Challenges confronting rural physical science educators in enhancing Grade 12 Performance

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ABSTRACT

The quality of Physical Science education in rural South African schools is a matter of significant concern, particularly in the context of the country's development goals aimed at uplifting education standards in these areas and nurturing a more skilled workforce. Physical Science plays a pivotal role in enhancing scientific literacy across the nation. This qualitative study, framed within Vygotsky's sociocultural theory, sought to identify the challenges faced by Physical Science educators in improving Grade 12 results in rural schools in Vuwani. Data were collected through semi-structured interviews and classroom observations involving a purposive selection of ten Physical Science educators from among 49 schools within the district. Thematic analysis was applied to the collected data, yielding insightful interpretations. The findings, primarily from interview responses, reveal that Physical Science educators in Vuwani grapple with various challenges. These challenges encompass resource scarcity, excessive workloads, inadequate support from school management teams (SMT), insufficient training when curricula change, overcrowded classrooms, and suboptimal learning environments. This study underscores the importance of fostering collaborative partnerships between schools, local communities, and business sectors. In particular, it recommends that businesses extend their support to rural schools, addressing infrastructure deficiencies and resource shortages. Such collaborative initiatives between government entities and businesses can enhance the overall quality of education in rural areas, ultimately mitigating the skills deficit and contributing to the nation's socioeconomic development goals.

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Introduction

Education is the cornerstone of socioeconomic development and individual empowerment in any society (Mosoge, 2015). In South Africa, a country undergoing rapid transformation and grappling with the persistent legacy of apartheid, the pursuit of equitable and high-quality education remains a paramount national objective (Ajani & Govender, 2023). While considerable strides have been made in post-apartheid South Africa to bridge educational disparities, challenges persist, particularly in rural areas where historical inequalities have left indelible marks (Baker, 2019). The South African government's commitment to universal access to quality education is enshrined in its Constitution (Republic of South Africa, 1996), positioning education as a fundamental human right for all citizens. However, translating these principles into practice, especially in rural schools, presents a multifaceted challenge that demands critical attention (Afolabi & Adepoyin, 2018; Muremela et al., 2023).

The importance of quality education, especially in rural contexts, cannot be overstated. It catalyses individual and community development, driving economic growth, reducing poverty, and fostering social cohesion (Chilisa & Ntshoe, 2016; Gustafsson & Mabogwane, 2018). Despite the undeniable significance of education, rural schools in South Africa often face many challenges that impede their ability to provide learners with the quality education they deserve (Mosoge, 2015). These challenges include limited...
access to resources, inadequate infrastructure, socioeconomic disparities, and a shortage of qualified educators (Chilisa & Nishoe, 2016; Department of Basic Education, 2018). Consequently, rural schools frequently need to catch up to their urban counterparts regarding educational outcomes and opportunities (Spaull & Kotze, 2015).

One crucial facet of South Africa’s education system is providing quality science education, particularly in Physical Science. Physical Science is a cornerstone of science education and a gateway to various Science and technology-related careers (Mukuka, 2016). Achieving excellence in Physical Science education is imperative for a nation striving to compete in the global knowledge economy. Furthermore, this subject is pivotal in fostering scientific literacy and problem-solving skills among learners, attributes essential for their future success (Afolabi & Adedoyin, 2018). This study focuses on the challenges faced by Physical Science educators in rural schools within the Vuwani district of South Africa. The choice of this geographical area is significant, as it has been historically marginalised and has experienced educational disruptions due to social unrest (Kitsara & Baker, 2017). Furthermore, understanding the challenges faced by educators in rural contexts (Muthala et al., 2022), such as Vuwani, is pivotal to addressing the broader educational disparities and inequalities that persist in South Africa’s education system (Baker, 2019).

Existing literature provides valuable insights into educators’ challenges in rural South African schools (Mbongambi et al., 2023). Research by Ramarumo (2015) highlights the need for more qualified Physical Science educators in rural areas, often resulting in educators teaching subjects they need to be adequately prepared. This issue directly impacts the quality of education provided to learners. Furthermore, Spaull and Kotze (2015) emphasise the importance of considering socioeconomic factors in understanding educational inequalities, particularly in rural contexts. Socioeconomic disparities affect learners’ readiness to learn and access educational resources, influencing their academic performance. The educational challenges faced by rural educators extend beyond classroom settings. Research by Mosoge (2015) underscores the importance of school management and leadership in mitigating these challenges. Effective school leadership can significantly impact resource allocation, educator morale, and overall performance (Buthelezi & Ajani, 2023). Additionally, Hlalele and Letseka (2016) highlight the crucial role of supportive school management teams in rural schools, arguing that such teams play a crucial role in fostering a conducive learning environment for both educators and learners.

Despite the rich literature addressing educational challenges in rural South Africa, there is a need for a focused investigation into the specific challenges faced by Physical Science educators in rural schools within the Vuwani district. This study aims to contribute to the existing body of knowledge by shedding light on the unique obstacles these educators encounter, which may differ from those in other subjects or provinces. By identifying and understanding these prevailing challenges, it is hoped that policymakers, educational institutions, and stakeholders can develop targeted interventions and support mechanisms to enhance the quality of Physical Science education in rural South African schools, ultimately promoting equity and fostering socioeconomic development.

The Department of Basic Education (DBE) in South Africa faces a significant challenge within its Physical Science section, primarily centred around the imperative of nurturing a more proficient cohort of Grade 12 Physical Science learners. The overarching objective is to cultivate a substantial pool of high-achieving graduates at this level (Hlalele & Letseka, 2016). This aspiration addresses the acute shortage of skilled professionals, particularly in fields like engineering and medicine, as outlined in the National Development Plan (2011). The crux of the matter pertains to the critical need for more learners to engage with Physical Science at the secondary level, thereby positioning themselves to pursue careers in these specialised domains at higher education institutions. However, the persistently low-performance levels observed among Grade 12 learners in Physical Science is a matter of deep concern. Consequently, developing and implementing effective strategies to enhance learner performance in this subject are deemed paramount (Ajani, 2023).

It is imperative to acknowledge that a substantial portion of South Africa’s learner population hails from rural areas, where suboptimal performance in Physical Science is remarkably prevalent (Muremela et al., 2023). Gardiner (2008) underscores the enduring legacy of South Africa’s apartheid-era education system, characterised by racial segregation and substantial resource disparities that disproportionately favoured white communities while disadvantaging black counterparts. Despite concerted efforts by the government to ameliorate the teaching and learning environment in rural regions, several schools continue to grapple with underperformance. A notable directive from the DBE, articulated in Circular No. 13 of 2014, underscores the pivotal role of schools in augmenting the number of successful Grade 12 candidates in both mathematics and Physical Science by a considerable margin, with the ambitious target year being 2024.

While the target may appear ambitious, it remains a tangible objective that can be achieved through the concerted efforts of all stakeholders. The National Senior Certificate Examination Report (2016) reports that the Minister of Basic Education cites recent international studies such as the Trends in International Mathematics and Science Study and the Southern and East African Consortium for Monitoring Educational Quality. These studies indicate an encouraging upward trajectory in the performance of Southern African learners. However, it is imperative to maintain our efforts and implement strategies to improve performance, especially within rural school settings where performance levels remain subpar (Muthala et al., 2023).

Critical to this endeavour is the indispensable role of schools in providing the requisite support and assistance to educators, enabling them to enhance learner performance (Baker, 2019). School leaders are intimately familiar with the daily challenges their educators face and, as such, are responsible for collaborating with physical science educators to address the multifaceted issues contributing to poor learner performance. Hlabane (2016) underscores learners’ salient challenges, including language proficiency, conceptual
comprehension, the ability to engage with questions requiring explanation and higher-order thinking skills, challenges in comprehending and answering questions, and mathematical proficiency. Achieving commendable results in Physical Science hinges upon the proactive engagement of schools and their educators in addressing these issues, thereby striving for excellence in learner outcomes (Gustafsson & Mabogone, 2018).

Hence, this introduction sets the stage for a comprehensive exploration of the challenges faced by Physical Science educators in rural schools, specifically focusing on the Vuwani district. Drawing from existing literature, it underscores the significance of quality education, particularly in rural areas (Muremela et al., 2023; Muthala et al., 2023), and the critical role of Physical Science in fostering scientific literacy and empowering learners. The introduction also highlights the historical disparities and ongoing challenges in South Africa's education system, emphasizing the need for a nuanced understanding of rural education contexts. Finally, it underscores the research gap related to the unique challenges of Physical Science educators in Vuwani's rural schools, laying the foundation for this study's objectives and contributions to educational research and policy development.

Theoretical Framework

A theoretical framework is a foundational structure that guides researchers in constructing and substantiating their studies (Grant & Osanloo, 2014). It delineates the overarching vision of the study and provides the theoretical underpinning upon which the research is built. In this study, which delves into the challenges confronted by physical sciences educators in rural schools aimed at enhancing Grade 12 results, the theoretical framework is grounded in Sociocultural Theory, primarily attributed to Vygotsky.

According to Vygotsky, sociocultural theory posits that human learning is fundamentally a social process, with cognitive functions evolving through interactions with individuals possessing more significant expertise in a given domain (Vygotsky, 1978). In the context of rural schools, this implies that learners' educational development is intricately linked to their interactions with educators and their peers. To foster effective learning, it becomes imperative for rural schools to be adequately equipped with the essential resources to empower educators with the requisite knowledge and create a conducive learning environment. Challenges that arise can manifest as behavioural obstacles or contextual hindrances. According to sociocultural theory, these impediments can be ameliorated through mentorship, with educators assuming the role of mentors and guiding learners' growth (Mahomaholo, 2017).

Furthermore, the theory posits that values, beliefs, and higher-order cognitive functions evolve through active participation in social groups and engagement in cultural activities. Vygotsky's conception of sociocultural theory emphasises that parents, caregivers, peers, and the broader cultural milieu collectively contribute to the development of higher-order cognitive processes (Vygotsky, 1978). The challenges educators face in rural schools can impede the progress expected from effective learning experiences. By addressing these challenges, learning effectiveness can be enhanced, leading to improved academic outcomes for learners. Ultimately, the study envisions a scenario in which the nation benefits from a more educated populace, with some individuals pursuing careers currently in short supply within the country.

Vygotsky's Sociocultural Theory, a foundational framework in educational psychology (Cohen, 1984; Wertsch, 1991), serves as the underpinning theoretical foundation for this study on the challenges facing Physical Science educators in improving Grade 12 results in rural schools in Vuwani. This theory, developed by Lev Vygotsky in the early 20th century, posits that learning is fundamentally a social and cultural process deeply intertwined with the context in which it occurs. It emphasises that individuals acquire knowledge, skills, and cognitive abilities through interactions with their social and cultural environment. In the context of this study, Vygotsky's theory provides a robust lens through which to explore the complex web of social and cultural factors impacting the teaching and learning of Physical Science in rural schools.

One fundamental tenet of Vygotsky's theory is the concept of the Zone of Proximal Development (ZPD), which refers to the gap between what a learner can do independently and what they can achieve with the support of a knowledgeable other, such as an educator or peer (Vygotsky, 1978). In rural education in Vuwani, understanding the ZPD of both educators and learners is essential. By identifying the challenges that hinder educators from providing adequate support and learners from receiving it, interventions can be tailored to bridge this gap. Moreover, Vygotsky's emphasis on cultural tools, including language, as mediators of cognitive development is highly relevant. As Mahomaholo (2017) notes, language is vital to teaching and learning, particularly in a multilingual context such as South Africa. The study can delve into how language barriers or the lack of resources for multilingual education affect the teaching and learning of Physical Science.

Furthermore, Vygotsky's sociocultural theory underscores the significance of social interaction and collaborative learning (Vygotsky, 1978). In rural schools, where resources may be scarce, peer support and collaborative learning strategies can be examined as potential solutions to enhance learners' understanding of Physical Science concepts (Cohen, 1994). Hence, the theory underscores the importance of the sociocultural context in shaping individuals' cognition and behaviour (Wertsch, 1991). In the rural setting of Vuwani, unique sociocultural factors, such as community involvement in education and local traditions, may influence the teaching and learning of Physical Science. These factors can be explored within the framework of Vygotsky's theory to gain a deeper understanding of their impact. Vygotsky's Sociocultural Theory provides a robust theoretical foundation for this study, exploring how social, cultural, and contextual factors influence the challenges facing Physical Science educators and learners in rural Vuwani.

By applying the principles of this theory, the study can unearth valuable insights into the complexities of teaching and learning in
this specific setting, ultimately contributing to the development of targeted interventions to improve Grade 12 results in Physical Science.

**Justification for the theory in this study**

The choice of Vygotsky's Sociocultural Theory as the theoretical framework for this study is highly justified, given its alignment with the unique context and objectives of the research. First and foremost, Vygotsky's theory strongly emphasises the social and cultural aspects of learning, particularly in rural schools in Vuwani. These schools often grapple with distinct sociocultural challenges, such as language diversity and community involvement in education. By adopting Vygotsky's lens, the study acknowledges and seeks to explore how these sociocultural factors shape the teaching and learning of Physical Science, providing a nuanced understanding of the challenges faced by educators and learners.

Secondly, Vygotsky's Zone of Proximal Development (ZPD) concept aligns perfectly with the study's objective of identifying challenges and support mechanisms. It allows for a focused exploration of the gap between what educators and learners can achieve independently and what they can achieve with appropriate support. This is especially crucial when investigating the hindrances to effective teaching and learning in rural schools. By delving into the ZPD of both educators and learners, the study aims to pinpoint specific areas where interventions can be targeted to improve Grade 12 results in Physical Science.

Furthermore, Vygotsky's Sociocultural Theory underscores the significance of collaborative learning and peer interaction in the learning process. In the resource-constrained environment of rural schools, where educators may face challenges in providing individualised support, understanding how peer interactions can foster understanding and problem-solving in Physical Science is invaluable. This theory aspect aligns perfectly with the study's intent to explore potential solutions and support mechanisms that extend beyond traditional pedagogical approaches.

Conclusively, Vygotsky's sociocultural theory is a well-justified theoretical framework for this study due to its compatibility with the social, cultural, and educational context of rural schools in Vuwani. The theory's emphasis on sociocultural factors, the Zone of Proximal Development, and collaborative learning aligns with the study's objectives of identifying challenges and support mechanisms to enhance Grade 12 results in Physical Science. By grounding the research in this theoretical framework, the study seeks to provide a comprehensive understanding of the complexities surrounding teaching and learning in rural settings, ultimately contributing to targeted interventions for improvement.

This study aims to investigate and identify the challenges faced by physical science educators in rural schools regarding improving Grade 12 results. The research seeks to gain an in-depth understanding of the specific obstacles and difficulties educators encounter in rural areas to enhance the academic performance of Grade 12 learners in Physical Science.

**Research Methodology**

The research methodology employed in this study serves as a systematic framework for conducting and supporting the research process (Grant & Osanloo, 2014). Kothari (2004) defines methodology as a structured approach to solving research problems. This study's methodology encompasses the population, sampling procedures, data collection methods, and data analysis techniques. These methodological aspects are crucial for addressing the research problem effectively. According to Welma, Kruger, and Mitchel (2005), Grade 12 Physical Science educators comprise the study's population. Specifically, it focuses on educators working in the rural schools of the Vuwani Cluster, situated within the Vhembe District of the Limpopo Province. The study seeks to understand the challenges these educators face in improving Grade 12 results in Physical Science. As South Africa grapples with a shortage of skilled workers in engineering and medicine (National Development Plan, 2011), learners' academic performance in subjects like Physical Science becomes a critical concern.

Mugo (2002) describes sampling as the process of selecting a representative subset from a larger population to study. Given the practical constraints of studying an entire population, purposive sampling was employed. This technique involves selecting participants based on pre-defined criteria relevant to the research question (Maree, 2015). In this case, Grade 12 Physical Science educators were purposively selected as they directly relate to the research topic. The study considered ten schools within the Vuwani area, selected randomly from a pool of 49 schools. If educators shared the subject, only one representative was included, resulting in eight participants agreeing to participate in interviews. Data was collected through semi-structured face-to-face interviews guided by an interview schedule (Kvale, 1996). The schedule was divided into two sections: the first gathered personal information about the participants, and the second comprised questions aligned with the research objectives. Probing techniques were employed during the interviews to ensure clarity and depth of responses. All interviews took place at the participants' respective schools in a comfortable and minimally distracting environment, ensuring confidentiality and obtaining informed consent before data collection commenced.

Following Flick's (2013) definition, qualitative data analysis involves systematically classifying and interpreting the interview data. The verbatim transcripts of the interviews were cleaned to remove repetitions, ensuring the accuracy of the captured data. A coding process was employed to organise and anonymise the data, categorising it into themes (Maree, 2015). This thematic analysis allowed for a comprehensive exploration of the challenges Grade 12 Physical Science educators face in rural schools. To ensure the study's trustworthiness, the researchers followed key criteria: credibility, transferability, dependability, and confirmability (Sattu et al., 2014). Credibility was achieved by aligning interview questions with the study's aims and ensuring that only Grade 12 Physical Science
educators were included. Transferability was considered as the study focused on educators working in rural schools. By providing a thorough account of the research process, it was possible to ensure dependability. Confirmability was maintained through audio recordings and notes to capture participants' views and perspectives.

Ethical considerations, such as the assurance of confidentiality and informed consent, were strictly adhered to during the research process. The researchers obtained permission from the Vhembe District's Department of Education and observed university research ethics policies (Kamat, 2006). The tension between research aims and participants' privacy rights was managed through voluntary participation, ensuring that participants' rights were respected (Orb et al., 2001). The research process maintained transparency and integrity, with participants' ideas contributing to the analysis of findings.

**Findings**

The study engaged eight participants in semi-structured interviews, providing insights into their challenges while instructing Grade 12 Physical Science within their respective school settings. These challenges were common among various schools, although a minority of participants articulated distinct concerns. These divergent challenges were categorised into themes, facilitating a comprehensive analysis of the participants' unique perspectives.

**Lack of Resources**

The participants' views were sought on the availability of resources in schools to teach physical science in their schools. Five of the eight participants mentioned a lack of resources as a challenge affecting their teaching in Grade 12. The following are some of their *verbatim* responses.

*There needs to be more scientific equipment in rural areas. We need the instruments to elaborate on our teaching. The SMT has no support as they do not buy the equipment for us* (P1-Participant 1).

Participant 3 asserted that Physical Science is a practical subject.

*There is a need for laboratories here. For practical lessons, learners go to the Science Centre. There, many learners are just given results* (P3).

Participant 5 similarly concurred with Participant 3:

*The biggest challenge we face is the need for laboratories, Physical Science equipment, and chemicals. These are necessary to teach theory. It is difficult for learners to grasp concepts if there are no experiments performed. If we have laboratories, equipment, and chemicals, it would be easy for learners to understand science. They will do the experiments themselves and see the results. It is easy to grasp the idea because learners will have done it by themselves, unlike when I teach them theoretically, where they cannot even visualise what a test tube looks like. That is the biggest challenge we face here* (P5).

Participant 6 and 8 concurred on their need for more scientific resources to teach the subject in rural schools.

*They supply books that need to be updated. Science is experimentally based. There is a need for apparatus. For experiments, learners are taken to the science resource centre. At the centre, they must be allowed to handle apparatus. They become spectators* (P6).

The school where I work is more rural. There are so many challenges. There needs to be more infrastructure and laboratories. The other one is an issue with textbooks. We use shallow textbooks and need study guides for learners. When we teach, we have to use language that is easy for learners to conceptualise. The other one is the issue of calculators. The department's calculators are only helpful for a short time. Those are the challenges that learners have at our school* (P8).

Most participants indicated that their schools lack resources that could enable them to teach effectively. Schools could perform better if educators are given the correct resources to use. Ngema (2016) cited the lack of resources as one factor that makes learners perform poorly at school. The Department of Education and all stakeholders should work together to eradicate the problem of the shortage of resources. Learners in rural schools need proper support, and this leads to more learners performing poorly. As a country, if learners develop to their full potential, their career choices might help develop this country.

**The use of resource centres as an alternative**

When probing the issue of lack of resources, participants indicated that there is a resource centre that schools visit to do experiments. The participants stated the following as relating to the resource centre they visit for experiments:

*At our circuit, we organise learners to visit the Vuwani Resource Centre, where we perform experiments for learners. When we arrive there, there will be many other schools. It is also difficult for them to conduct the experiments so that every learner benefits. Sometimes, they give learners the results without doing the experiments. If, as a school, we have a laboratory, we can do our experiments there, where our learners would greatly benefit* (P3).

Around our school, we have a science resource centre. We make appointments to take our learners there, but it is less fruitful than expected. Many schools use the resource centre and would come for the same experiments in a day. Learners are grouped in huge
numbers, and some cannot notice what is happening. They take the results and return because it is a prescribed experiment, and there is nothing one can do. We do that to obtain marks for the learners (P5).

On that issue, we arrange transport for the learners and dump them in a particular area. Nearby, a science centre is under construction (by the local university). When we go there, many learners end up doing something. In short, we have a challenge: they go there to visualise from a distance. They tend to be spectators (P6).

The science resource centre utilised by schools in the region needs help adequately accommodating the substantial influx of learners who frequent the facility for experimental purposes. These learners visit the centre with the primary objective of observing and gaining insights into experimental procedures. The increased number of learners accessing the science resource centre underscores schools’ commitment to fostering academic excellence. In the Grade 12 Physical Science final examinations, a specific question necessitates proficiency in experimental techniques and knowledge. Learners with limited exposure to practical experimentation often need help responding to such inquiries. Therefore, the centre must allocate sufficient time for learners to conduct experiments effectively.

**Changes in curriculum**

The national curriculum undergoes frequent revisions driven by the objective of producing globally competitive and proficient generations. However, it was revealed by some participants that these curriculum alterations pose challenges. Their perspectives on the challenges associated with curriculum changes are summarised as follows:

Number two, as the system of education is constantly changing, there is a need for in-service training so that we can fill the content gap. By so doing, we increase the performance and improve the results in Physical Science (P3).

The last part might be a curriculum change. Sometimes, we need to be fully equipped with the curriculum change, yet we are supposed to teach learners based on the new curriculum. It is not functional because we are not well-versed in the topics (P7).

When a curriculum undergoes modification, educators must comprehensively understand the specific changes and their implications. They must be fully informed about their roles and responsibilities within the revised curriculum. Educators needing the requisite knowledge to navigate these changes may find it challenging to assist learners in reaching their maximum potential. Moreover, any curriculum transformation should encompass corresponding adjustments in teaching and learning methodologies to effectively address newly introduced or modified content (Pastory, 2016). Despite the shift from the National Curriculum Statement (NCS) to the Curriculum Assessment Policy Statements (CAPS), educators have largely adhered to their previous teaching approaches, primarily due to insufficient training provisions (Gudyanga, 2017). This reliance on traditional teaching methods could hinder their ability to effectively convey knowledge to learners. As educators are the crucial link between the curriculum and the learners, their outdated approaches may contribute to learners’ suboptimal performance (Jadhav & Pantankar, 2013). Some learners may need help academically due to educators’ inability to teach specific topics accurately.

While probing further, the participants were asked if they were given enough training when the curriculum changes. The following were some of the responses to this:

During the training, the time is insufficient to grasp all the content. One finds that we are given two to three days for paper 1 and paper 2—more than the training is needed (P3).

Actually, we can have more than one or two days of training. Topics might be the same, but our teaching is not similar to the previous curriculum. It then gives us problems in producing good results. There are also new topics (P7).

Educators often encounter challenges related to inadequate training opportunities concerning new curriculum modifications, resulting in protracted adjustment periods that subsequently impact learners’ performance. Pastor (2016) has observed that curriculum changes in schools, especially in science subjects, often overlook the availability of essential teaching and learning materials. In rural school settings, curriculum adjustments rarely translate to procuring or utilising additional resources. The need for more teaching and learning resources, coupled with insufficient training, significantly impedes the effective implementation of curriculum changes. Comprehensive and targeted training is imperative to equip educators with the skills and knowledge to empower learners effectively. By imparting accurate and up-to-date knowledge to learners, educators can significantly enhance the overall quality of education.

**Educators’ Workload**

Educators, in their professional capacity, must fulfil both teaching and managerial responsibilities, a dual role that demands significant time and effort. Two participants specifically identified an excessive workload as a noteworthy challenge within their respective schools. It is well established that an overwhelming workload often results in a decline in the quality of services provided. The participants articulated their concerns in the following manner:

I teach Physical Science in grades 11 and 12. I also teach life sciences in Grades 11 and 12. Being overloaded with work makes us lose focus, and thus, we concentrate more on Grade 12 at the expense of the lower Grades. Our school is tiny and has many streams (P2).
Looking at my workload, I handle NS Grade 8 and Physical Science Grades 10 to 12, all papers. I do this alone (P6).

The participants in this study expressed dissatisfaction with their current workload allocation in their respective schools. One participant attributed their workload challenges to the school's small size and the multiple streams' subsequent presence. A potential solution would be to reduce the number of streams in smaller schools to alleviate the excessive workload placed on educators. This reduction in streams was seen as a strategy to enhance the effectiveness of educators, as overloading them could compromise their overall performance. Therefore, participants suggested that school leadership in smaller institutions should consider stream reduction to ensure that educators can fulfill their teaching roles more effectively.

Furthermore, another participant highlighted the difficulty of exclusively teaching Physical Science in the Further Education and Training (FET) band. The participant emphasized that improving performance in Physical Science can be challenging when learners rely on a single educator for this subject. They proposed that educators could provide better support if they shared subjects, fostering collaboration that benefits both educators and learners. Such collaboration could lead to improved learning outcomes, as learners who struggle to understand one educator might succeed more when taught by another (Ajani & Govender, 2023). This perspective aligns with Zenda's (2016) observation that high workloads contribute to a high failure rate in rural areas, mainly when educators must attend to multiple grade levels. The data from this study indicated that smaller schools with multiple streams were more likely to experience these high workload challenges.

Curriculum Support

In order to facilitate quality educational outcomes, educators require substantial support from the School Management Team (SMT). The SMT must provide educators with all the necessary resources to implement the curriculum effectively. The study participants voiced their concerns regarding the challenges they face during their teaching experiences as follows:

The Headmaster is not oriented to Science, so it is not easy to get support from him. One cannot get financial support to buy apparatus. They feel it is worthless to buy science equipment (P2).

It takes work to get support. It depends on what the Head of the school supports. The support I get is minimal (P5).

The other point might be support from the SMT. One finds that when we need support in motivating learners, they need to be compensated. If we need a person to motivate our learners, the SMT says they do not have money to pay for that person. It is discouraging (P7).

A notable concern raised by educators pertains to the inadequate support they receive from the School Management Team (SMT). In cases where educators do not receive sufficient support in fulfilling their daily responsibilities within the school, the learners ultimately bear the brunt of these challenges. It becomes crucial to fortify curriculum support mechanisms to facilitate the cultivation of proficient learners. In this regard, school leadership should prioritise providing essential science resources to empower educators in their teaching endeavours. According to the Department of Basic Education (DBE, 2016), the Head of Department (HOD) is tasked with various responsibilities, including engagement in classroom instruction, overseeing the department's effective functioning, and organising extracurricular activities related to the subject matter or phase to ensure the learners' educational progress.

The HOD plays a pivotal role as an immediate senior member of the SMT to whom educators can address their concerns and grievances. Adequate support from school leadership is instrumental in fostering favourable conditions for achieving positive academic outcomes. Even when a school lacks a fully equipped laboratory, it remains essential to provide educators with the fundamental resources necessary for effective Physical Science instruction. Such provisions can stimulate learners' interest in the subject and enhance their academic performance.

Regenerate

Classroom Environment

The classroom environment encompasses the physical and contextual conditions within which the teaching and learning processes occur. An optimal environment is conducive to effective learning, ensuring learners can comfortably engage in the educational process. However, certain educators in rural school settings grapple with less-than-ideal teaching conditions. Several participants highlighted specific challenges related to the classroom environment, as follows:

Lack of classroom. They have broken windows and doors (P5).

Yes, I encounter several challenges, including the Science classroom environment; by that, I mean the classroom atmosphere or the learners. Some of us conduct lessons under the trees and the shacks where we need better resources nearby or in the walls, which is conducive for the periodic table. Whatever is related to Science, we do not have a place to hang them to create a science classroom environment where learners can feel that they are in a scientific room (P6).

Research conducted by Maemeko, Nkengbeza, and Ntabi (2017) underscores the significance of the learning environment in shaping learners' academic performance. Learners with poor learning conditions often face additional hurdles in their educational journey. When teaching occurs outdoors, such as under trees, educators may be compelled to miss classes due to adverse weather conditions,
further disrupting the learning process. As highlighted by Sayani (2015), educators are responsible for facilitating knowledge acquisition, skill development, and critical thinking among their learners by implementing innovative teaching strategies. However, these efforts' effectiveness is contingent upon a positive and conducive learning environment. Therefore, schools must actively support educators in creating an appropriate classroom atmosphere, as it is imperative for them to fulfill their educational mandates.

Overcrowded classrooms

Overcrowded classrooms pose a significant challenge to effective teaching and learning. In such crowded environments, educators encounter difficulties maintaining control and providing individualized attention to each learner. Two research participants noted that overcrowding affects their ability to deliver instruction effectively.

More learners do sciences, leading to poor performance (P2).

_I teach them under one roof, a single classroom where I cannot move in between. I stand in front to write on the chalkboard. It is hard; I cannot even move to help learners individually (P5)._  

The issue of overcrowded classrooms not only hinders educators from effectively fulfilling their teaching responsibilities but also impacts the performance of learners. Educators often must resort to traditional lecture-based teaching methods when faced with overcrowded classes, limiting their ability to provide individualized support and assessment. In the context of Physical Science, where a focus on enhancing individual comprehension is essential, overcrowded classrooms create significant obstacles for educators. As Shah (2012) noted, smaller class sizes are more manageable and conducive to effective teaching, allowing educators to exert better control and assist all learners, thereby facilitating more effective learning experiences.

Discussion

Physical Science educators in rural areas experience different challenges that limit them from producing quality results. Most schools in rural areas need more resources to promote Physical Science teaching. The lack of resources at schools' compromises how Physical Science is taught. A study by Legotho, Maaga and Sebego (2002) also cited the lack of resources as a significant cause of poor performance in Grade 12. A resource centre was built where learners' skills and knowledge of Physical Science must be promoted, but it is not practical because of the large numbers of learners visiting the place at once. All Physical Science FET (Grade 10 to 12) learners are supposed to visit the centre to do experiments if their schools have no resources. Lessons offered at the resource centre are through demonstrations. Learners only learn how certain aspects must be carried out rather than skills for doing experiments. The curriculum of the country changes because learners must be competent enough to take their place in the world order. A change in curriculum affects educators because some contents and approaches change. When the curriculum changes, educators need to be thoroughly trained. They are given a few days for training and cannot master all the changes they have to implement. Lack of knowledge delays proper teaching processes. The finding is supported by Kriek and Grayson's (2009) study, which noted that poor performance in Physical Science is due to limited content knowledge and ineffective teaching approaches. Physical Science educators need to get sufficient support from SMTs. The performance of Physical Science learners in rural schools does not improve because schools need to buy science educators the basic apparatus they are supposed to use. SMTs also fail to monitor the educators' activities.

Leadership in schools in rural areas wants learners to choose subjects as they wish. Though the enrolment of learners might be small, they choose to have most of the streams. Most educators' workload is high because their schools are small and have many different streams. If educators' workload is high, their effectiveness is reduced. A study by Zenda (2016) also cited high workload as one factor leading to a high failure rate. The discussion of the study's findings delves into the challenges faced by Grade 12 Physical Science educators in rural schools as they strive to improve learners' academic performance. These challenges are illuminated in the context of the sociocultural theory of Vygotsky, which underscores the importance of social interactions and mentorship in the learning process. Firstly, the study's findings resonate with the sociocultural theory as they underscore the role of mentors and the influence of the learning environment on educators' challenges (Vygotsky, 1978). The educators in this study identified several challenges, including limited resources, work overload, lack of support from the school management team (SMT), insufficient training during curriculum changes, overcrowded classrooms, and inadequate classroom environments. These challenges align with the sociocultural perspective, as they are influenced by educators' interactions with their surroundings, colleagues, and superiors (Hlabane, 2016).

Secondly, the challenges reported by educators are not isolated but are interconnected with broader systemic issues in South African education, particularly in rural areas. Gardiner (2008) notes that South Africa's education system carries the historical legacy of apartheid, resulting in unequal resource allocation and funding disparities. The challenges faced by rural educators are rooted in these historical inequalities, affecting the quality of education in these areas. The sociocultural theory emphasizes the need for a supportive social and educational environment, and in the South African context, addressing these historical disparities is crucial to alleviate these challenges (Gardiner, 2008).

Furthermore, the study findings highlight the critical role of mentors and collaborative efforts among educators, which align with Vygotsky's emphasis on social interaction and guidance (Vygotsky, 1978). Educators identified that a lack of support from the SMT and limited training during curriculum changes hindered their ability to address learners' needs effectively. This underscores the importance of fostering collaborative environments where experienced educators can mentor their colleagues and where school leadership provides the necessary support (Hlabane, 2016). Additionally, the study's findings are consistent with the broader literature.
on challenges in South African education, emphasising that issues such as overcrowded classrooms and inadequate resources significantly hinder effective teaching and learning (Mhlanga & Moloi, 2020). The sociocultural theory emphasises the importance of the learning environment, and these challenges directly affect the quality of that environment. Comprehensive efforts are required at institutional and policy levels (Mhlanga & Moloi, 2020).

Conclusions

In conclusion, this study’s findings underscore the multifaceted challenges faced by Grade 12 Physical Science educators in rural South African schools. These challenges are intricately linked to historical disparities, resource limitations, and the sociocultural context in which education takes place. To address these challenges and improve the quality of education in rural areas, a comprehensive approach that involves mentorship, collaboration, resource allocation, and policy changes is essential. Vygotsky’s sociocultural theory provides a valuable framework for understanding these challenges and underscores the importance of social interactions and environmental factors in learning. Teaching Physical Science in rural schools is challenging since they need more resources to make Science meaningful to learners. The lack of resources at schools’ limits educators’ proper teaching of Physical Science. Parents also need to be more supportive of their children’s education. The DBE must prioritise the assistance of schools in rural areas in order to develop our country. Schools must be supplied with science equipment so that learners may develop a love for the subjects. If schools in rural areas are addressed, people in such areas will be educated, which burdens the country.

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