



## Can School Principals Manage Recruitment and Retention of Maths and Science Teachers in Rural Secondary Schools? A Case Study in the Vhembe District, South Africa

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<http://dx.doi.org/10.47814/ijssrr.v6i9.1592>

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### **Abstract**

Mathematics and science subjects are critical subjects in high schools across South Africa. This study explored how principals managed the recruitment of scarce skills subjects' teachers, based on demand and supply in Vhembe District. Myriad studies assert that Mathematics and science teachers are in short supply across South African rural schools, which creates a concern for the education system. This problem is prominent in rural Vhembe District, Limpopo. This study examined how rural secondary schools in the Mutale area recruited and retained permanent mathematics and science teachers. An interpretive paradigm was employed to understand the phenomenon under study. This study used a face-to-face qualitative methodology, where targeted principals, teachers, heads of departments, and circuit and district managers were interviewed. Participants were selected via purposive and simple random sampling for the one-on-one structured interviews. All the interviews were audio-recorded with the permission of the 10 participants and were thematically analysed. Various crucial factors have an impact on principals' ability to control the supply and demand of subjects with important, rare skills. Environmental and societal variables participate in the recruitment and retention of rural schools' struggle to hire and retain maths and science teachers. Findings further revealed that these teachers need incentives to be employed and retained in rural schools. The study, therefore, recommends that teacher training programmes be supported with adequate bursaries or funding for pre-service teachers, while Maths and science teachers should be well remunerated to attract and retain them in rural schools.

**Keywords:** *Rural; Scarce Skills Subjects; Mathematics; Science; Recruitment; Management; South Africa*

## ***Introduction***

Contemporary society is characterised by a growing level of unpredictability, as individuals navigate a highly intricate and unstable social environment. Education is widely recognised as a pivotal factor in addressing the needs of our constantly evolving society and its capacity to foster well-functioning communities. The education system is approaching a state of crisis due to the increasing prevalence of scarce skills subjects' teacher shortages in rural schools. According to the EFA Global Monitoring Report of 2008, the global teacher population reached approximately 60 million individuals by the year 2008. However, it is estimated that an additional 35 to 65 million teachers will be required to fulfil the crucial objective of achieving universal education by 2025. The underlying issues can be attributed to a significant surge in the need for fresh teachers, primarily driven by two intersecting demographic patterns: escalating learner enrollments and a rising rate of teacher attrition due to an ageing teaching workforce. Stakeholders within the realm of education have put forth the contention that the presence of competent teachers is imperative for the facilitation of successful learning outcomes. Ngada (2007) highlighted the significance of having enough qualified, competent, and dedicated teachers for a successful education system (Japo, Amasuomo, Chukwama, & Ozurumba, 2017).

Nonetheless, the scarcity of adequately trained mathematics and science teachers remains a prevalent issue within the rural regions of the Vhembe District. Various schools within this locality encounter the dual challenge of attracting and retaining scarce skills subject teachers (Muremela et al., 2023). The recruitment and retention of new teachers are both of paramount importance, particularly in rural areas where schools fail to attract and retain teachers, to address persistent shortages. Thus, many of these school principals face constraints in attaining their school goals, as their schools lack adequate teachers in scarce skills subjects. Ingersoll (2006) reports that supply and demand dynamics in the fields of mathematics and science education are two distinct categories of teacher turnover within schools. The initial phenomenon, commonly referred to as teacher attrition, pertains to individuals who opt to discontinue their engagement in the teaching profession. The second category, commonly known as teacher migration, pertains to individuals who relocate or transition to alternative teaching positions within different educational institutions. Teacher migration is often perceived as a less impactful manifestation of turnover in the education sector.

Teacher migration does not directly affect the overall supply of teachers, unlike retirements and career changes. Consequently, it is commonly assumed that teacher migration does not exacerbate the issue of staffing schools or contribute to the broader problem of teacher shortages. Nonetheless, when considering the perspective of school administrators, both teacher migration and attrition yield a similar outcome, as they invariably lead to a reduction in staff that necessitates subsequent recruitment. Therefore, from an institutional standpoint, the phenomenon of teacher migration can undeniably exacerbate the challenge of maintaining a qualified teaching workforce within schools. The lack of adequate teachers compels some rural schools to employ unqualified teachers to fill some teaching positions, which affects school performance (Ingersoll, 2006). Conversely, the problem of recruiting and retaining scarce skilled subject teachers is a social issue in Mutale, Vhembe district.

## ***Theoretical Framework***

The theory of demand and supply provides a useful framework for understanding the dynamics of the demand and supply of mathematics and science teachers in rural schools globally. According to this economic theory, the equilibrium between demand and supply determines the quantity of a good or service that is available in the market. Thus, in the context of mathematics and science teachers in rural schools, the theory can be applied, as the demand for Mathematics and Science Teachers in rural schools is driven by several factors. These include the number of students enrolled in math and science classes, the significance that educational policies and curricula place on these subjects, and the need to enhance

student achievement and outcomes in STEM fields (Monk, 2007). Additionally, societal expectations and the growing emphasis on STEM education to meet the demands of a globalized and technology-driven world.

The availability of qualified candidates, their willingness to teach in rural areas, and the allure of teaching careers relative to other professions all have an impact on the supply of math and science teachers in rural schools. The number of people pursuing degrees and certifications in mathematics and science education, as well as the ability of teacher education programmes to produce a sufficient supply of qualified teachers, all have an impact on the supply (Ingersoll & Perda, 2010). Thus, the imbalance between demand and supply for teachers in rural schools remains worrisome. The supply of mathematics and science teachers in rural schools often exceeds the available supply, resulting in an imbalance. This can be attributed to factors such as the geographic isolation of rural schools, limited resources, lower salary scales compared to urban areas, and a lack of professional development opportunities (Howley et al., 2003). The shortage of mathematics and science teachers in rural areas perpetuates educational disparities and limits learners' access to quality STEM education. Hence, there is a need for equilibrium and interventions to address the demand and supply imbalance. Interventions are needed to align the equilibrium. These interventions may include targeted recruitment strategies, financial incentives, rural teacher training programmes, and technology-enhanced learning platforms (Leroux & Tharp, 2017). By implementing effective interventions, equilibrium can be restored, ensuring an adequate supply of qualified mathematics and science teachers in rural schools.

The topic of employee supply and demand holds significant importance in the realm of organisational theory and research. To gain a comprehensive understanding of the challenges associated with the recruitment of teachers in rural areas, it is imperative to analyse the demand and supply management systems. It is imperative to comprehend this matter within the context of the causes and consequences associated with school staffing issues in mathematics and physical science (Baron & Bielby, 1980; Hom & Griffeth, 1995). This study aims to demonstrate the necessity of efficient management of the supply and demand of mathematics and science teachers in the Mutale Area of the Vhembe District in South Africa, from a carefully constructed perspective. The region in question has experienced significant deficiencies in the number of teachers, which has had a detrimental effect on the establishment of conducive learning and teaching environments (Mbulaheni, 2016).

The research investigates the management of teacher recruitment, as well as the demand, supply, and shortage of mathematics and physical science teachers in the Vhembe District of South Africa. This study is based on the overarching economic labour market theory of demand and supply. Several prominent scholars (Darling-Hammond, 2003, Hanushek, Kain, & Rivkin, 2004) have extensively examined the application of this theory to teacher labour markets. According to this viewpoint, the equilibrium between the number of teaching positions available and the pool of qualified people willing to teach at a particular level of pay affects both the decisions made by aspiring teachers to pursue a career in education as well as the choices made by current teachers to remain in their current school, transfer to another institution, or leave the profession altogether. The concept of overall compensation encompasses various components such as present and anticipated remuneration, bonuses, and benefits, as well as any form of gratification derived from the act of teaching, including intrinsic personal fulfilment (Jansen, 1998).

According to Ayuk (2012), the labour market theory posits that the determinants of teachers' decisions to remain in, transition from, or exit the teaching profession are contingent upon the comparative desirability of their present role with alternative employment opportunities. Ayuk argues that the theory suggests that schools that lack sufficient financial resources are likely to consistently be at a disadvantage compared to schools with greater financial resources. In this context, the degree of desirability associated with a job influences the likelihood of a teacher being available in the pool of potential candidates. When the job no longer holds its relative appeal, the teacher will opt to explore

opportunities at a different educational institution or within another district. Consequently, this study is based on these theories, as they both centre on matters of management. Education administrators, encompassing school principals, ought to possess the capacity to effectively oversee the process of recruiting teachers specialising in mathematics and physical science disciplines. The effective management of demand and supply in rural areas is of utmost importance, as posited by the labour market theory. Understanding the theory of demand and supply provides insights into the complex factors influencing the availability of mathematics and science teachers in rural schools globally. By applying this theory, policymakers and education stakeholders can develop strategies and interventions that address the challenges and promote a more balanced equilibrium between the demand and supply of qualified teachers in these critical subjects.

### **Global Demand and Supply of Mathematics and Science Teachers in Rural Schools**

Special education, math, and science teachers are scarce in many of the United States' school districts (Feng & Sass, 2018). Despite a 13% increase in the teachers' population over four years, which is 2% higher than learners' enrollment, inadequate math and science teacher shortages exist (Aragon, 2016; Viadero, 2018). Viadero (2018) argues that the federal data shows that in all 50 states and most territories, there were statewide teacher shortages between 2016 and 2018. Math, science, and other subjects were often considered difficult in rural districts as schools struggled to hire enough teachers. National teacher shortages are an endless problem in rural schools, as are resource shortages there. The shortage of qualified, scarce skilled subject teachers is a common worry, as rural schools are understaffed (Feng & Sass, 2018). Feng and Sass further assert that maths and science teachers are faced with significant opportunity costs. In an unrestricted market, teachers should earn more than other occupations, especially in rural schools, where they struggle to recruit and retain talented teachers are critical. Teachers decide whether to teach in schools with little amenities or in more prosperous schools with more comfort. Thus, maintaining maths and science teachers is challenging since these teachers prefer jobs with better benefits.

Rural teacher recruitment has long been a problem (Ingersoll & Perda, 2009). Ingersoll and Perda further agree that many rural schools experience challenges recruiting qualified maths and science teachers. This suggests that local and global efforts to address rural secondary school mathematics and science teacher shortages have failed. Aragon (2016) states that many states in American task forces and working groups have been formed to study teacher shortages and provide solutions. Arizona, California, Delaware, Illinois, and Indiana all have math and science teacher shortages as indicated by Aragon (2016), especially in rural, inner-city, and low-income schools. Policymakers have been advised to implement many suggestions to address teacher shortages. The suggested measures include acknowledging and highlighting teachers' importance and indispensability in the public domain, reducing administrative burdens on schools, and offering bonuses and tuition grants to incentivize teachers, to serve in the rural areas (Aragon, 2016; 2018). Teacher training institutions are encouraged to cooperate with rural schools, to recruit and retain young teachers (Cowen, Butler, Fowles & Streams, 2012). McDonald and Grossman (2008) posit that initiatives to reduce teacher shortages are failing. The studies further demonstrate the need for new programmes to address past failures in recruiting and training skilled rural teachers.

Rural schools are understudied compared to urban ones, to understand the variables that affect rural schools and find new ways to address them, which requires more research (Tran, Douglas, & Fox, 2018). Aragon (2016) opines that stringent recruitment may lower teacher quality. Recruitment efforts that ignore employee retention issues perpetuate high turnover rates among new hires. Thus, teachers in rural schools struggle to adapt and seek other jobs, which are often available. As an approach to recruiting teachers, the US is considering financial incentives (Aragon, 2016; Viadero, 2018). Several schools have implemented an innovative certification scheme to help school districts recruit highly skilled professionals or graduate learners in specific subjects. These individuals receive extensive training and

coaching to prepare them for rural schools. Leadership and compensation play a role in retaining or dismissing maths and science teachers, according to some studies (Tran et al., 2018). Since they have the highest turnover rate, teachers in limited-skill fields need leadership support. Without adequate support, rural schools across the US will continue to lack maths and science teachers unless leaders are creative in helping them find jobs (Argon, 2016).

Similarly, studies in Sweden show that the recruitment and retention of scarce skills subject teachers is a challenge to rural schools, as teachers prefer to work in urban schools. Sweden is a small country with a robust social system, where asylum and refugee policies draw migrants into the system (Bunar, 2017). The "Further Education of Migrant Teachers" programme, established in 2007, requires licenced teachers to complete a two-year programme with firsthand professional experience (Bunar, 2017), to become proficient in Swedish. Then, with a completed degree that includes a Swedish proficiency exam, graduates can fulfil their professional duties. This effort is a problem for migrated teachers (Bunar, 2017). Swedish teacher unions support the migratory teacher programme for long-term integration, an effort that aims to address teacher shortages in the country (Feinberg, 2000). The programme's four to five-year length after immigration, however, is a problem because it contributes to language incompetence (Bunar, 2017). Swedish language instruction at the start of the academic year before discipline-specific courses can help overcome the language barrier (Feinberg, 2000).

Thus, a series of challenges to retain scarce skills subjects' teachers prompted the Swedish government to embrace several initiatives to draw and retain these teachers to rural schools. Among which is the "quick track programme" to streamline the hiring of foreign teachers to address the issues of scarce skills subject teachers (Bunar & Ambrose, 2016). This plan streamlines and improves Sweden's teacher certification validation, establishment, and practical in-service training (Feinberg, 2000). The 26 week-program improves the efficiency and efficacy of migrant teachers, but still need further schooling, despite a "fast track" scheme that has solved the math and science teacher shortage (Bunar & Ambrose, 2016).

In a study conducted in Australia, Handal, Watson, Petocz, and Maher (2018) report that a scarcity of teachers exists in rural Australian schools. The rural locations still lack teachers despite financial incentives-based recruitment strategies. Weldon (2015) agrees that an overabundance of teachers exists in some schools while rural schools struggle to recruit and retain teachers at all levels. According to the Australian Bureau of Statistics (2013), population expansion, particularly among youngsters, increased the demand for primary school teachers. The percentage of part-time versus full-time employees, the ratio of female to male teachers, and teacher attrition also affect the number of teachers needed (Weldon, 2015). The growing learner population in England has outpaced the inadequate teachers. Foster (2018) reports that the qualified teacher-to-learner ratio rose from 17.8 in 2013 to 18.7 in 2017. With the financial incentives created to boost initial teacher training enrollment, which includes bursaries and scholarships for trainees pursuing subject specialisation; Foster (2018) observes that supplemental tactics were used to attract and retain maths and science teachers. Foster (2018) further avows that initial attempts include teacher training, maths, and science bursaries and scholarships.

Continuous professional development has been used to increase qualified teacher status, flexible teaching and working hours to improve teacher retention, and retention payments introduced for early-career mathematics and science teachers in their third and fifth years. Foster (2018) further explains that the government helps schools recruit and retain staff. However, the rising lack of inadequate teachers has raised worries about teacher recruitment, particularly in maths, science, and rural areas (Foster, 2018). Foster (2018) posits that the teaching workload is the main reason teachers quit. Teaching workload concerns are also linked to most attrition solutions. This suggests that numerous influences throughout time shape the decision to leave the profession. Despite government incentives, teacher shortages persist. Incentives had unintended consequences, as teachers refused to fill any open positions. Thus, the lack of adequate maths and science teachers remains unsolved.



Studies from India show that scarce skills subjects' teachers are mostly willing to work in urban schools than in rural schools, according to Sharma (2016). Thus, Indian teachers have emigrated for centuries, leading to unique Indian teachers' foreign mobility (Sharma, 2016). Sharma explains that Indian teachers migrate to affluent nations like the US, UK, Australia, and Canada due to poor welfare. Most of these teachers specialise in high-demand, scarce skills subjects which make them highly employable. As more Indian teachers migrate, the need for Indian teachers, particularly in maths and science, is rising in Indian schools. Moreso, those in India who are science and maths teachers are reluctant to work in remote areas. India needs 1,300,000 teachers (MHRD, 2012) and 2,000,000 teachers (UNESCO, 2014) in schools across the country (Sharma, 2016).

A study conducted in Finland with 49 schools surveyed on sustainability in education pedagogy in lower secondary schools revealed that maths and physics teachers are difficult to be recruited and retained in rural schools (Uitto & Saloranta, 2017). Another study conducted in Honduras shows that initiatives to increase Honduran teachers in rural schools due to severe shortages include radio announcements to advertise rural teaching opportunities (Kind, 2018). The local government invites candidates for screening and qualified candidates receive training. Kind (2018) asserts that this recruitment for rural schools increases teacher retention, with new teachers getting two-week in-service training each trimester. The 250-hour annual training programmes offer significant professional development opportunities to teachers, while field supervisors observe teachers and provide instructional support. Kind (2018) found that competent leadership from the head teachers and district-wide support are essential for teachers to take more responsibility for their professional growth and improve the school.

### **Demand and Supply of Maths and Science Teachers in African Rural Schools**

Most Kenyan teachers leave unsatisfactory jobs for better ones (UIS, 2013). Employee satisfaction affects productivity, performance, non-attendance, negative thoughts of quitting, and well-being (Usop et al., 2013). Teaching job discontent produces an unpleasant environment that affects learner performance. Thus, teachers should be empowered through in-service training workshops to improve their skills (Buitendach & Rothmann, 2009). Kenya National Union members occasionally embark on strikes to complain about pay hikes (Gashing & Wachira, 2013), while South African teachers often strike over wage and job satisfaction. Most teachers quit finding jobs that value their skills and talents (Zahra, Mir, & Chishti, 2013), due to their scarce skills and talents, maths, and science teachers find it easy (Oduor, 2012).

Even in rural African schools, the lack of resources affects teacher supply and demand and the education system. Kenya's education system requires adequate teachers with resources to provide effective education (Moes, 2005). Most teacher training schools reduce their admission requirements to encourage trainees to fill vacancies due to high demand (Ojiambo, 2009). To balance the teacher market, this is done to encourage those from disadvantaged groups (Kafu, 2011). Recruiting and retaining maths and science teachers is still difficult in most Kenyan rural schools. This suggests that tackling the maths and science teacher shortage may entail looking back at what worked and creating a structure that makes teachers feel at home wherever they are.

### **Demand and Supply of Maths and Science Teachers in South African Rural Schools**

There exists a divergence of viewpoints regarding the issue of teacher supply and demand in the context of South Africa. The National Teacher Audit in 1995 revealed that South Africa experienced an excess of teachers during that timeframe (Ayuk, 2012), but due to an increase in learners' enrolment and scarce skills subject teacher shortage, rural schools are lacking teachers (Hofmeyer, Sheingold & Kloffer, 2015). Several approaches have been employed (HSRC, 2005; Mowbray, 2012) to address the issue, including teacher mentoring and optimising the teacher-learner ratio. Thus, the South African education system has been making efforts to tackle the shortage of mathematics and science teachers for a

considerable period but has not achieved success thus far. Hence, it is imperative to enhance strategies that can address the challenges.

The concept of teacher demand refers to the quantity of competent and proficient teachers needed to achieve a specified desired outcome within an educational system (Mereku, 2000). This analysis focuses on the relationship between supply and demand in the context of employing teachers with rare skills, specifically in rural secondary schools located in the Mutale area. Science and maths are classified as rare skills subjects (Ingersoll & Perda, 2010), with teachers qualified in these fields as scarce skills subject teachers. According to Ingersoll and Perda (2010), individuals who have completed a bachelor's or master's degree in mathematics, statistics, mathematics education, engineering, biology, physics, chemistry, geology, or another related scientific field are typically identified as mathematics and science teachers.

According to the study conducted by Ingersoll and Perda (2010), schools that experience difficulties in filling their job vacancies are significantly more likely to have high turnover rates compared to schools that do not report such challenges (Symeonidis & Eloff, 2023). The difference in turnover rates between these two groups is found to be substantial. Rural schools across South Africa face significant difficulties in recruiting and retaining suitably qualified mathematics and science teachers, due to various circumstances such as teacher relocation, pregnancy, child-rearing, medical concerns, family relocations, and attrition (Mowbray, 2012). Recruiting new mathematics and science teachers when vacancies exist by departing mathematics and science teachers has not been easy (Donista-Schmidt, 2014). Supply and demand of scarce skills teachers play a crucial role in organising and assessing teacher preparedness remains a significant challenge. The functioning of the employment marketplace is governed by the principles of supply and demand (Symeonidis & Eloff, 2023). The supply of qualified teachers in scarce skills subjects is limited, school principals sometimes hire teachers who have inadequate skills to replace them (Pandor, 2006; Kriek & Grayson, 2009). Schools can only hire when there are job vacancies. Hence, schools are left without scarce skills teachers when they resign, left, or retire.

The inadequate supply and demand of Mathematics and Science teachers in rural schools have persistently continued in most rural schools in South Africa (Pandor, 2002; 2006; Symeonidis & Eloff, 2023), with the Department of Basic Education failing to address this matter. Parker (2003) reports that the Plan of Action aimed at enhancing access to free and high-quality primary education for all individuals has revealed a significant shortage of teachers in rural schools, especially after the independence. Supply and demand of Mathematics and Science teachers in rural secondary schools can be approached from a policy perspective. Specifically, the demand for these teachers can be attributed to established policy imperatives, such as the learner-to-teacher ratio (Tshiredo, 2013). These factors determine the required number of teachers, who should be recruited and retained in schools.

According to Mbulaheni (2016), there is a lack of significant learner enrollment in Mathematics and Science subjects in some rural schools, which impacts the demand and supply of teachers in these areas. The recruitment of teachers is negatively affected by specific challenges that rural schooling in South Africa faces (Coetzee, Ebersohn, Ferreira & Moen, 2017; Symeonidis & Eloff, 2023). This suggests that the prevailing circumstances in rural areas play a role in the scarcity of mathematics and science teachers in rural secondary schools. Hence, the government must develop effective strategies to attract scarce skills subject teachers to rural schools, despite the challenging circumstances prevalent in these areas.

### ***Research Methodology***

McMillan and Schumacher (2014) define a research method as a systematic way to collect and assess data to solve a research problem. This study adopts a qualitative research design to explore maths and science teacher supply and demand in rural high schools. Qualitative researchers study how people

evaluate their environment and experiences, according to Merriam and Greiner (2019). Hence, this qualitative research uses qualitative methods for complex social phenomena with minimal data (Liebscher, 1998), evaluating people's environment and experiences (Merriam & Grenier, 2019). In-depth face-to-face interviews provided data collection for this study. The participants were purposively selected randomly, from the study's population. Asika (2000) defines a research study's population as all elements, individuals, and observations related to the phenomenon of interest. These participants possess in-depth information that answered the research questions (Ghauri & Gronhaug, 2005). Thus, three principals, three teachers, three heads of departments, and one circuit/district manager were the participants, as they provided in-depth (Barker et al., 1998). All the interviews recorded were duly transcribed and coded to generate themes, for presentation and discussion of findings (Braun & Clarke, 2006). These themes align with the research goals, for data analytic verification (Poggenpoel, 1998). The researchers ensured systematic procedures for this study, for credibility, confirmability, dependability, and transferability (Lincoln & Guba, 1995; Kumar, 2018).

### **Presentation and Discussion of Findings**

Thematic analysis of one-on-one interviews with the purposively selected participants for the study resulted in the generation of themes, which will be presented and discussed in this section. Selected excerpts from the interviews were presented with pseudonyms (teacher, principal, circuit manager).

#### *Can Teachers' Resignations Be Controlled?*

As noted in the reviewed literature, some teachers who are appointed permanently resign when they discover a better opportunity. The researchers sought to know if principals had any influence over the resignation of teachers from schools in rural locations. The task of effectively managing the demand and supply of teachers, particularly in situations where principals have limited control over teacher resignations, can present significant challenges. The resignation of Mathematics and Science teachers has a detrimental effect on the equilibrium of demand and supply, as school principals are compelled to engage in continuous recruitment efforts to fill the vacancies left by departing teachers. According to Weda & De Villiers (2019), the length of time the department took to replace teachers had a negative effect on students' academic performance. During the interview, some participants had these to say:

*“Yes, when teachers die you will find that it is not easy for the department to replace these teachers, because sometimes you may find that they sacrifice the other subjects throughout and out with that post. In some other areas you will find that teachers are resigning to go work in the private sectors where there are greener pastures” (Teacher 03).*

*“I think principals need to be lifelong learners that is as a principal you must do a lot of counselling for example those teachers who are resigning because of social problems for example debt maintenance principals need to get away or refer them to the debts managers who can manage their finances furthermore those who are resigning because of household maintenance, principals can refer them to social workers to advise them” (Teacher 08).*

*“Those who are resigning sometimes they might be resigning just because of social problems so as the principals of a school we have to find these things called employee wellness wherein we are going to every time we have meetings, have workshops wherein they are going to be workshopped on how to handle issues because sometimes you might find that they are having a problem with other teachers inside the schoolyard” (Principal 05).*

According to the participants who were interviewed, it was observed that certain teaching positions become vacant due to the unfortunate circumstance of teachers passing away while still actively



serving. While some agreed that some teachers resigned because of family problems. The consensus among the interviewees was that these vacancies pose significant challenges in terms of finding suitable replacements. The decision of other teachers to resign is not primarily motivated by a desire for better opportunities but rather stems from various personal challenges they are facing. Individuals may encounter various challenges, such as familial, personal, or other related issues, which could potentially compel them to resign. One of the teachers articulated their perspectives on the difficulties encountered by teachers. The teacher posits that in instances where certain teachers encounter insurmountable obstacles, they may choose to relinquish their positions. According to Weda and De Villiers (2019), the task of filling vacancies that have been generated poses significant challenges. According to Podolsky et al. (2019), the interviewed teacher suggests that to enhance teacher retention in rural regions, principals should assume the role of counsellors and provide support to individuals facing personal challenges. This measure may potentially contribute to a decrease in the annual rate of resignations experienced by educational institutions. The management of teacher demand and supply, as indicated by the teachers interviewed, encompasses a variety of strategies that may be contingent upon the specific circumstances. One of the principals posited the perspective that certain challenges encountered by teachers may arise from interactions among teachers within the school. Hence, these findings imply that school administrators should contemplate the implementation of workshops aimed at supporting teachers to effectively manage their personal finances.

#### *Influence of Learner-Teacher Ratio on Teachers' Interests to Teach*

The learner-teacher ratio is a significant factor that influences teachers' classroom practices. The learner-teacher ratio can encourage or discourage teaching practices. Participants were asked to express their views on how the learner-teacher ratio affects or influences the resignation or recruitment of scarce skills subjects' teachers in rural schools. Some of the shortage is caused by the decrease in the production of scarce skills subjects' teachers. Therefore, there are so many mathematics and science learners without teachers. Managing the teacher-learner ratio is difficult in rural schools, as posited by the participants. One of the participants had this to say:

*“The decrease in the production of scarce skills subjects' teachers from the various teacher training institutions is a factor that increases learner-teacher ratio in schools. Teachers will always want to teach in schools where the ratio of the learner to the teacher is not high. These days now, many do not want to be trained as teachers, especially those who are supposed to be trained in scarce skilled subjects. They prefer other plum careers” (Teacher 08).*

The learner-teacher ratio is a critical factor that influences learners' performance in schools. Most rural schools are usually overcrowded and this impact the learner-teacher ratio in these schools (Mbonambi, Gamede & Ajani, 2023). Furthermore, Ajani (2023) argues that overcrowding of schools with learners has consequences on teachers' classroom practices, as well as learners' academic performances across South African schools. This suggests that while learner-teacher ratio may be considered when managing the supply and demand of mathematics and science teachers. Principals may not have absolute control over the management of the teacher ratio in rural schools to the satisfaction of Mathematics and Science teachers as established by Tshiredo (2013).

Managing of learner-teacher ratio in rural schools affects the teacher's workload in schools. In a study conducted by Muremela et al. (2023), findings revealed that the management of learner ratio is considered when teachers decide on their permanent employment in rural areas. This suggests that the learner-teacher ratio may be considered when managing the supply and demand of mathematics and science teachers, as this makes employment and retention of these teachers to be reasonable. Principals may not have absolute control over the management of the ratio in rural schools across South Africa, to the satisfaction of Mathematics and Science teachers (Tshiredo, 2013).

### *Retention of Scarce Skill Subjects' Teachers in Rural Schools*

Mathematics and Science teachers who are employed at rural schools do not stay for longer periods before they relocate to urban schools. Various studies affirm that teaching in rural schools is challenging for most teachers, as schools do not have adequate resources to support their classroom practices (Govender, Ajani, Ndaba & Ngema, 2023). While Dlamini, Gamede, and Ajani (2021) assert that scarce skills subjects' teachers are scarce, and therefore, once recruited, they must be retained. Their movement from school to school negatively impacts the smooth continuity of teaching and learning in the subjects. Some principals employ alternative strategies to attract and retain teachers in rural areas to teach Mathematics and Science. In the interview with a circuit manager on the problem of retention of scarce skills subjects' teachers, he expressed:

*“Principals can keep them by giving them incentives, by incentives it means while they are offering extra lessons, they can give them money so that those teachers can stay in that school for a long time”* (Circuit Manager 06).

Some teachers provide additional instructional sessions for learners who are struggling to comprehend certain subjects. Principals can provide incentives to teachers as a means of acknowledging and valuing their diligent efforts. This may subsequently serve as a source of motivation for them to remain. During the interview, a teacher made the following statement:

*“The incentive that I am talking about is the salary package though it might sound discriminatory, teachers with scarce skills must be allocated a salary that is better than the teachers because we want to keep them. Teachers must be given allowances most of the government employees have an allowance but as for teachers they said we are too many but now the number is going down so I think the department must consider giving an allowance, a car allowance where teachers won't struggle to keep up with the standard of living which is high these days”* (Teacher 08).

Principals possess significant authority in determining the path of action within their respective schools. The retention of teachers may be contingent upon the managerial abilities of the principal (Grissom & Bartanen, 2019). While some principals may find it quite easy to acquire and retain these specialised subjects' teachers, others may encounter challenges in doing so. There is, however, a smaller proportion of teachers in rural areas, indicating to some extent the challenges associated with retaining mathematics and science teachers in rural schools. This implies that a single teacher may be assigned to teach large class groups within a school. Managing the demand and supply of mathematics and science teachers in rural schools can pose a considerable challenge for principals. The retention of teachers may not solely rely on the geographical area in which they are recruited (Darling Hammond, 2003). It is likely that other factors, which extend beyond the scope of this study, also play a significant role, and warrant further investigation. Teachers posit that a higher remuneration is apt to entice teachers to remain within the region, regardless of its rural nature. Incentives can potentially be implemented to augment an individual's salary. The findings indicate that it would be beneficial to provide additional incentives, such as salary increments and car allowances, to mathematics and science teachers who are hired in rural regions. Hence, it is imperative for the government to actively participate in the recruitment, administration, and retention of mathematics and science teachers in rural regions (Tran & Smith, 2019), which have faced challenges in retaining such professionals.

### *Creating Enabling Environments for Scarce Skills Subjects' Teachers in Rural Schools*

Mathematics and Science are scarce skills subjects in the education system (Dlamini et al., 2021). School principals must create a positive environment within the school system to lure, encourage and retain these scarce skills teachers to work in rural schools. Participants' views on this were sought during the interviews with these participants. The participants' findings indicate that the principal must establish

favourable working conditions for both teachers and learners. Several teachers who were interviewed corroborated as follows:

*“To keep this teacher. What is most important is to ensure that the environment is good. They must provide a good environment for teaching and learning, particularly these days in rural schools, you find that most of the learners are ill-disciplined or even within the staff members. The relationship between the colleagues. Then I think that if the principal could manage the environment within the school. Then that would keep the teacher” (Teacher 07).*

*“I think one of the strategies is that the principal can also promise the teachers that he is going to get something when he is in the school. For instance, maybe, he can get some incentives by offering extra lesson classes, so that the learners will be able to get more information during extra hours lessons, and the principal himself can manage that by looking at how the teacher is implementing that lesson during the class sessions” (Teacher 05).*

The establishment of a conducive environment for Mathematics and Science teachers, characterised by the acknowledgement of their performance, holds significant importance in the field of Mathematics and Science education. According to the findings of Muremela et al. (2023), the provision of recognition for exemplary performance has been shown to foster a positive educational atmosphere among Mathematics and Science teachers. They contend that the significant impact of the teaching and learning environment on the establishment of a favourable teaching and learning atmosphere is substantial. This finding is in line with previous research conducted by Kiruja and Mukuru (2018). The participants' findings indicate that the establishment of a positive teaching and learning environment is crucial, as it can influence teacher recruitment and motivation. Previous studies (Adedeji & Olaniyan, 2011; Schullion, 2011) have also demonstrated that such an environment may even contribute to teachers choosing to remain in their schools permanently. According to Geiger and Pivovarova (2018), the retention of teachers in the teaching profession is contingent upon favourable working conditions.

The establishment of conducive learning environments necessitates the presence of disciplined learners, which allows teachers to conduct their instructional activities without any disruptions or obstacles. According to the teachers who were interviewed, it was found that most learners exhibit a lack of discipline. The presence of such environments may hinder the facilitation of effective teaching, thereby influencing teachers' decisions regarding their long-term commitment. The establishment of an educational setting that influences the dynamics of teacher demand and supply is also influenced by disciplinary factors. Teachers may experience challenges in maintaining effective performance when they are faced with a classroom environment characterised by inadequate learner discipline. According to Ni, Yan, and Pounder (2018), it can be inferred that for principals to establish a favourable atmosphere within a school, they must proficiently oversee learner discipline. Hence, the maintenance of discipline is of utmost importance for principals in fulfilling their managerial responsibilities.

#### *Employment of Foreign Teachers on a Short Contract*

When South African teachers are not accessible for long-term positions, foreign teachers are engaged temporarily. A significant proportion of teachers who possess qualifications in teaching mathematics and science subjects are individuals from foreign countries. These individuals are engaged in temporary employment agreements that have the potential to last up to five years. This implies that upon the conclusion of each contract, there is a need to either recruit a new teacher or renew the existing contract. Managing the supply and demand of mathematics and science teachers poses a significant challenge for principals.

One of the interviewed teachers confirmed:

*“Yes, you know when everybody is looking for a job one may need the security of that job. So, these foreigners are used to be hired for the term of registration. They will only be registered for a year then from there they must reapply, or they must go back and organize their papers. So, in other words, this issue of contracting these foreigners for a year also affects these people because they will look for somewhere where they can be hired for a permanent post”* (Teacher 02).

According to the study conducted by Muremela et al. (2023), it has been observed that short-term contracts tend to motivate foreign nationals to voluntarily resign from their current positions and actively seek permanent employment opportunities elsewhere.

Foreign individuals seeking teaching positions in South Africa may encounter challenges in securing permanent employment. These individuals often find that their teaching posts are not guaranteed, leading them to resign and seek employment opportunities elsewhere that offer more long-term stability. During the interview, several participants expressed their decision to resign from their teaching positions due to a lack of job security, prompting them to seek employment opportunities elsewhere. There is no guarantee of securing alternative employment upon reapplication. The job security factor significantly influences teachers' choices to relocate from rural areas in pursuit of permanent employment opportunities.

According to the literature, one of the primary factors contributing to high teacher turnover rates is the prevailing school conditions (Roussouw, 2005; Han, Borgonovi, & Guerriero, 2018). It is recommended that the inclusion of retention strategies be incorporated into the training curriculum for principals, ensuring the effective implementation of national guidelines for support. The flexibility of employment to accommodate individuals seeking part-time work or job-sharing arrangements may contribute to the reduction of avoidable losses (Han, Borgonovi, & Guerriero, 2018).

#### *Effect of Managing Demand and Supply of Scarce Skills Subjects' Teachers on Resignations*

Studies revealed that teachers are prone to resignations for several reasons (Dlamini et al., 2021). Some of these teachers resign from classroom teaching for greener pastures or to change careers. Hence, it becomes critical for school principals and other employers to manage the employment of scarce skills subjects' teachers to control their resignations. However, resignations cannot be controlled most times by school principals but need to be managed to sustain school systems. Some of the participants had these to say:

*“For the teachers who are resigning. Currently, the Department of Education has opened the gates for matric learners who are completing matric immediately when they complete matric, they are allowed to apply and come and teach these scarce skills subjects such as mathematics and physical science, without experience and qualification, and when they are within the system, they can make efforts to register on their own to the Universities of Higher Learning and make sure that they get the relevant qualification”* (Teacher 04).

*“I think the issue of closing the gap is like I have indicated above here. In other words, what I am saying is that the department has to offer bursaries to train new teachers, and the youth so that they teach Mathematics and Science. That will; also help. And again, another thing is that what is happening you find that, many teachers are coming from other countries, maybe from Zimbabwe and other countries, which are outside of our country they are also employed in our country to fill the gap of Mathematics and Science teachers”* (Teacher 05/HoD).

*“The gap can be closed by re-employing them temporarily. Or if a teacher has resigned, we always employ them on a temporary base and then another thing there is an issue of redeployment of*

*teachers, so if teachers are on an R and R, they are extra according to the post establishment. It means those teachers can fill the gaps or they can fill the post of those teachers who have resigned” (Teacher 06).*

The management approach adopted by principals of rural schools regarding teacher employment significantly impacts the rate of teacher resignations within these schools. According to Muremela et al. (2023), the way principals oversee the hiring and retention of Mathematics and Science teachers significantly influences their likelihood of resigning. The findings of their research indicate that the influence of school managers' management practices on the availability of Mathematics and Science teachers, as well as their decision to resign, may be minimal. The foundational elements of teacher development hold significant importance; however, it is worth noting that even a highly skilled teacher may be compelled to seek alternative employment due to inadequate management practices. This, in turn, can have a detrimental impact on the overall performance of the educational institution (Barnes, 2017). The principal should thus assume the role of an advocate for their schools, fostering a conducive atmosphere that promotes positivity among both teachers and learners. This suggests that inadequate administration of the recruitment process for mathematics and science teachers has a detrimental impact on the educational setting. The closure of the gap resulting from the resignation of teachers, which can be attributed to inadequate management of teacher demand and supply, is imperative. There undoubtedly exist prospective strategies for the future regarding pedagogical approaches for learners.

### **Conclusions**

This study presents findings that highlight the difficulties faced by principals and circuit managers in the recruitment and management of teachers specialising in scarce skills subjects, specifically mathematics and science, in rural secondary schools located in the Mutale Area of the Limpopo Province. The current shortage of teachers can be attributed to a decrease in the number of training institutions, which has led to a reduced capacity for participating universities to train teachers. The Department of Education is contributing to the challenging circumstances in rural areas, where schools are facing significant shortages of Mathematics and Science resources. The Department should therefore consider taking initiative-taking measures to address these shortages. The availability of educational facilities in schools, which has an impact on recruitment and the promotion of teaching and learning, should be enhanced. If the Department of Education were to enhance the physical conditions within schools, teachers would be more inclined to seek employment opportunities where they can foster their academic and professional growth. The high rate of teacher resignations in schools, particularly in rural areas, indicates that improving conditions within the teaching industry could potentially attract and retain prospective teachers in these regions. The presence of incentives may enhance the likelihood of mathematics and science teachers accepting positions in rural schools.

### **Recommendations**

Principals and district officials must recruit more maths and science teachers, with good salaries and entitlements to keep them in rural schools, thus, decreasing teacher turnover. Rural maths and science teachers should be provided with regular and adequate bursaries. Rural teaching needs encouragement, where graduates become teachers. Rural teaching allowance and low-cost staff house should be provided to scarce skills subjects' teachers to encourage rural maths and science teachers to stay. Government and circuit management should recruit these teachers using various approaches and retain them in schools. Bland, Church, and Luo (2016) recommend ongoing teacher recruitment planning. The Department of Basic Education can recruit long-term teachers by setting annual district recruiting targets. Community and school districts should highlight their assets to encourage pre-service teachers from teacher training institutions to visit schools. School visits should include informal interactions with learners and teachers,



especially those in similar career stages. Furthermore, rural schools can host pre-service teachers during their teaching practice training. Such initiative can address potential teachers' formal interview preconceptions.

Since rurality persists, rural teacher training is important. Rural teachers need context-assessment training. Bursary-eligible teachers should be employed and supported to assist rural schools. This helps principals hire hard-to-get math and science teachers. To optimise teacher and administrative practicum positions in high-need rural schools, teacher training institutions should strengthen connections with the rural school districts. Practicum and learner teaching placements lead to full-time employment, which can be promoted with relevant higher education institutions to help rural school principals, teachers, and learners (Tran, Smith, & Fox, 2018). Tran et al. (2018) further recommend the development of individualised leader development plans, embedding rural practicums and paid internships, teaching rural context and turnaround principles and training, engaging learners in rural community activities, leadership succession plan development, and transitional and early career support. These programmes improve demand and supply management of limited skills topic teachers. Strong administration can improve teacher working conditions, making permanent appointments in remote places easier despite education system issues.

Unfavourable conditions drive teachers away. Rural school communities should support rural teachers. Teacher retention depends on relationships, which are encouraged by community-school connections through various programmes. School principals in rural communities must know this. Communities should welcome teachers and support them with conducive working environments.

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