Impact of Instructional Leadership on Stem Education: A Case Study of Secondary Schools in Chivi, Zimbabwe

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Abstract: *This study investigated the impact of instructional leadership on STEM education in secondary schools within the Chivi district of Zimbabwe. The research aimed to examine how effective leadership practices influenced the implementation and success of STEM curricula. A mixed-methods approach was employed, utilizing surveys and interviews with school leaders, teachers, and students. Results indicated that instructional leadership significantly enhanced the quality of STEM education by fostering collaborative teaching environments, promoting professional development, and facilitating resource allocation. The findings highlighted the importance of leadership styles that prioritize teacher support and student engagement. Furthermore, the study identified barriers such as limited resources and inadequate training that hindered effective instructional leadership. The research contributes to the growing body of literature on educational leadership in developing contexts, especially regarding STEM education. It emphasizes the need for targeted policies and training programs to strengthen instructional leadership in secondary schools. Recommendations for future research include exploring the long-term effects of instructional leadership on student outcomes in STEM fields.*

Keywords: *instructional leadership, secondary education, STEM education, Zimbabwe.*

1. INTRODUCTION

The significance of instructional leadership in educational systems has garnered considerable attention in recent years, particularly as the global demand for quality education continues to rise (Bush, 2008). Instructional leadership is crucial for fostering effective teaching and learning environments (Fullan, 2001). In Zimbabwe, the government has prioritized STEM (Science, Technology, Engineering, and Mathematics) education as a critical component of its national development strategy (OECD, 2015). This focus aims to equip students with the skills necessary to thrive in a rapidly changing economy and to foster innovation and technological advancement.

However, despite the importance of STEM education, many secondary schools in Zimbabwe face challenges in effectively implementing these curricula (Shengnan & Hallinger, 2021). These challenges include a lack of resources and infrastructure, and a shortage of qualified teachers in STEM subjects (Bush & Oduro, 2006). Research has shown that the quality of educational leadership can greatly influence the success of teaching and learning processes, especially in STEM subjects (Gordon, Oliver, & Soli, 2016). Effective instructional leaders are pivotal in creating a supportive environment that encourages teacher collaboration, student engagement, and the effective use of resources. In the context of Chivi, a district characterized by its unique socio-economic challenges, understanding the role of instructional leadership in enhancing STEM education becomes crucial. This study aims to explore how different leadership practices impact the implementation of STEM curricula in secondary schools within this district. By examining the relationship between instructional leadership and STEM education, this research seeks to contribute valuable insights to the existing literature and inform policy recommendations that can strengthen educational outcomes in Zimbabwean schools. The findings of this study are intended to benefit educational leaders, policymakers, and researchers interested in improving STEM education through effective leadership practices (Rhodes & Brundrett, 2010).

1.1. PURPOSE OF STUDY

The primary purpose of this study was to explore the impact of instructional leadership on the implementation and effectiveness of STEM education in secondary schools in Chivi, Zimbabwe. Given the increasing emphasis on STEM education as a driver of economic growth and innovation, it is

essential to understand how leadership practices within schools can enhance or inhibit educational outcomes in these critical subjects.

Specifically, this study aimed to achieve the following objectives:

1. Assess Leadership Practices: To identify and analyze the specific instructional leadership practices that positively influence the delivery of STEM curricula. This includes examining how leaders foster collaboration among teachers, set clear goals, and allocate resources effectively.

2. Evaluate Teacher and Student Perspectives: To assess the perceptions of both teachers and students regarding the role of instructional leadership in their educational experiences. Understanding these perspectives can provide insights into how leadership styles impact classroom dynamics and student engagement in STEM subjects.

3. Identify Barriers and Challenges: To investigate the barriers that school leaders face in implementing effective instructional leadership for STEM education. This includes exploring issues related to resource limitations, training needs, and external pressures from educational authorities.

4. Contribute to Policy Recommendations: To provide evidence-based recommendations for policymakers and educational leaders aimed at enhancing instructional leadership practices. This is particularly relevant in the context of Zimbabwe, where the educational system is evolving and requires strategic interventions to improve STEM education outcomes. By focusing on these objectives, the study sought to fill a significant gap in the existing literature regarding the intersection of instructional leadership and STEM education in Zimbabwean secondary schools. The findings are expected to inform future leadership development programs and contribute to the broader discourse on educational reform in the country. Ultimately, the goal is to enhance the quality of STEM education and equip students with the necessary skills for success in a competitive global landscape.

1.2. RESEARCH OBJECTIVES

1. To identify the leadership practices that positively influence STEM education.

2. To assess the barriers faced by leaders in implementing effective STEM programs.

3. To evaluate the perceptions of teachers and students regarding instructional leadership in STEM education.

2. RESEARCH GAP

While there is a growing body of literature on instructional leadership and its impact on educational outcomes (Leaf & Odhiambo, 2017), there remains a significant gap in understanding its specific influence on STEM education within the context of Zimbabwean secondary schools. Most existing studies focus on general instructional leadership practices without delving into how these practices translate into effective STEM teaching and learning. Several key areas highlight this gap:

Contextual Relevance: Much of the existing research on instructional leadership is rooted in Western educational contexts, which may not be directly applicable to Zimbabwean schools. The unique socio-economic, cultural, and political landscape of Zimbabwe necessitates a localized understanding of how instructional leadership can be tailored to address the specific challenges and needs of STEM education (Chaka & Jansen, 2020).

Limited Empirical Evidence: There is a scarcity of empirical studies that investigate the direct relationship between instructional leadership and STEM education outcomes in Zimbabwe (Tenha & Makamure, 2024). Most available studies focus on general leadership effectiveness or school management practices without specifically addressing the nuances of STEM education, such as curriculum design, teacher training, and student engagement strategies.

Barriers to Implementation: Previous research has not adequately explored the barriers faced by educational leaders in Zimbabwe when implementing instructional leadership practices specific to STEM education (Munyoro, 2019). Understanding these barriers is crucial for developing targeted strategies that can enhance leadership effectiveness and improve educational outcomes.

Teacher and Student Perspectives: There is a lack of qualitative research that captures the experiences and perceptions of teachers and students regarding instructional leadership in STEM education. Insights

from these stakeholders are essential for understanding how leadership practices impact classroom dynamics and learning experiences.

Policy Implications: While various studies discuss the theoretical aspects of instructional leadership, few provide actionable recommendations for policymakers and educational leaders in Zimbabwe (Maphosa & Shumba, 2013). Bridging this gap could inform the development of policies and professional development programs that support effective instructional leadership in STEM education.

By addressing these gaps, this study aims to contribute to a more nuanced understanding of instructional leadership's role in enhancing STEM education in Zimbabwean secondary schools. It seeks to provide a framework that can inform future research and practical applications, ultimately leading to improved educational outcomes in this critical area.

3. THEORETICAL FRAMEWORK

The theoretical framework provides a structured lens through which to understand the research focus on instructional leadership and STEM education. This study draws upon several key theories that inform the relationship between educational leadership, teacher effectiveness, and student outcomes.

Distributed Leadership Theory: Distributed Leadership Theory posits that leadership is not the sole responsibility of a single individual but is shared among various members within a school environment (Spillane, 2006). This framework is particularly relevant in the context of STEM education, where collaborative efforts among teachers, administrators, and external stakeholders can enhance instructional practices. By fostering a culture of shared leadership, schools can tap into the collective expertise of their staff, leading to improved educational outcomes.

Transformational Leadership Theory: Transformational Leadership Theory emphasizes the role of leaders in inspiring and motivating their followers to achieve higher levels of performance (Bass & Avolio, 1994). In the context of this study, transformational leadership practices—such as setting a vision for STEM education, encouraging innovation, and providing support—are essential for creating an environment conducive to effective teaching and learning. Leaders who embody transformational qualities can empower teachers, facilitate their professional growth and enhance student engagement in STEM subjects.

Social Constructivism: Social Constructivism, as proposed by Vygotsky (1978), highlights the importance of social interactions in the learning process. This theory suggests that knowledge is constructed through collaborative efforts and shared experiences. In STEM education, this framework underscores the significance of collaborative teaching practices and peer learning. Instructional leaders who create opportunities for teachers to work together and share best practices contribute to a more dynamic and engaging learning environment for students.

Theories of Change: Theories of Change focus on the processes and conditions necessary for effective educational reform (Weiss, 1995). Implementing STEM education initiatives requires a clear understanding of the systemic changes needed within schools. This framework helps to identify the barriers that hinder successful implementation, such as resource constraints and insufficient professional development. By utilizing a Theory of Change approach, school leaders can develop targeted strategies to address these challenges and promote sustainable improvements in STEM education.

Summary: The integration of these theoretical frameworks provides a comprehensive understanding of the complex dynamics at play in instructional leadership and STEM education. By applying Distributed Leadership, Transformational Leadership, Social Constructivism, and Theories of Change, this study aims to explore how effective leadership practices can enhance teaching efficacy and student engagement in STEM subjects. This theoretical foundation will guide the analysis of the data collected and inform the recommendations for improving STEM education in Zimbabwean secondary schools.

4. LITERATURE REVIEW

The literature widely acknowledges the critical role of instructional leadership in fostering effective teaching and learning environments. Instructional leadership is generally understood as the actions that school principals and other leaders take to promote growth in teacher knowledge and skills, and to improve student learning. Shengnan and Hallinger (2021) define instructional leadership as the

influence a principal has on classroom interaction and, ultimately, on student learning outcomes Through instructional leadership, principals can indirectly affect student achievement by working with teachers.

Effective instructional leadership is characterized by a clear vision for student success, the building of consensus among stakeholders, and a plan that outlines rigorous standards and expectations. Mupa (2015) tie high academic achievement to educational leaders who articulate such a vision and develop a plan to achieve it. These leaders also commit to empowering teachers by understanding their career goals, delivering authentic feedback, and using data to inform discussions. Gordon, Oliver, & Soli (2016) emphasize the importance of relevant and personalized professional development for educators. Several key practices enhance student learning, including establishing clear goals and expectations, strategic resourcing, ensuring quality teaching, leading and supporting teacher learning and development, and maintaining an orderly and safe learning environment. Viviane Robinson's research highlights these practices as having a profound impact when executed well by leaders. Good instructional leaders also value peer-to-peer learning, encourage a growth mindset, take time to reflect, and value both content and comprehension.

However, implementing effective instructional leadership, particularly in the context of STEM education in Zimbabwe, faces several challenges. These include limited resources, inadequate training, curriculum rigidity, and inconsistencies between policy and practice. Bush & Oduro (2006) note that principals in African contexts often work in under-resourced settings with inadequately trained staff and limited formal leadership training. Furthermore, school heads may struggle to balance competing expectations from multiple stakeholders, including the Ministry of Primary and Secondary Education, responsible authorities, and the community. Mupa (2015) found that instructional leadership significantly contributes to both teacher and pupil performance in Zimbabwe. Despite these challenges, research suggests that instructional leadership positively impacts teacher and pupil performance Crankshaw (2011) concludes that effective leaders improve teachers' perceptions of their instructional leadership efforts by being more visible and practicing effective communication. Rhodes and Brundrett (2010) also found that successful instructional leaders talk to teachers about their instruction and encourage collaboration, thereby enhancing teacher effectiveness. Vurayayi & Muchuweni (2024) recommend strategic human and material resource mobilization and utilization to improve district instructional leadership support at the school level

5. METHODOLOGY

This study employed a mixed-methods approach to explore the impact of instructional leadership on the implementation of STEM education in secondary schools in Chivi, Zimbabwe. This approach allowed for a comprehensive understanding of the phenomenon by integrating quantitative and qualitative data.

5.1. Research Design

A concurrent triangulation design was utilized, where both qualitative and quantitative data were collected simultaneously but analyzed separately. This design facilitated a richer understanding of the research questions by corroborating findings across different data sources (Creswell, 2014).

5.2. Participants

The study targeted secondary school teachers and school leaders in Chivi District. A sample of 150 teachers and 30 school leaders was selected using stratified random sampling to ensure representation from various school types (urban, rural, high-performing, and low-performing) (Mugenda & Mugenda, 2013).

6. DATA COLLECTION

6.1. Quantitative Data

A structured questionnaire was developed to assess teachers' perceptions of instructional leadership practices and their impact on STEM education. The questionnaire included Likert-scale items to measure aspects such as leadership support, collaboration, and resource allocation (Fowler, 2014). The reliability of the questionnaire was established through a pilot study, yielding a Cronbach's alpha coefficient of 0.85.

6.2. Qualitative Data

In-depth interviews were conducted with a subset of 20 teachers and 10 school leaders to gain deeper insights into their experiences and perceptions of instructional leadership in STEM education (Kvale, 2007). The interviews were semi-structured, allowing for flexibility while ensuring that key topics were covered.

7. DATA ANALYSIS

7.1.Quantitative Analysis

Descriptive and inferential statistics were used to analyze the survey data. The data were processed using Statistical Package for the Social Sciences (SPSS), focusing on frequency distributions, means, and correlation analyses to identify relationships between instructional leadership practices and STEM education outcomes (Field, 2013).

7.2. Qualitative Analysis

Thematic analysis was employed to analyze the interview transcripts. This involved coding the data and identifying recurring themes related to instructional leadership practices and their effects on teaching and learning in STEM subjects (Braun & Clarke, 2006).

7.3. Ethical Considerations

Ethical approval was obtained from the relevant educational authorities, and informed consent was secured from all participants. Confidentiality and anonymity were assured, with all data stored securely and used solely for research purposes (Creswell, 2014).

By employing this mixed-methods approach, the study aimed to provide a comprehensive understanding of the role of instructional leadership in enhancing STEM education in secondary schools in Chivi, Zimbabwe. The integration of quantitative and qualitative data strengthened the validity of the findings and allowed for a more nuanced interpretation of the results.

8. RESULTS

The findings of this study are presented in two main sections: quantitative results derived from the survey data and qualitative results from the interviews.

8.1. Quantitative Results

The survey responses from 150 teachers revealed several key insights regarding instructional leadership practices and their perceived impact on STEM education.

Descriptive Statistics: The majority of respondents (75%) indicated that they felt supported by their school leaders in implementing STEM curricula. Additionally, 68% of teachers reported that collaboration among staff was encouraged, which they believed enhanced their teaching effectiveness.

Inferential Statistics: Correlation analysis showed a significant positive relationship between perceived instructional leadership practices and STEM education outcomes ($r = 0.65$, $p < 0.01$). Specifically, aspects such as leadership support and resource allocation were particularly strong predictors of effective STEM teaching. Teachers who rated their leaders highly on support and collaboration also reported higher student engagement and achievement in STEM subjects.

8.2. Qualitative Results

The thematic analysis of interview data from 20 teachers and 10 school leaders yielded several recurring themes that highlighted the nuances of instructional leadership in the context of STEM education.

Theme 1: Leadership Support: Many participants emphasized the importance of support from school leaders. Teachers noted that when leaders actively engaged in STEM initiatives—such as providing professional development opportunities and resources—they felt more motivated and equipped to teach effectively. As one teacher stated, "Our principal's commitment to STEM has transformed how we approach our lessons; we feel empowered to innovate."

Theme 2: Collaboration and Teacher Agency: Respondents highlighted the role of collaborative practices fostered by school leaders. Many teachers described initiatives where they worked together to

develop interdisciplinary projects and share best practices. This collaboration not only enhanced their teaching strategies but also created a sense of community among educators. A school leader remarked, *"When teachers collaborate, they share their strengths, which ultimately benefits our students."*

Theme 3: Resource Challenges: Despite the positive perceptions of leadership support, several teachers pointed out significant resource challenges that hindered the effective implementation of STEM education. Issues such as inadequate laboratory facilities, lack of teaching materials, and limited access to technology were commonly cited. One teacher noted, "We can have all the plans in the world, but without proper resources, it's hard to make STEM come alive for our students."

Theme 4: Student Engagement and Outcomes: Participants expressed a belief that effective instructional leadership positively influenced student engagement in STEM subjects. Teachers reported observing increased student interest and participation in STEM-related activities, which they attributed to supportive leadership practices. A common sentiment was that when students saw their teachers actively engaged and supported, they were more likely to invest effort in their learning.

8.3. Summary of Findings

Overall, the results indicate a strong connection between effective instructional leadership and positive outcomes in STEM education. The quantitative data support the assertion that leadership practices such as support and collaboration significantly enhance teaching efficacy and student engagement. Qualitative findings provide depth to these results, illustrating the lived experiences of teachers and leaders in the context of STEM education. These insights underscore the importance of fostering a supportive leadership culture within schools to improve educational outcomes in STEM fields, while also highlighting the challenges that need to be addressed to realize the full potential of STEM education in Chivi, Zimbabwe.

9. DISCUSSION OF FINDINGS

The results of this study indicate a significant connection between effective instructional leadership and positive outcomes in STEM education in secondary schools in Chivi, Zimbabwe. The quantitative data reveal that leadership practices such as support and collaboration significantly enhance teaching efficacy and student engagement. These findings are further enriched by qualitative data, illustrating the lived experiences of teachers and leaders in the context of STEM education. This section will discuss these findings in relation to existing literature and previous research, highlighting both corroborating evidence and unique insights.

9.1. leadership support and stem outcomes

The study's finding that leadership support positively influences STEM education outcomes aligns with numerous studies emphasizing the critical role of school leaders in fostering a conducive environment for teaching and learning (Leaf & Odhiambo, 2017). Teachers in this study noted that active engagement from leaders in STEM initiatives, such as providing professional development opportunities and resources, significantly boosted their motivation and preparedness. This resonates with Musandu (2013), who underscores the importance of school heads being in touch with classroom realities to appreciate and address the challenges faced by teachers. Similarly, Ponnusamy (2010) found a positive correlation between teachers' organizational commitment and students' academic achievement, suggesting that supportive leadership enhances teachers' dedication and, consequently, student performance. The importance of well-equipped STEM classrooms, qualified teachers, and extracurricular programs cannot be overstated.

However, the context of Zimbabwean schools presents unique challenges. As Chaka and Jansen (2020) highlight, the socio-economic, cultural, and political landscape necessitates a localized understanding of instructional leadership. The current study's findings suggest that while general principles of leadership support hold true, their implementation must be tailored to address the specific needs and constraints of the Zimbabwean educational system.

9.2. collaboration and teacher agency

The study also found that collaborative practices fostered by school leaders play a crucial role in enhancing teaching strategies and creating a sense of community among educators. Teachers described initiatives where they worked together to develop interdisciplinary projects and share best practices,

leading to improved teaching and learning. This aligns with the broader literature on collaborative learning, which emphasizes the benefits of teamwork, shared knowledge, and diverse perspectives in solving complex problems (Vangrieken et al., 2017).

Consistent collaboration among teachers can foster effective STEM-based instruction. This collaboration not only enhances their teaching strategies but also creates a sense of community among educators. A school leader remarked, *"When teachers collaborate, they share their strengths, which ultimately benefits our students."* Furthermore, the study's emphasis on teacher agency—the capacity of teachers to act autonomously and make decisions that impact their classrooms—is supported by research indicating that empowered teachers are more likely to innovate and engage students effectively (Gordon et al., 2020). The findings suggest that when school leaders encourage collaboration and provide teachers with autonomy, they foster a sense of ownership and responsibility, leading to improved STEM education outcomes.

9.3. resource challenges and implementation barriers

Despite the positive perceptions of leadership support and collaboration, the study revealed significant resource challenges that hinder the effective implementation of STEM education. Issues such as inadequate laboratory facilities, lack of teaching materials, and limited access to technology were commonly cited. These findings corroborate existing literature on the barriers to STEM education in Zimbabwe (Gadzirai et al 2016; Kadziya & Ndebele, 2021).

These resource constraints underscore the need for targeted interventions to address the systemic challenges facing Zimbabwean schools. The findings suggest that while effective instructional leadership can mitigate some of the negative impacts of resource scarcity, it cannot fully compensate for the lack of essential materials and infrastructure. Munyoro (2019) emphasizes the importance of understanding these barriers to develop targeted strategies that can enhance leadership effectiveness and improve educational outcomes.

9.4. student engagement and outcomes

Participants in the study expressed a belief that effective instructional leadership positively influenced student engagement in STEM subjects. Teachers reported observing increased student interest and participation in STEM-related activities, which they attributed to supportive leadership practices. This aligns with research indicating that student engagement is a critical factor in academic success, particularly in STEM fields (Fredricks et al., 2004).

When students see their teachers actively engaged and supported, they are more likely to invest effort in their learning. Effective instructional leadership is positively correlated with student engagement in STEM subjects (Miller & Gentry, 2015). This is supported by findings that when students see their teachers actively engaged and supported, they are more likely to invest effort in their learning.

9.5. policy implications and recommendations

The findings of this study have several implications for policy and practice in STEM education in Zimbabwe. First, they underscore the importance of investing in leadership development programs that equip school leaders with the skills and knowledge necessary to support effective STEM teaching. These programs should focus on fostering a supportive school culture, promoting collaboration among teachers, and addressing the unique challenges facing Zimbabwean schools.

Second, the study highlights the need for increased investment in resources and infrastructure for STEM education. Policymakers should prioritize the provision of adequate laboratory facilities, teaching materials, and technology to ensure that teachers have the tools they need to deliver high-quality STEM instruction.

Third, the findings suggest that greater attention should be paid to the experiences and perspectives of teachers and students in STEM education. Qualitative research that captures the lived realities of these stakeholders can provide valuable insights into the impact of leadership practices and inform the development of more effective interventions. Finally, the study calls for greater collaboration between policymakers, educational leaders, and researchers to develop evidence-based policies and practices that support STEM education in Zimbabwe. By working together, these stakeholders can create a more equitable and effective educational system that prepares students for success in the 21st century.

10. CONCLUSION AND RECOMMENDATIONS

This study provides empirical evidence supporting the critical role of instructional leadership in promoting STEM education in Zimbabwean secondary schools. The findings highlight the importance of supportive and collaborative leadership practices in enhancing teacher effectiveness and student engagement, even in the face of significant resource constraints. Based on these findings, several recommendations can be made to improve STEM education in Zimbabwe: Investment in leadership development is crucial. The Ministry of Education should prioritize leadership development programs for school principals, focusing on instructional leadership skills specific to STEM (Dat et al., 2023). These programs should equip leaders with strategies to foster a supportive school culture, promote teacher collaboration, and effectively manage limited resources. Mentorship programs pairing experienced and newly appointed principals could provide valuable on-the-ground support.

Addressing resource disparities is essential. The government should allocate more resources to improve infrastructure and equipment in rural schools, particularly laboratory facilities and access to technology. Exploring cost-effective solutions, such as utilizing locally available materials for STEM projects and establishing resource-sharing networks between schools, can also be beneficial. Developing partnerships with local businesses and organizations to secure additional funding and resources for STEM education is another viable strategy. Enhancing teacher training and support is vital. Ongoing professional development opportunities for STEM teachers should focus on innovative teaching methods, curriculum development, and integration of technology. Encouraging teachers to participate in action research to identify and address specific challenges in their classrooms can lead to improved practices. Facilitating collaboration between teachers through professional learning communities and mentorship programs will also strengthen instructional practices.

Promoting STEM awareness and engagement is important. Implementing programs to raise awareness among students, parents, and communities about the importance of STEM education and career opportunities can foster a supportive environment. Schools should organize STEM-related events, such as science fairs, workshops, and competitions, to spark student interest and engagement. Incorporating culturally relevant examples and real-world applications of STEM concepts into the curriculum can make learning more meaningful for students. Fostering collaboration and partnerships is key. Encouraging collaboration between schools, universities, and industry can provide students with access to internships, mentorships, and hands-on learning experiences. Establishing partnerships with international organizations to facilitate knowledge exchange and access to best practices in STEM education can further enhance local efforts. Engaging parents and community members in STEM education initiatives can create a supportive ecosystem for student learning. Policy recommendations are also necessary. The Ministry of Education should develop clear and comprehensive STEM education policies that align with national development goals. These policies should address issues such as curriculum standards, teacher training, resource allocation, and assessment. Regularly reviewing and updating STEM education policies based on evidence and feedback from stakeholders will ensure their effectiveness and relevance.

By implementing these recommendations, Zimbabwe can create a more robust and equitable STEM education system that prepares students for success in the 21st century and contributes to the country's socio-economic development. It is crucial to recognize that improving STEM education requires a holistic approach that addresses not only instructional practices but also systemic challenges related to resources, infrastructure, and policy (Mufanechiya & Makgalwa, 2024). Through sustained commitment and collaboration, Zimbabwe can unlock the full potential of its students and build a brighter future through STEM.

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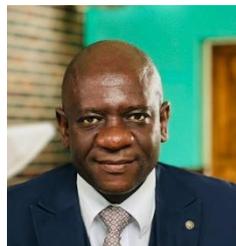
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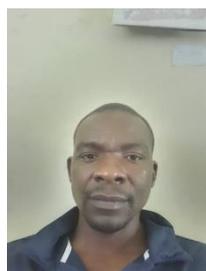
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