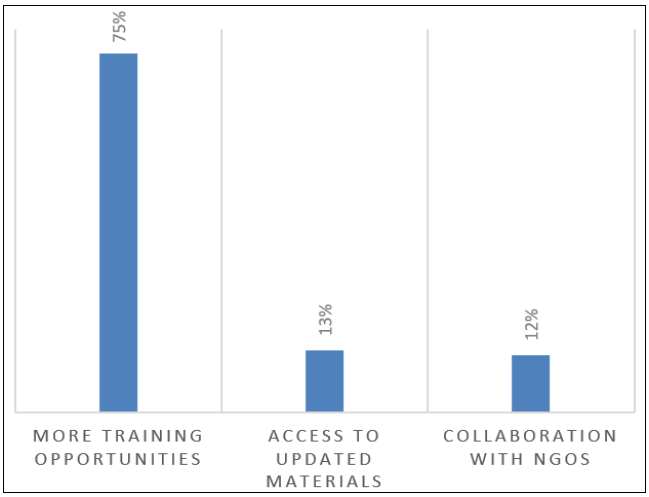

Fig 4.4.8: Support Needed to Enhance Climate Change Education

Figure 4.4.8 highlights the types of support that secondary school teachers in Masaiti District believe are most needed to enhance climate change education. The data reveals that the primary need, identified by 18 teachers (75%), is "More training opportunities." Additionally, 3 teachers (13%) indicated a need for "Access to updated materials," while 3 teachers (12%) believe that "Collaboration with NGOs" is an important form of support needed to enhance climate change education.

5. Discussion of Results for Teachers and Key Informants

1. Teachers

a) Gender of the Respondents

Figure 4.1.1 shows the gender distribution of the respondents. Out of the participants, 37 (74%) were male and 13 (26%) were female. This gender imbalance among teachers is significant and may affect how climate change education is delivered. Research indicates that female teachers often provide different perspectives that can engage students better, especially on environmental topics. The predominance of male teachers suggests a need to encourage more women to enter teaching, particularly in climate change subjects. Addressing this imbalance through recruitment and mentorship programs could help create a more diverse teaching environment. A balanced representation of teachers can lead to a more inclusive approach to climate change education, benefiting all students.

b) Qualification of Respondents

Figure 4.1.2 presents the academic qualifications of the respondents. Most teachers (25 or 50%) held a diploma, followed by 18 (36%) with a degree, 2 (4%) with a certificate, and 5 (10%) with a postgraduate diploma. The qualifications of teachers are important for climate change education. Teachers with higher education, like degrees or postgraduate diplomas, may understand climate change better and teach it more effectively. However, the large number of diploma holders (50%) indicates potential gaps in knowledge and teaching skills. These teachers may need more professional development to effectively teach climate change. The low percentage of teachers with certificate-level qualifications (4%) is positive, as this level may not provide enough knowledge on the topic. All teachers should receive training to include climate change education in their lessons. Future research should explore the link between teachers' qualifications, their understanding of climate change, and their teaching methods to identify areas needing improvement.

d) Challenges Faced by Teachers in Teaching Climate Change

Teachers in Masaiti District face several challenges when teaching climate change. The biggest issue is lack of student interest and engagement (38%), meaning teachers struggle to keep students interested. The second challenge is limited time in the curriculum (30%), which restricts how much they can teach about climate change. Many teachers (30%) also feel they have insufficient training on climate change topics, making it hard for them to teach effectively. Lastly, lack of resources (36%), like books and teaching materials, makes it difficult for teachers to provide quality education.

e) Availability of Teaching Resources for Climate Change Education

Regarding teaching resources, 34% of teachers rate the availability as "Excellent," while 26% say it's "Good." However, 32% consider it "Fair," and 8% rate it as "Poor." This shows that while some teachers have good access to materials, many still struggle to find the resources they need for effective teaching.

f) Support Needed to Overcome Challenges in Climate Change Education

To overcome challenges, teachers indicated they need more training and professional development (46%). They also want access to updated teaching materials (36%) and increased support from school administration (8%). 10% of teachers believe that collaborating with other organizations could help them teach climate change better.

g) Perceptions of the Role of Local Education Authorities in Climate Change Policy Implementation

Teachers feel that local education authorities provide some guidance (40%) on climate change education, but many (42%) believe that climate change is not a priority for these authorities. Some teachers (18%) are unaware of any involvement from local authorities in climate change education.

2. Key Informants

a) Gender Distribution of Respondents

Among the key informants, there is a gender imbalance, with 59% being male and 41% female. This reflects a broader trend in Zambia where teaching is often male-dominated. This imbalance may affect how climate change education is delivered.

b) Academic Qualifications of Respondents

Most key informants (50%) hold a diploma, followed by 36% with a degree. This suggests that many teachers may lack deep knowledge and skills in climate change education, which could hinder effective teaching.

c) Strengths of Current National Policies on Climate Change

Teachers see the strengths of national policies as providing clear guidelines (54%) for educators and involving the community (42%). However, only 4% believe the policies address local challenges, indicating room for improvement in making policies relevant to local needs.

d) Motivations for Involvement in Climate Change Education

Teachers are motivated to engage in climate change education mainly due to personal interest (46%) in environmental issues, followed by a sense of professional responsibility (33%) and the influence of educational policies (21%).

e) Effective Teaching Methodologies for Climate Change Education

The most effective teaching method identified is field trips and outdoor learning (62%), followed by interactive workshops (21%) and project-based learning (13%). These methods encourage hands-on and engaging learning experiences.

f) Barriers to Adopting Innovative Teaching Methodologies

The biggest barrier to innovative teaching is lack of training (54%), followed by curriculum constraints (25%) and insufficient resources (21%). These factors make it challenging for teachers to adopt new teaching methods.

g) Significant Challenges Faced by Educators in Teaching Climate Change

The main challenges for educators are lack of resources (63%) and limited curriculum time (37%). These issues prevent teachers from effectively covering climate change topics.

h) Support Needed to Enhance Climate Change Education

Teachers believe they need more training opportunities (75%) to improve climate change education. They also want access to updated materials (13%) and collaboration with NGOs (12%) to enhance their teaching efforts. Providing these supports can help teachers deliver better climate change education.

6. Conclusions and Recommendations

6.1 Conclusion

The study uncovered significant challenges faced by teachers, including a lack of resources (63%), limited curriculum time (37%), and insufficient training (30%). These barriers hinder the effective delivery of climate change education and limit teachers' ability to use innovative teaching methods. Despite these challenges, many teachers (46%) are motivated to teach climate change due to personal interest in environmental issues. This intrinsic motivation, coupled with the recognition of the importance of climate change education, provides a strong foundation for improving climate change teaching in Masaiti District.

6.2 Recommendations

Strengthen Policy Communication and Implementation

- Make sure all teachers know about national climate change policies.
- Provide training to help teachers understand and use these policies in their teaching.
- Involve teachers in creating policies to meet their needs.

Enhance Teacher Capacity-Building

- Create professional development programs to improve teachers' knowledge and skills in climate change education.
- Focus on training that includes hands-on learning methods like field trips and interactive workshops.
- Provide updated teaching materials, such as textbooks and digital resources.

Optimize Curriculum and Assessment

- Update the curriculum to cover climate change topics thoroughly, including its scientific aspects and local impacts.
- Encourage teaching climate change across different subjects.
- Use assessments that measure students' understanding and involvement in climate change issues.

Strengthen Collaboration and Community Engagement

- Build partnerships between schools, local authorities, and environmental organizations to share resources and expertise.
- Involve parents and the community to raise awareness about climate change education.
- Support student-led projects that address local climate challenges.

Advocate for Increased Resource Allocation

- Secure funding to support climate change education programs, including materials and field trips.
- Work with policymakers to prioritize climate change education in resource allocation.

By following these recommendations, Masaiti District can improve climate change education, helping both teachers and students tackle climate challenges effectively. This approach aims to create environmentally responsible citizens ready for a sustainable future.

6.3 Contribution to Knowledge

This study significantly adds to the understanding of climate change education in Masaiti District, Zambia, by:

- Evaluating teachers' knowledge and skills in teaching climate change.
- Identifying gaps in teachers' understanding of key concepts and the disconnect between national policies and classroom realities.
- Highlighting the need for better communication of policies and teacher training.
- Showing the importance of community engagement and partnerships in enhancing education.
- The recommendations provide practical strategies for policymakers and education authorities, creating a framework for improving climate change education in Zambia. Overall, this research fills important gaps in existing literature and serves as a valuable resource for educators, researchers, and policymakers working to enhance climate change education.

7. Acknowledgements

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