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<b>JOURNAL</b>	International Journal of Innovative Technologies in Social Science
<b>p-ISSN</b>	2544-9338
<b>e-ISSN</b>	2544-9435
<b>PUBLISHER</b>	RS Global Sp. z O.O., Poland
<b>ARTICLE TITLE</b>	IMPACT OF MANAGING THE SUPPLY AND DEMAND FOR SCARCE SKILL SUBJECT TEACHERS ON THE QUALITY OF LEARNING AND TEACHING IN RURAL SECONDARY SCHOOLS
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<b>ARTICLE INFO</b>	Matodzi Grace Muremela, Azwidohwi Phillip Kutame, Ingrid Sibongile Kapueja, Oluwatoyin Ayodele Ajani. (2023) Impact of Managing the Supply and Demand for Scarce Skill Subject Teachers on the Quality of Learning and Teaching in Rural Secondary Schools. <i>International Journal of Innovative Technologies in Social Science</i> . 4(40). doi: 10.31435/rsglobal_ijitss/30122023/8068
<b>DOI</b>	<a href="https://doi.org/10.31435/rsglobal_ijitss/30122023/8068">https://doi.org/10.31435/rsglobal_ijitss/30122023/8068</a>
<b>RECEIVED</b>	25 September 2023
<b>ACCEPTED</b>	30 October 2023
<b>PUBLISHED</b>	04 November 2023
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# IMPACT OF MANAGING THE SUPPLY AND DEMAND FOR SCARCE SKILL SUBJECT TEACHERS ON THE QUALITY OF LEARNING AND TEACHING IN RURAL SECONDARY SCHOOLS

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**DOI:** [https://doi.org/10.31435/rsglobal\\_ijitss/30122023/8068](https://doi.org/10.31435/rsglobal_ijitss/30122023/8068)

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## ARTICLE INFO

**Received** 25 September 2023

**Accepted** 30 October 2023

**Published** 04 November 2023

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## KEYWORDS

Scarce Skills Subjects,  
Mathematics Education,  
Physical Science Education,  
Rural Secondary Schools,  
Teacher Recruitment, Quality  
of Learning.

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## ABSTRACT

The study addresses the pressing issue of needing more permanent teachers in critical skills subjects, particularly mathematics and physical science, within rural areas of South Africa's Vhembe District. This shortage of permanent teachers has been adversely affecting the quality of teaching and learning in these rural schools. The primary objective of the research is to investigate the effect of demand and supply management on these scarce skills subject teachers in rural secondary schools, specifically in the Mutale area. To achieve this, the study adopted a quantitative research methodology. This employed surveys through questionnaires for quantitative data. The study targeted a diverse population, including principals, teachers, heads of departments, and managers at district levels. The sampling technique utilised simple random sampling to select participants. Three hundred questionnaires were administered to gather this quantitative data, but 201 respondents returned the questionnaires. The data was analysed using the Statistical Package for the Social Sciences (SPSS). The study's findings reveal the critical effects of managing the supply and demand for teachers in Mathematics and Science, particularly in rural environments. Schools in rural areas struggle to attract Mathematics and Science teachers, and the study recommends restructuring teacher training programmes to motivate teachers to accept positions in rural areas. The study suggests further that offering attractive incentives is crucial to encouraging Mathematics and Science teachers in rural regions. At the same time, school principals should effectively manage the demand and supply of these teachers in rural areas.

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**Citation:** Matodzi Grace Muremela, Azwidohwi Phillip Kutame, Ingrid Sibongile Kapueja, Oluwatoyin Ayodele Ajani. (2023) Impact of Managing the Supply and Demand for Scarce Skill Subject Teachers on the Quality of Learning and Teaching in Rural Secondary Schools. *International Journal of Innovative Technologies in Social Science*. 4(40). doi: 10.31435/rsglobal\_ijitss/30122023/8068

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## **Introduction.**

The shortage of permanent teachers, particularly in subjects like Mathematics and Physical Science, is widespread in South Africa and globally. This scarcity negatively impacts the quality of education, particularly in rural areas like the Vhembe District. Research by Ingersoll (2012) highlights the growing demand for STEM teachers worldwide and the difficulties many countries face in meeting this demand. According to the research by Goe and Stickler (2008), rural areas need help attracting and keeping qualified teachers. This study focuses on the management of recruiting permanent teachers, specifically in mathematics and physical science, in rural secondary schools in the Mutale area of South Africa. The research involves multiple stakeholders, including principals, teachers, and educational managers, recognising the complexity of teacher supply and demand management. Environmental and social conditions play a significant role in this context, with rural schools often struggling to attract teachers due to factors like limited infrastructure and geographic isolation.

The historical legacy of apartheid continues to impact rural education in South Africa. Apartheid left many rural schools with insufficient resources and infrastructure, perpetuating educational disparities. This situation makes it challenging for rural schools to attract and retain highly qualified mathematics and physical science teachers. Therefore, addressing these challenges requires a multifaceted approach, considering both recruitment processes and broader societal and structural factors. This study explores the complexities of managing teacher supply and demand in rural South African secondary schools, focusing on mathematics and physical science. By understanding the challenges teachers and administrators face in the Mutale area, the research seeks to contribute to developing effective strategies for improving teacher recruitment and, consequently, the quality of education in rural South African schools.

## **Teacher Shortage in Scarce Skills Subjects in Rural South African Schools.**

The shortage of qualified teachers, particularly in subjects like mathematics and physical science, is a critical issue facing South Africa's education system, especially in rural areas (Muremela et al., 2023). This scarcity has profound implications for education quality and learners' prospects, particularly in STEM fields (Carver-Thomas, 2018). Historical factors play a significant role, as apartheid-era policies led to disparities in resources and quality education between urban and rural schools (Buthelezi & Ajani, 2023). These historical inequities continue contributing to the shortage of teachers in critical subjects today. Geographic isolation is another crucial challenge, as rural South African schools are often far from urban centres (Muremela et al., 2023). This isolation makes attracting and retaining teachers easier, as rural areas may need more amenities, healthcare access, and proper infrastructure (Ajani, 2023). Inadequate school facilities, including classrooms and teaching resources, further discourage teachers, particularly those needed for specialised subjects like mathematics and physical science (Ajani & Govender, 2023).

Limited professional development opportunities in rural areas significantly contribute to teacher shortages (Ajani, 2023). STEM teachers, in particular, require ongoing training to stay current with curriculum developments and teaching methods (Coetzee et al., 2018). However, rural schools often need more professional development, resulting in teacher skills gaps and potentially affecting education quality. Career growth and personal safety concerns also deter teachers from rural postings (Darling-Hammond et al., 2017). Opportunities for advancement and professional growth are typically more limited in rural areas than urban centres (Darling-Hammond et al., 2018). Safety concerns, including crime and inadequate housing, discourage teachers from considering rural positions.

Addressing the teacher shortage in rural South African schools requires a multifaceted approach. This should involve incentives like financial support, housing, and professional development opportunities (Fin24, 2015; Bryan, 2018). Investing in rural school infrastructure and digital resources can also create an attractive working environment for teachers (Foster, 2018). Comprehensive strategies are needed to rectify historical disparities in rural education, ensuring all learners have access to quality education (Muremela et al., 2023). Historical, geographic, and socioeconomic factors all impact the shortage of qualified teachers in rural South African schools teaching subjects that require scarce skills. Addressing this challenge requires short-term measures to attract and retain teachers and long-term strategies to rectify historical education inequalities. A comprehensive understanding of the factors contributing to the teacher shortage is crucial for policymakers and educators to improve education quality in rural South African schools and provide learners with better opportunities.

### **The Global Context of Teacher Shortages.**

Teacher shortages are a global issue affecting countries worldwide, with implications for education quality, development goals, and societal well-being (Feng & Saa, 2018). The scale of this challenge is massive, as UNESCO estimates a need for an additional 69 million teachers by 2030 to achieve universal primary and secondary education (UNESCO, 2018). Low-income countries, conflict-affected regions, and remote rural areas are particularly hard-hit, with sub-Saharan Africa facing an estimated shortage of 17 million teachers by 2030 (Tharp, 2018). Quality education is as crucial as quantity, with many nations grappling with teacher shortages and needing more adequately trained and qualified educators (Devlin & Gottfredson, 2018). This dual challenge compromises learning outcomes and exacerbates educational inequalities. Strategies aimed at enhancing teacher training, professional development, and the status of the teaching profession are vital components of comprehensive solutions (DBE, 2009, 2015, 2017).

Geographic differences in teacher distribution worsen shortages because most teachers live in cities, leaving rural and remote areas without enough teachers (Cowan & Goldhaber, 2018). This exacerbates educational inequalities, demanding policies and incentives to attract and retain teachers in underserved areas (DBE, 2009). Teacher attrition due to low salaries, inadequate working conditions, limited career growth opportunities, job dissatisfaction, and migration to other professions pose significant challenges to addressing teacher shortages, particularly in disadvantaged regions (Uitto & Saloranta, 2017). Strategies to make teaching a more appealing and sustainable career choice are imperative (Trans & Smith, 2019). The global teacher shortage affects the achievement of sustainable development goals, particularly Goal 4, which focuses on inclusive and equitable quality education for all (UNESCO, 2018). Progress toward this goal is only possible with enough qualified teachers. Quality education underpins multiple other development objectives, including poverty reduction, gender equality, and improved well-being (Tharp, 2018). International cooperation is essential in tackling this global challenge, with organisations like UNESCO, UNICEF, and the World Bank playing pivotal roles in supporting countries (Swanson & Mason, 2018). Collaborative efforts can advance the goal of providing every child with quality education through motivated and qualified teachers (Sulisworo et al., 2017).

Teacher shortages are a worldwide concern, impacting education quantity and quality. Countries must implement comprehensive strategies focusing on teacher training, equitable distribution, attraction and retention, and elevating the teaching profession's status. International cooperation is crucial to achieving sustainable development goals and ensuring quality education for all children.

### **The Unique Challenges of Rural Education.**

Rural areas, such as South Africa's Vhembe District, encounter distinct obstacles in recruiting and retaining teachers due to geographic isolation, limited amenities, and a dearth of professional development opportunities (Goe & Stickler, 2008). These challenges amplify the scarcity of educators in rural schools, where the demand for qualified teachers, especially in specialised subjects, remains high (Podolsky et al., 2019). Rural education in South Africa is riddled with distinctive complexities stemming from historical, social, and economic factors, significantly impacting educational quality and rural learners' prospects (Pendola & Fuller, 2018). Apartheid's historical legacy profoundly influences the difficulties of rural education in South Africa (Ogboro & Adeyemi, 2017). During apartheid, non-white South Africans, including those in education, were systematically discriminated against, resulting in vast disparities in resources, infrastructure, and opportunities between rural and urban schools (Ni et al., 2018). Despite the official end of apartheid in 1994, its enduring legacy continues to mould the educational landscape, with rural schools still grappling with decades of underinvestment (Moffa & Metlentry-Sober, 2018).

The ongoing effects of apartheid on rural education are shown by differences in infrastructure, teacher quality, and learning outcomes between rural and urban schools (Mabusele, 2016). This was studied by Hlatywayo, Nkambule, and Phasha (2017). Inadequate infrastructure is one of the most visible challenges facing rural education in South Africa, with many schools lacking basic amenities like electricity, sanitation facilities, and safe classrooms (Human Rights Watch, 2018). This not only hampers the learning environment but also poses safety risks to learners, especially in cases where pit latrines are still in use. Rural schools in South Africa frequently grapple with teacher shortages, particularly in subjects like mathematics and science, which compromise educational quality (Mncube,

2015). These schools often rely on underqualified or unqualified teachers, leading to suboptimal educational outcomes. The reluctance of qualified teachers to accept rural postings due to a lack of amenities, limited career prospects, and challenging working conditions exacerbates the shortage (Mabusela, 2016). Geographical isolation is another substantial challenge, forcing many rural learners to endure lengthy, sometimes hazardous journeys to school, impacting attendance and learning progress (Mabusela, 2016). Furthermore, profound socioeconomic inequality is a hallmark of rural education in South Africa, with higher poverty rates in rural areas, impeding learners' access to quality education (Grissom & Bartanen, 2019). Poverty-related issues, including food insecurity, inadequate uniforms, and a scarcity of educational materials, further hinder learning (Ngesi, 2017).

These intricate challenges in South African rural education necessitate a multifaceted approach. It calls for targeted investments in rural schools, strategies to attract and retain qualified teachers, improved transportation infrastructure, and efforts to alleviate poverty and inequality in rural communities (Mabusela, 2016). Equitable access to quality education for all South African learners, regardless of their geographic location, is a pivotal step in addressing these distinctive rural education challenges.

### **The Legacy of Apartheid in South African Education.**

The historical legacy of apartheid in South African education is a deeply entrenched and multifaceted issue that continues to shape the country's educational landscape. Apartheid, from 1948 to 1994, enforced racial segregation and discrimination, significantly affecting education (Bolman & Deal, 2018). Its legacy has resulted in enduring challenges related to quality education, educational inequalities, and broader socioeconomic disparities in South Africa. The apartheid regime enforced racial segregation in education, creating stark disparities among schools serving different racial groups (Bhebhe et al., 2014). White schools received substantial funding and resources, while non-white schools, especially those serving black South Africans, faced systematic disadvantages. Consequently, black schools endured overcrowded classrooms, insufficient infrastructure, and underqualified teachers. This historical inequality in educational access persists as a critical issue in post-apartheid South Africa (Nkomo, 2008).

Research by Spaul (2013) underscores the long-lasting consequences of apartheid policies, revealing that despite significant progress since 1994, educational inequalities have endured along racial lines. Learners in historically disadvantaged Black schools experience resource shortages and lower educational outcomes than their peers in historically advantaged White schools. One of apartheid's lasting legacies is the uneven allocation of educational resources. The apartheid government directed more resources to schools serving White learners, perpetuating racial disparities in educational opportunities (Schollar, 2014). Despite efforts to address these disparities post-apartheid, resource allocation remains unequal. A report by the Centre for Development and Enterprise (2018) highlights the unequal distribution of educational resources in South Africa, with well-resourced schools thriving while under-resourced schools, often in rural or township areas, struggle to provide quality education. This resource inequality exacerbates educational disparities and hinders efforts to achieve educational equity (Hyler, 2020).

Apartheid-era policies also had a significant impact on teacher development. Black teachers were subjected to discriminatory training and often received subpar education, limiting their ability to provide quality instruction (Mncube, 2015). Despite post-apartheid efforts to enhance teacher training and development, challenges persist. A study by Reddy et al. (2012) found that teacher development in South Africa needs to be more cohesive, with some teachers having limited access to professional development opportunities. This disparity in teacher training contributes to variations in the quality of education across schools. The apartheid-era curriculum was designed to reinforce racial hierarchies and maintain the status quo, often excluding or distorting Black South Africans' histories, cultures, and languages (Preston-Whyte, 2004). Post-apartheid reforms aimed to create a more inclusive and culturally sensitive curriculum, but challenges remain in ensuring that all learners have access to a curriculum that reflects their diverse cultural backgrounds.

In conclusion, the legacy of apartheid in South African education is characterised by deeply rooted inequalities, racial disparities, inadequate resource allocation, and challenges in teacher development and curriculum reform (Adebisi et al., 2023). Despite substantial progress since the end of apartheid, the enduring legacy of this system continues to shape the educational experiences of South



African learners. Ongoing efforts are required to redress historical injustices, ensure equitable resource allocation, improve teacher training, and create an inclusive and culturally sensitive curriculum that reflects the diverse backgrounds of learners.

### **Social and Environmental Factors.**

Social and environmental factors exacerbate teacher shortages in rural areas. Härmä and Tshele (2013) identify several issues, such as the lack of suitable housing, limited career growth opportunities, and concerns about personal safety, that deter teachers from considering positions in rural schools. These factors contribute to the challenges of recruiting and retaining teachers in rural areas, especially in specialised subjects like Mathematics and Physical Science. Social and environmental factors encompass a broad spectrum of influences that shape human behaviour, well-being, and development (Foster, 2018). Socioeconomic status (SES) is a critical element of these factors, encompassing income, education, and occupation. SES profoundly impacts individuals' access to resources, opportunities, and overall quality of life, with lower SES often associated with more significant challenges in health, education, and economic mobility (Adler & Stewart, 2010; Feng & Sass, 2018). Addressing SES disparities is essential for achieving social equity and improving well-being, making education a key factor in promoting social mobility and reducing inequalities (Heckman, 2006; de Villiers & Weda, 2018).

Social support networks, consisting of relationships with family, friends, and communities, play a crucial role in individuals' lives by providing emotional, practical, and social assistance. Strong social connections are linked to improved mental and physical health outcomes (Uchino, 2006), while isolation and the absence of social support can negatively impact well-being. Cultural norms and values influence how individuals perceive and interact with the world, shaping their beliefs and behaviours (Castro et al., 2018). Cultural diversity enriches societies but can also lead to misunderstandings, emphasising the importance of understanding and respecting diverse cultural perspectives for fostering inclusivity and social cohesion. Environmental factors, encompassing aspects like access to clean air, safe housing, and pollution exposure, significantly affect health and well-being. Poor environmental quality can lead to various health issues, highlighting the importance of environmental sustainability for the well-being of present and future generations (Prüss-Üstün et al., 2016).

Political and policy decisions at various governance levels profoundly impact social and environmental contexts. Healthcare, education, social welfare, and environmental protection policies can shape the circumstances in which people live and influence their well-being (Cowan & Goldhaber, 2018). Advocating for evidence-based policies that promote social justice, environmental sustainability, and equitable resource allocation is crucial for addressing global challenges (Hassan, 2005). In conclusion, social and environmental factors are integral to human life and society, significantly influencing individual well-being, opportunities, and development. Recognising their importance and working to address disparities and challenges within these factors are essential steps toward creating a more equitable and sustainable world.

### **The Need for Multifaceted Solutions.**

Addressing the shortage of mathematics and physical science teachers within rural South African schools requires a comprehensive and multifaceted strategy. This approach involves immediate actions, such as offering incentives and professional development opportunities to attract and retain teachers (Mabusela, 2016). However, it also necessitates broader structural changes within the education system. This includes rectifying historical inequities in rural education, creating a conducive environment that entices qualified teachers, and addressing these schools' interconnected challenges. Due to inadequate infrastructure and resources in rural schools, teacher shortages in crucial subjects like mathematics and science frequently worsen (Castro et al., 2018). Therefore, a multifaceted solution acknowledges South African rural education's intricate challenges.

The enduring legacy of apartheid plays a pivotal role in South Africa's education landscape, influencing teacher recruitment, curriculum development, and overall education quality (Viadero, 2018). Any effective solution must recognise and redress this historical injustice. Additionally, South Africa grapples with profound socioeconomic disparities, with rural areas experiencing the most significant impact. Poverty, lack of access to essential services, and limited economic opportunities perpetuate educational disadvantages. Multifaceted solutions should encompass strategies to address these

socioeconomic disparities, including providing school meals, improving healthcare access, and fostering community development (Martin & Mulvihill, 2016). A holistic approach is essential, involving investments in teacher development, infrastructure, curriculum reforms, and community engagement (Mabeba, 2019; Chetty et al., 2017; Taylor et al., 2014; Modisaotsile, 2018). By adopting this multifaceted strategy, South Africa can address its interconnected educational challenges and work towards a more equitable and effective education system, particularly benefiting rural learners (Leonard et al., 2018; Liang et al., 2016).

#### **Management and recruitment of demand and supply of scarcely skilled teachers.**

The management of the recruitment and supply of teachers in scarcely skilled subjects, notably mathematics and physical science, holds substantial implications for the quality of education in South African schools. These subjects are fundamental for the country's educational excellence and economic progress. However, the persistent shortage of qualified teachers, particularly in rural areas, presents formidable obstacles (Leonard et al., 2018). This scarcity directly hampers the quality of education for South African students, particularly in schools grappling with inadequate teacher resources. Numerous studies have underscored the adverse effects of teacher shortages, highlighting their detrimental impact on educational quality (Motala, 2016; Taylor, 2017). These consequences are especially pronounced in rural regions, where schools often face staffing challenges. The unequal distribution of teachers between urban and rural schools further exacerbates educational disparities, curbing opportunities for students in remote areas. This imbalance in educational resources has persisted as a documented issue in South African education literature (Fleisch, 2008). In schools grappling with severe teacher shortages, the variety of subjects available to students may be restricted, limiting their pursuit of interests and potential career prospects. Scarce skills subjects are pivotal in nurturing critical thinking and problem-solving abilities, essential for South Africa's economic growth and competitiveness (Reddy et al., 2018).

The recruitment of teachers for scarce-skilled subjects is fraught with multifaceted challenges. Factors such as low salaries, inadequate professional development opportunities, and concerns about working conditions in rural locales discourage educators from specialising in these subjects and teaching in under-resourced schools (Taylor, 2014). Therefore, recruitment strategies must address these barriers to attract and retain qualified teachers. The ramifications of mishandling the recruitment and supply of teachers in scarce skill fields extend far into South Africa's future development (Martin & Mulvihill, 2016). A well-qualified and adequately equipped workforce in critical areas like mathematics and science is vital for fostering innovation, spurring economic growth, and addressing societal challenges. The failure to address teacher shortages in these subjects jeopardises the nation's capacity to meet future labour market demands. It obstructs progress towards equitably providing quality education to all learners (Pendola & Fuller, 2018). In sum, managing the recruitment and supply of teachers in South African education is a complex issue with profound and far-reaching implications. Teacher shortages, particularly in rural areas, undermine educational quality, restrict subject offerings, and perpetuate inequalities. A comprehensive approach that enhances teacher working conditions offers targeted incentives, and invests in professional development is essential. Ultimately, resolving the scarcity of qualified teachers in critical subjects is crucial for South Africa's future prosperity and the educational advancement of its learners (Stiell et al., 2018).

#### **The effects of the management and recruitment of demand and supply of scarce skills.**

Scarce skill subjects, notably mathematics and physical science, are fundamental to South Africa's education system and critical for economic development. However, an enduring shortage of qualified teachers in these subjects, particularly in rural areas, poses significant challenges (Muremela et al., 2023). Students in South Africa suffer directly as a result of this shortage. Schools with insufficient teacher resources struggle to maintain effective teaching and learning environments, leading to diminished academic outcomes. Numerous studies have illuminated the adverse effects of teacher shortages on educational quality, with rural areas facing particularly acute staffing challenges. The uneven distribution of teachers between urban and rural schools exacerbates educational inequalities, limiting opportunities for learners in remote regions. The inequitable allocation of educational resources, a well-documented issue in South African education literature, further compounds the problem. Schools with severe teacher shortages often need more subject offerings, restricting students' ability to pursue their interests and potentially hindering their future career prospects. Scarce skills subjects are pivotal

in nurturing critical thinking and problem-solving skills, vital for South Africa's economic growth and competitiveness (Reddy et al., 2018).

Recruiting teachers for scarce-skilled subjects involves multifaceted challenges. Factors such as low salaries, inadequate professional development opportunities, and concerns about working conditions in rural areas dissuade educators from specialising in these subjects and teaching in under-resourced schools (Taylor, 2014). Consequently, recruitment strategies must address these barriers to attract and retain qualified teachers. The consequences of mismanaging the recruitment and supply of scarcely skilled teachers have enduring implications for South Africa's development. A well-equipped and qualified workforce in critical fields like mathematics and science is pivotal for innovation, economic growth, and addressing societal challenges (Muremela et al., 2023). The failure to address teacher shortages in these subjects jeopardises the country's ability to meet future labour market demands. It hinders progress towards equitable access to quality education for all learners. The effects of managing the recruitment and supply of scarce skills teachers in South African education are profound and multifaceted (Ni et al., 2018). Teacher shortages, especially in rural areas, undermine educational quality, limit subject offerings, and perpetuate inequalities.

### **Theoretical framework.**

#### **The Economic Labour Market Theory in Education.**

The economic labour market theory has significantly influenced education policy and practice worldwide by regarding education as an investment in human capital, where individuals make educational and career choices based on anticipated returns in the labour market. In South Africa, particularly concerning teacher shortages in rural schools, this theory provides a valuable framework for understanding supply and demand dynamics. This theory underscores the role of education as an investment in human capital. Like other professionals, teachers decide their educational and career paths based on the expected returns, such as wages and employment opportunities. Psacharopoulos and Patrinos (2018) emphasise the importance of human capital in economic development, noting that individuals with higher levels of education generally earn higher wages.

In South Africa, the challenge of attracting and retaining qualified teachers in rural schools is well-documented, and the economic labour market theory can help elucidate this phenomenon. Teachers may be reluctant to work in rural areas due to the perception of lower returns on their educational investment. Factors such as lower salaries, limited career advancement prospects, and suboptimal working conditions in rural schools can deter teachers from choosing rural placements (Reddy et al., 2018). An essential concept within this theory is wage differentials, which encompass wage variations based on factors like education, skills, and location. In South Africa, these wage differentials are notably pronounced between urban and rural teaching positions, with rural teachers often earning less than their urban counterparts (Spaull & Kotzé, 2015). This wage gap can be a disincentive for teachers seeking rural postings, exacerbating teacher shortages in these regions.

Understanding economic labour market theory can guide policy decisions addressing teacher shortages in rural South African schools. Policy interventions may involve offering financial incentives, such as rural allowances or loan forgiveness programmes, to make teaching positions in underserved areas more appealing (Reddy et al., 2018). Additionally, the theory underscores the importance of equitable access to quality education, especially for individuals from disadvantaged backgrounds in rural areas, to improve their educational attainment and employment prospects. Quality education, ongoing teacher training, and professional development are also essential, as they enhance teacher quality and improve educational outcomes in rural schools (Taylor et al., 2014). By considering the expected returns on education in the labour market and working towards making rural teaching positions more attractive, South Africa can make strides towards achieving equitable access to quality education for all learners.

### **Research Methodology.**

#### **A quantitative research methodology.**

Was developed to investigate teacher management and recruitment in scarce skills subjects, particularly mathematics and physical science, within the rural areas of South Africa's Vhembe District (Merriam & Grenier, 2019). This methodology aimed to understand the phenomenon in this specific geographic context comprehensively. A quantitative research design was selected to gather data from a substantial number of teachers, involving the distribution of 300 structured questionnaires to educators



in rural Vhembe District schools. These questionnaires were designed to collect quantitative data on various aspects of teacher recruitment, including incentives, working conditions, and career motivations. The study received and analysed 201 completed questionnaires, forming the basis for quantitative data analysis. The participant selection process combined simple random and purposive sampling methods, with rural schools in the Vhembe District initially identified and schools with teachers specialising in mathematics and physical science purposively selected due to the focus on scarce skill subjects. Subsequently, teachers from these chosen schools were selected using simple random sampling, ensuring a representative sample of educators in these subjects.

The primary data collection instrument was a structured questionnaire consisting of closed-ended questions, designed based on existing literature and validated for reliability. These questionnaires inquired about teachers' motivations, experiences, and perceptions of teacher recruitment and management in rural areas. Participants were given ample time to complete and return the questionnaires. The quantitative data obtained were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS) software. Ethical principles, including informed consent and confidentiality, were strictly adhered to throughout the research process. Participants were provided clear information about the study's purpose, and their voluntary participation was emphasised. The data collected were kept confidential, with no identifying information included in the analysis. However, the study had some things that could have been improved, such as possible response bias in the questionnaire survey and the fact that its results were only relevant to the Vhembe District, which made it hard to apply them to other areas or countries. Still, this research method made getting valid quantitative data from teachers in the rural Vhembe District more accessible. This data showed the problems and factors affecting hiring teachers in subjects with scarce skills. These findings provide a foundation for addressing teacher shortages in rural areas and developing targeted strategies to improve teacher management and recruitment practices.

### **Results.**

#### *The Impact of the Teacher-Learner Ratio on Teachers' Readiness to Commit to Permanent Positions.*

The class size significantly influences the quality of the teaching and learning environment. An excessive number of learners within a classroom can hinder teachers from providing individualised attention when necessary. Subjects like mathematics and science often demand smaller class sizes to cater to learners' individual needs effectively. Moreover, an overcrowded classroom may even deter some teachers from accepting assignments, which can restrict their mobility and effectiveness. Table 1 illustrates these findings:

Table 1. The Impact of the Teacher-Learner Ratio on Teachers' Readiness to Commit to Permanent Positions.

Item	Frequency	Per cent
Strongly Agree	17	8.5
Agree	83	41.3
Not sure	35	17.4
Disagree	46	22.9
Strongly Disagree	20	10.0
Total	201	100

In educational settings, it is imperative to acknowledge that classrooms characterised by excessive overcrowding may need to cultivate a conducive atmosphere conducive to positive learning experiences. Such conditions, in turn, can substantially influence teachers' decisions concerning their long-term employment prospects within a particular geographic area. The present study's findings elucidate this intricate dynamic, with 8.5% of respondents expressing strong agreement and 41.3% concurring that the teacher-learner ratio in mathematics and science classrooms holds significance when teachers deliberate upon securing permanent employment. Nonetheless, it is noteworthy that a notable proportion (17.4%) of respondents appear to harbour uncertainties, indicating a need for complete

conviction regarding whether teachers genuinely regard class size as a pivotal factor when contemplating permanent appointments. Surprisingly, the dataset also shows a small group of people who actively disagree with this idea. These people comprise 22.9% of the participants, and another 10% strongly reject the hypothesis. These outcomes imply that considering workload, including class size, occupies a certain degree of prominence in teachers' decision-making processes regarding their career trajectories. These findings align with the conclusions drawn by Sutchter, Darling-Hammond, and Carver-Thomas (2019), underscoring the intricate interplay between teacher-learner ratios and teachers' choices regarding their professional endeavours.

#### *Impact of the Rationalisation of Teachers in Rural Regions.*

In certain instances, schools experience fluctuations in learner enrollment, which subsequently impacts the teacher-to-learner ratio within the school. Rural regions, in particular, tend to bear the brunt of these fluctuations, often witnessing declining learner enrollments. Consequently, some teachers find themselves subject to relocation to other areas. This process of teacher movement is governed by the Rationalisation and Redeployment policy, which regulates teacher mobility across all educational settings, including rural schools and, notably, schools employing mathematics and science teachers (Asim et al., 2019). The mechanism behind this process typically results in teachers assigned to classes with lower enrollment being the ones most frequently affected by reassignment. This scenario frequently involves mathematics and science teachers. The implications of this rationalisation process for teachers in rural areas are elucidated in Table 2.

Table 2: *Impact of the Rationalisation of Teachers in Rural Regions.*

Item	Frequency	Per cent
Strongly Agree	25	12.4
Agree	72	35.8
Not sure	32	15.9
Disagree	55	27.4
Strongly Disagree	17	8.5
Total	201	100

The findings of the study indicate that a combined 12.4% of respondents strongly agree. In comparison, 35.8% agree that the rationalisation and redeployment policy has a detrimental impact on the mobility of mathematics and science teachers within rural schools. Mathematics and science classes typically accommodate fewer learners, rendering them susceptible to teacher redundancies as they are considered to exceed the staff establishment quota. Consequently, teachers from these subjects are frequently relocated to schools with larger learner populations (Mulkeen, 2015; Makgato & Mji, 2006; Ogboro & Adeyemi, 2017). This process, in turn, leaves rural schools, particularly those in rural areas, bereft of qualified instructors, particularly in Mathematics and Science. The effective management of the supply and demand for these specialised teachers in rural schools is thus fraught with challenges, significantly impacting the overall quality of teaching and learning. It is crucial to note that mathematics and science teachers are disproportionately affected by the reassignment of teachers based on staff establishment criteria. Given the inherent nature of mathematics and science instruction, which typically involves smaller classes, the policy disproportionately impacts teachers in these subjects. Consequently, the rationalisation and redeployment of teachers can negatively influence learner performance, further underscoring the need for a more nuanced approach to teacher redistribution policies in rural areas.

#### *Impact of Salary on Teachers' Career.*

In considering permanent employment in rural areas, salary emerges as a pivotal motivator, particularly for teachers qualified to teach scarce skills subjects that often lead to opportunities in more affluent regions. Additionally, teachers commonly weigh the impact on their social lives when contemplating permanent employment. To empirically assess the influence of salaries on teachers' decisions regarding permanent employment in rural schools, a survey was conducted to gather teachers' perspectives, as depicted in Table 3.

Table 3. Impact of salary on teachers' careers.

Item	Frequency	Per cent
Strongly Agree	90	44.8
Agree	68	33.8
Not sure	13	6.5
Disagree	19	9.5
Strongly Disagree	11	5.5
Total	201	100

Teachers' motivation to stay dedicated to the teaching profession is mainly dependent on the compensation they receive. In cases where teachers perceive inadequate compensation, their motivation may dwindle, potentially leading to attrition from the profession. Analysing the survey data (Table 3), it becomes evident that a significant proportion of respondents, comprising 44.8% who strongly agree and 33.8% who agree, acknowledge the positive influence of teachers' salaries on their motivation to persist in the profession. Notably, a segment of teachers, constituting 6.5%, need more certainty regarding the impact of salary on their career decisions. However, a smaller group—9.5% disagree and 5.5% strongly disagree—does not agree with the majority. This suggests that the current pay levels are insufficient, which may make some teachers consider changing careers. This aligns with prior research findings (Santiago, 2002; Armstrong, 2007; Asim et al., 2019), underscoring the potential impact of salary considerations on teachers' career choices. For teachers specialising in mathematics and science, competitive salaries are a compelling incentive to remain committed to teaching.

#### *Illegal migrants' effects on Mathematics and Science teachers' demand and supply in rural schools.*

In certain rural schools grappling with significant shortages of mathematics and science teachers, foreign teachers are sometimes hired, only to discover later that their immigration status in the country has been falsified. These undocumented immigrant mathematics and science teachers adversely affect the recruitment and availability of teachers in rural educational institutions.

Table 4. Illegal migrants' effects on rural schools.

Item	Frequency	Per cent
Strongly Agree	13	6.5
Agree	60	29.9
Not sure	61	30.3
Disagree	47	23.4
Strongly Disagree	20	10.0
Total	201	100

The results indicate that 6.5% strongly agree, and 29.9% agree that the employment of undocumented foreign teachers has a negative impact on the supply and demand of teachers. It is reasonable to assume that once these teachers are discovered to have illegal status, they are subsequently removed from the school, creating a vacancy that can be challenging to fill. However, it is noteworthy that a substantial 30.3% of respondents are uncertain whether hiring illegal migrants affects teacher supply and demand. Additionally, slightly less than a quarter (23.4%) disagree, while 10.0% agree. These varying perspectives may be attributed to factors that require further investigation. These findings align with existing literature, which suggests that South Africa has actively welcomed migrant teachers as a strategy to alleviate teacher shortages in the country (Roussouw, 2005). Research has indicated that political and economic instability in foreign countries often acts as a push factor, compelling individuals to leave their home countries for opportunities elsewhere. This push factor plays a significant role in teachers' decisions to migrate, often outweighing the pull factors that may exist within the country or region itself. Additionally, establishing migration networks in specific regions can further facilitate the movement of teachers (Roussouw, 2005).

*The impact of xenophobic attacks on the extended employment of foreign teachers.*

Xenophobic attacks sometimes target foreigners, including teachers, which can adversely affect their tenure in the country. Foreign nationals fill many vacancies for mathematics and science teaching positions, and incidents of xenophobia may disrupt schools, particularly those in rural areas. The findings, as depicted in Table 5, provide insight into this phenomenon:

Table 5: *The impact of xenophobic attacks on the extended employment of foreign teachers.*

Item	Frequency	Per cent
Strongly Agree	26	12.9
Agree	62	30.8
Not sure	47	23.4
Disagree	43	21.4
Strongly Disagree	23	11.4
Total	201	100

The results indicate that 12.9% of the participants strongly agree, while 30.8% agree that xenophobic attacks deter foreign mathematics and science teachers from considering long-term appointments in rural schools. A significant portion of the participants (23.4%) remained unsure, potentially due to factors not explored in this study. It is worth noting that xenophobic attacks are relatively uncommon in rural areas. However, a large majority (21.4%) disagreed, and 11.4% strongly disagreed. These kinds of attacks often happen in rural areas and affect the supply and demand of math and science teachers in these schools. Foreign teachers often live in fear, especially in areas prone to xenophobic attacks. Consequently, recruiting mathematics and science teachers in such regions becomes challenging, leading to an overreliance on short-term contracts that negatively affect learners' performance. This observation aligns with existing literature, suggesting that xenophobic attacks may dissuade foreign teachers from seeking permanent roles. It underscores the importance of recognising that a country's growth and development are interdependent with others, and provinces should strive to create favourable conditions for foreign teachers (fin24, 2015; de Villiers & Weda, 2018). Regrettably, foreign teachers often emigrate to other countries due to unfavourable conditions, inadequate salaries, and housing shortages in their home countries (fin24, 2015).

*Considerations for teachers' views on mathematics and science teachers' appointments.*

Teachers can provide input regarding the selection of mathematics and science teachers, and these inputs are often given due consideration. It is logical to value the insights of mathematics and science teachers, given their extensive experience and training knowledge.

Item	Frequency	Per cent
Strongly Agree	27	13.4
Agree	92	45.8
Not sure	25	12.4
Disagree	43	21.4
Strongly Disagree	14	7.0
Total	201	100

Table 6. *Considerations for teachers' views on mathematics and science teachers' appointments.*

The findings indicate that 13.4% strongly agree and 45.8% agree, suggesting that teacher input in the appointment of mathematics and science teachers is frequently considered. A substantial proportion (12.4%) still determines whether teachers' opinions on mathematics and science teacher appointments are consistently considered. Notably, just under a quarter (21.4%) disagree, with 7.0% strongly disagreeing. Giving weight to teachers' viewpoints may have limited influence on managing teacher supply and demand. This aligns with existing literature, which indicates that curriculum

requirements have grown due to various pressures, making it challenging for organised groups to consider their perspectives, although exceptions may exist (Australian Parliamentary, 1996). Cross-tabulation analysis reveals the significance of the responses to this item (Chi-Square = 26.247,  $p = 0.05$ ; Cramer's  $V = 0.181$ ) (Annexure 5). Respondents of all age groups concur that teachers' input into Mathematics and Science teacher appointments is routinely considered. However, the results suggest that, despite considering teachers' viewpoints, this does not significantly influence teachers' decisions to seek permanent positions in rural schools. Consequently, schools continue to grapple with shortages of teachers in critical skills subjects, a situation consistent with the findings of Wright (2018).

*Demand and supply of teachers' Management on learner performance.*

The management of teacher supply and demand can significantly impact learner performance in rural schools. When insufficiently qualified teachers are available to meet the needs of learners, it can lead to larger class sizes, less individualised attention, and reduced access to specialised subjects like mathematics and science. These factors, in turn, can hinder the quality of education and negatively affect learner performance. On the other hand, effective management of teacher supply and demand can lead to smaller class sizes, more qualified teachers, and improved access to a diverse range of subjects. This can enhance the overall quality of education in rural schools and positively impact learner performance.

Table 6. Effect of poor management of demand and supply of teachers on learner performance.

Item	Frequency	Per cent
Strongly Agree	39	19.4
Agree	97	48.3
Not sure	36	17.9
Disagree	22	10.9
Strongly Disagree	7	3.5
Total	201	100

The research findings reveal a significant sentiment among respondents, with 19.4% strongly agreeing and 48.3% agreeing that managing teacher supply and demand has a detrimental effect. A noteworthy 17.9% express uncertainty on this matter, while a smaller proportion, 10.9%, disagree, and merely 3.5% strongly disagree. The preponderance of agreement among respondents strongly suggests that the performance of mathematics and science subjects, particularly in rural schools, is experiencing a decline. Statistical analysis of this item underscores its significance (Chi-Square = 26.428,  $p = 0.05$ ; Cramer's  $V = 0.181$ ) (see Annexure 5). This statistical significance holds across respondents of various age groups, all of whom concur that poor teacher supply and demand management negatively influences the academic performance of mathematics and science learners. The results, therefore, imply a prevailing issue with the management of teacher supply and demand, adversely affecting the quality of teaching and learning. This inattention to the subject may be attributed to some educational managers' need for more seriousness (Wilson et al., 2001; Darling Hammond, 2003; Tharp, 2018). These findings suggest that, for an extended period, matters related to the demand and supply of Mathematics and Science teachers have yet to be accorded the necessary attention they warrant in educational discourse.

**Discussion.**

Numerous studies have established a strong correlation between teacher supply and demand management and learner performance. Research by Darling-Hammond and Youngs (2002) demonstrated that effective teacher allocation strategies, such as reducing class sizes, can improve learner achievement. Similarly, Ingersoll and Strong (2011) found that having qualified teachers in every subject area can significantly enhance learner outcomes. Adequate teacher supply and demand management is pivotal in determining learner performance in rural schools. Strategies for recruiting, retaining, and allocating teachers can result in smaller class sizes, more qualified educators, and improved access to diverse subjects, all of which contribute to enhanced learner performance (Muremela et al., 2023). Conversely, inadequate teacher supply and demand management can result in larger class



sizes, reduced access to specialised subjects, and lower overall educational quality, negatively impacting learner outcomes (Swanson & Mason, 2018).

This discussion focuses on managing the supply and demand of mathematics and science teachers and their profound impact on learner performance in rural schools. The study findings reveal a widespread concern among teachers, indicating that managing teacher supply and demand has substantial implications for the quality of education in these areas. A substantial 67.7% of participants either strongly agree or agree that the management of teacher supply and demand negatively affects learner performance in rural schools, aligning with existing research emphasising the importance of retaining high-quality teachers for educational excellence (Darling-Hammond, 2003; 2018). The uncertainty of 17.9% of respondents suggests further investigation into this matter, raising questions about awareness and communication of the challenges associated with teacher supply and demand management in rural settings. Even the minority (10.9%) who disagree with the statement recognises the problem's existence, while the 3.5% who strongly disagree may hold alternative perspectives warranting further exploration. Statistical analysis reinforces the significance of this issue, which transcends age groups, emphasising the importance of addressing the quality of education in rural schools due to teacher supply and demand management as a widespread and persistent concern.

In conclusion, managing teacher supply and demand in rural schools, especially in Mathematics and Science subjects, remains a critical issue with far-reaching consequences (Muremela et al., 2023). The study findings underscore the need for comprehensive strategies to address this problem, including attracting and retaining qualified teachers in rural areas. This discussion highlights the pressing challenges associated with teacher supply and demand in rural education, providing a foundation for further exploration and policy development in this crucial area of education.

### **Recommendations.**

Based on the research findings and the critical issues surrounding the management of teacher supply and demand in rural schools, particularly in mathematics and science subjects, the following recommendations are proposed:

*Improve Teacher Recruitment and Retention Strategies:* Addressing the chronic shortage of mathematics and science teachers in rural areas requires implementing targeted recruitment strategies. Education authorities should consider offering incentives such as financial bonuses, housing assistance, and professional development opportunities to attract and retain qualified teachers in these subjects. Additionally, measures should be taken to make teaching in rural schools an appealing long-term career choice. This can be achieved by improving working conditions, providing opportunities for career advancement, and recognising the unique contributions of rural educators.

*Enhance Teacher Training Programmes:* Teacher training institutions should develop specialised programmes that equip teachers with the skills and knowledge needed to thrive in rural environments. These programmes should emphasise the unique challenges and opportunities of teaching in remote areas. This includes strategies for effective classroom management, innovative teaching methods that address the needs of diverse learners, and community engagement to build strong ties between schools and the local communities they serve.

*Utilise Technology and Online Resources:* Given the geographical isolation of many rural schools, technology can play a pivotal role in bridging gaps in teacher supply. Adopting virtual classrooms, online mentoring programmes and digital learning resources can connect rural schools with expert teachers and educational materials. This approach can help alleviate the shortage of specialised teachers and improve the quality of education in mathematics and science. Furthermore, it can give students in rural areas access to a broader range of educational opportunities.

*Strengthen Data Collection and Analysis:* Education authorities should establish robust data collection systems to monitor rural teacher supply and demand trends. Regularly updated databases can help identify emerging issues, track the movement of teachers, and inform policy decisions. Comprehensive data analysis is crucial for guiding resource allocation and the development of targeted interventions. Implementing these suggestions will help education stakeholders ensure that every child can access high-quality education from qualified teachers, no matter where they live. This benefits individual learners and contributes to the overall development and prosperity of rural communities and the nation as a whole.

### **Conclusion.**

Managing teacher supply and demand in rural South African schools, particularly in the critical subjects of Mathematics and Science, remains a complex and multifaceted challenge. This study has shed light on the various factors influencing the availability and retention of qualified teachers in remote areas. The findings highlight the urgent need for targeted interventions to address the shortage of teachers and improve the quality of education in these regions. While the South African government has significantly enhanced teacher recruitment and retention in rural schools, further action is required. Implementing specialised training programmes, leveraging technology, and providing incentives are vital steps to attract and retain qualified teachers in Mathematics and Science. Moreover, ongoing data collection and analysis will be crucial in adapting policies and strategies to the evolving dynamics of teacher supply and demand. Ultimately, the success of rural education in South Africa hinges on the collective commitment of policymakers, teachers, communities, and stakeholders to ensure that every child receives a high-quality education, regardless of their geographical location.

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