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# School infrastructure challenges in South Africa: Experiences of high school principals and teachers

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There is growing concern regarding the inadequate infrastructure in South African schools leading to unsafe environments for teachers and learners. This qualitative single case study involved interviews with 18 participants, including 6 high school principals and 12 mathematics teachers that were sampled purposively and conveniently. The interviews were transcribed and thematically analysed. Additionally, school premises were observed, and field notes were recorded. Maslow's Hierarchy of Needs Theoretical Framework guided the study. The findings highlight the urgent need for attention to school infrastructure. Educators expressed a lack of knowledge regarding school safety policy procedures, which hindered their effective implementation. Poor safety conditions were found to be detrimental to teaching and learning. We emphasise the necessity for policymakers, principals, teachers, and stakeholders to gain a deeper understanding of safety aspects in South African schools, particularly regarding infrastructure deficiencies. Recommendations include providing training sessions on school safety policy procedures for principals and teachers. Additionally, newly appointed teachers should receive induction on school safety policies during their initial days at a new school, addressing the identified absence of such inductions.

**Keywords:** challenges; infrastructure safety; safety aspects; single case study

## Introduction

Safety in South African schools has recently occupied the centre stage again (Department of Basic Education [DBE], Republic of South Africa [RSA], 2018; Mahopo, 2017). Many South African schools have become death traps instead of centres of teaching and learning (T&L). Extensive research has indicated that the lack of safety within schools may contribute to low academic achievement among learners (Katschnig & Hastedt, 2017; Musu, Zhang, Wang, Zhang & Oudekerk, 2019). What is noteworthy is that safety issues in South African schools are a growing concern. Physical infrastructure safety is of great importance as "physical facilities play pivotal role in actualization of educational goals and objectives by satisfying the physical and emotional needs" (Gatua, 2015:1) of teachers and learners. Gatua (2015:1) argues that "physical needs are met through provision of safe physical structures, adequate sanitary facilities, a balanced visual environment, appropriate thermal environment, and sufficient shelter space for work and play." Supporting this viewpoint, Swaminathan, Narayanan, Blossom, Venkataramanan, Saunik, Kim and Subramanian (2020) emphasise that physical school infrastructure is a vital aspect for improving educational outcomes. Sebastian and Allensworth (2019:24) go as far as to say that "leaders who are anxious to improve learning gains in their schools should consider how strongly they are working to improve students' sense of safety." When referring to physical infrastructure of schools, we encompass various components such as laboratories (Murillo & Román, 2011), libraries (Cuesta, Glewwe & Krause, 2016; Murillo & Román, 2011), toilets (Cuesta et al., 2016), classrooms, playgrounds, playground equipment, green spaces (Mokhtarmanesh & Ghomeishi, 2019), water points and electricity infrastructure (Cuesta et al., 2016). This definition also includes basic services provided at schools, such as access to water, sufficient bathrooms, sewage services and supply of electricity. Many schools, particularly in non-high-income countries, face deficiencies in these basic services, which have been associated with poor academic achievement among learners (Capule-Navarro & Alampay, 2020; Murillo & Román, 2011). Priorities for the provision of school infrastructure differ between developing and first-world countries and from one context to another (Barrett, Treves, Shmis, Ambasz & Ustinova, 2019). In South Africa, inequalities in school infrastructure stem from the historical legacies of apartheid and colonialism (McKeever, 2017; Muswede, 2017). With this study we aimed to explore the perspectives of high school principals and teachers in South Africa regarding the challenges related to school infrastructure. The objectives included exploring South African schools' physical infrastructure safety challenges and identifying potential measures to address these challenges. Through this manuscript, we demonstrate the justiciability of the right to education which includes feeling safe at school.

### Problem Statement

Many studies highlight the lack of safety in South African schools, which put principals, teachers, and learners at risk (Mestry, 2015; Singh & Steyn, 2014). These individuals are constantly subjected to incidents of violence and unsafe environments, hindering effective T&L. To achieve academic excellence, learners must be free from an unsafe learning environment (Masitsa, 2011). There is still overwhelming research on the incidence of poor or lack of infrastructure in schools which poses a danger to principals, teachers and learners. Of particular

concern is the low achievement in mathematics among South African learners (Hanaya, McDonald & Balie, 2020). In light of these concerns, we developed an interest in assessing the safety aspects, particularly school infrastructure challenges, and their association with mathematics achievement. To the best of our knowledge, no research has been conducted to specifically investigate the association between infrastructure safety challenges and mathematics achievement among South African learners. Our extensive search[i] in databases such as Web of Science and Scopus yielded no relevant studies. To address the issues mentioned above, the research questions of our study are: What are the views and perceptions held by South African high school principals and teachers concerning the challenges associated with school infrastructure? How do South African high school principals and teachers envision resolving the challenges related to school infrastructure?

## Literature Review

### *Shortage of or inadequate physical infrastructure of schools*

Internationally, research has shown that a shortage of or inadequate physical school infrastructure affects academic achievement. According to Bhunia, Shit and Duary (2012:412), "the development of education depends on a large number of factors, including the infrastructure resources available to a school." School infrastructure is widely assumed to influence academic achievement (Cuesta et al., 2016; Etefa, 2019; Mokhtarmanesh & Ghomeishi, 2019; Murillo & Román, 2011). Research has shown a lack of basic school infrastructures such as laboratories, libraries, toilets, classrooms, playgrounds, water points and electricity in many countries, for example, in Nigeria (Kabiru & Arshad, 2016), Tanzania (Lawrent, 2020) and Zambia (Ginsburg, Balwanz, Banda, Park, Tambulukani & Yao, 2014). Cuesta et al. (2016) found evidence that adequate school facilities such as toilets, laboratories and water drinking points increase learner enrolment and learning.

In the South African context, the physical infrastructure of schools is conceptualised as providing basic infrastructure such as classrooms, water points, toilets and electricity. The South African government has recognised the importance of addressing infrastructure challenges in schools and has implemented measures to alleviate these issues. For instance, in the 2011/2012 financial year, the School Infrastructure Backlogs Grant (SIBG) was introduced, along with the Minimum Uniform Norms and Standards for School Infrastructure (DBE, RSA, 2013) and other guidelines. These initiatives were intended to tackle the shortage or inadequacy of school infrastructure. To this end, such initiatives failed to address the challenges of the lack of school infrastructure or providing adequate school infrastructure. According to Moodly and Toni (2017), the DBE is capsizing its objectives of ensuring a safe school environment due to a lack of support in terms of adequate school infrastructure provision.

Studies have shown that many learners in South Africa still attend classes in muddy classrooms or under trees, and in some instances, two grades are accommodated within a single classroom (Marais, 2016; West & Meier, 2020). If left unresolved, the lack of adequate school infrastructure has the potential to continue adversely affecting T&L outcomes. The lack of basic facilities and infrastructure in schools plays a major role in performance (Akomolafe & Adesua, 2016; Barrett et al., 2019; Khumalo & Mji, 2014).

### *School infrastructure safety challenges*

In the context of this study, school infrastructure safety challenges refer to visible security measures such as metal detectors (Perumean-Chaney & Sutton, 2013), closed-circuit television (CCTV) surveillance systems, the presence of security services (Makota & Leoschut, 2016), ageing infrastructure (Eitland & Allen, 2019), building conditions (Maxwell, 2016), infrastructure hazards and maintenance (Eberlein & Moen, 2016; Rivera, 2017; Rodriguez, Kramer & Sherriff, 2013).

Internationally, the implementation of physical features such as metal detectors, locked doors, fences, and security cameras in and around the school is regarded as a mechanism used to increase physical infrastructure security. Perumean-Chaney and Sutton (2013:570), in their study conducted in the United States of America (USA), discovered that "the number of visible security measures employed in school were associated with a decrease in student reports of feeling safe." In addition, Ronoh (2018), who conducted a study in Kenya, reported that fencing and surveillance of the school environment are of paramount importance to enhance schools' safety needs and standards. It is assumed that such security measures may, in turn, improve learners' academic achievement when both teachers and learners feel safe and secure at school (White, Gina & Coetzee, 2015). On the other hand, Perumean-Chaney and Sutton (2013) found that metal detectors and the use of at least two physical security measures may have a serious unintended consequence on learners' perceptions of safety, i.e., learners feeling less safe.

For South Africa, Xaba (2014) reports that many South African schools use surveillance systems, such as CCTV, as a fundamental safety and security measure in ensuring the physical safety of school environments. Likewise, Manu, Maluleke and Douglas (2017) argue that secure fencing and monitoring access and exits play a vital role in creating a safe school environment

conducive to T&L without interruptions. Conversely, Makota and Leoschut (2016) found that visible physical measures such as policing or CCTV surveillance cannot replace the corrective measures to address school safety.

### *School building condition*

In international studies, poor school building conditions and ageing infrastructure affected learner safety and academic achievement (Elie & Andala, 2021; Hopkins & Woulfin, 2015). Asiyai (2012) found that infrastructure in Nigerian schools was generally in a state of disrepair, with inadequate maintenance being carried out on most facilities. On the other hand, Maxwell (2016:206), who conducted a study in 236 American schools, discovered that "academic achievement is linked to building condition mediated by the social climate and student attendance." Maxwell (2016) added that academic achievement was linked to the conditions and adequacy of the school infrastructure mediated by the school climate and student classroom attendance. Conversely, Martorell, Stange and McFarlin (2016), who also conducted a study in the USA, found that improving school building conditions through renovation has little effect on academic achievement.

In South Africa, the poor school building conditions are still a considerable challenge. Dilapidated school infrastructure can still be found, especially in the rural provinces such as Limpopo, Mpumalanga and the Eastern Cape (Abdoll & Barberton, 2014; Du Plessis & Mestry, 2019). According to McKay, Mafanya and Horn (2018:1), the "embedded apartheid resource backlog of poor infrastructure … cuts across both public and at least some private schools" in South Africa. Furthermore, Khumalo and Mji (2014) conducted a study in rural schools and found that poor school infrastructure negatively impacts T&L. Moreover, De Jager, Coetzee, Maulana, Helms-Lorenz and Van de Grift (2017) found that dilapidated school buildings are common, especially in rural South African schools, negatively affecting quality teaching. Some schools in South Africa are neglected and have a severe lack of proper school building infrastructure necessary to facilitate T&L (Bantwini & Feza, 2017). Teachers and learners have to bear the brunt of the deplorable school infrastructure or a lack of infrastructure in the form of lower academic achievement (Barrett et al., 2019). Moreover, Barrett et al. (2019) found that safe and efficient school infrastructure impacts learning positively. Ntjatsane (2017) asserts that the quality of infrastructure is equally as important as quantity. Khumalo and Mji (2014) identified an urgent need to address poor infrastructure provisioning as it negatively affects the proper functioning of schools. What is noteworthy is the statement by Thaba-Nkadimene and Mmakola (2019:169) that "the Department of Education is blamed for not providing adequate school resources and infrastructure vital for the creation of conducive learning environment, and delivery of quality education and learning." Despite evidence of the importance of school infrastructure, South African school infrastructure is at the brink of collapse due to a lack of maintenance, increased demands and poor quality of the available infrastructure. There is still a lack of investment in the maintenance and renewal of school infrastructure (Du Plessis & Mestry, 2019; Ncanywa & Stuurman, 2018; West & Meier, 2020).

### *School infrastructure hazards*

Internationally, studies have revealed the prevalence of unsafe school infrastructure hazards that pose risks to principals, teachers and learners. Ismail, Hamzah, Makhtar, Daud, Khidzir, Hassan and Mansor (2017) report a high-level risk exposure among Malaysian learners and teachers on the school grounds, contributing to increased accidents on school grounds. Surprisingly, Malaysia is ranked among the top-performing countries in mathematics and science globally (Mullis, Martin, Foy & Hooper, 2016).

In South Africa, Rodriguez et al. (2013) report unintentional and intentional injuries due to school infrastructure hazards and the level of risk to which learners are exposed. They discovered that learners are subjected to injuries due to fire and electrocutions, among other risk factors.

### *Maintenance of school infrastructure*

International studies found that poor school infrastructure was a partial predictor of learners' academic achievement, evidenced in run-down school facilities where attendance was poor (Maxwell, 2016; Rivera, 2017). These findings suggest that learners who attended fewer classes on average might translate into lower academic achievement. Moreover, Barrett et al. (2019) report that the condition and design of school infrastructure affect educational outcomes. Similarly, Nepal (2016) found that school infrastructure with well-maintained facilities is likely to achieve better educational outcomes than those with poor or a lack of such facilities. In 2017, Smith pointed out that poorly maintained school infrastructure has adverse safety impacts on learner health and safety, resulting in poor academic achievement. Research confirms that the quality and conditions of school infrastructure impact teachers, learners and academic achievement in schools (Eitland & Allen, 2019). Osaro and Wokekoro (2018) found that building neglect, and lack of maintenance, among other factors, lead to the dilapidation of school infrastructure. Their findings contribute empirical evidence to support

the influence of school infrastructure on learners' academic achievement.

Interestingly, in South Africa, the DBE affirmed that it takes school safety very seriously, and as a top priority to ensure that both teachers and learners are safe in schools (DBE, RSA, 2016). Despite such affirmations and recommendations, research conducted on safety in South Africa indicates that infrastructure safety in schools remains a huge challenge. Moreover, they also found that, "investments in quality school infrastructure are strongly associated with improved learning outcomes" (Barrett et al., 2019:v).

### Theoretical Framework

As pointed out by many researchers, there is no single approach to address safety issues in schools. Various researchers have approached the issue of school safety from different theoretical perspectives, highlighting the complexity of addressing this issue. For instance, Morrison, Furlong and Morrison (2000) used the resiliency approach to understand school safety. Gina (2013) addressed school safety by using Maslow's hierarchy of needs to manage safety in schools. Our study was guided by Maslow's Hierarchy of Needs Theoretical Framework (Maslow, 1943). According to this theory, safety needs are a basic need that, when not met, could cause teachers and learners to feel anxious and tense. These needs need to be satisfied for teachers and learners to be free from any physical harm, hurt, loss of life and property, or collapse, in order for a safe learning and teaching environment to be created. Furthermore, this theory purports that lower needs must be satisfied before a higher need can be activated, and therefore, the assumption is that the physiological needs (learners having access to food and water) are met. This explains why physiological needs are not included in the revised model. Under Maslow's Hierarchy of Needs Theory, teachers and learners concerned about meeting safety needs cannot devote their full attention to T&L in schools. Safety needs is a prerequisite for higher-order needs such as social needs (learners' sense of belonging and acceptance in the learning environment), self-esteem needs (learners are given opportunities to advance their learning) and self-actualisation needs (learners performing to their maximum potential). Safety needs need to be activated so that teachers can teach and learners can learn free from harm.

## Methodology

### Data Collection and Analysis Procedures

We used a qualitative approach and an interpretive paradigm. Data were collected through a single case study of six research sites as the setting for this study, with the case considered being school infrastructure challenges. Both convenience and purposive sampling methods were used to select participants. A total sample size of 18 participants consisting of six public high school principals and 12 mathematics teachers from no-fee-paying (Quintiles 1, 2 and 3) and fee-paying (Quintiles 4 and 5) schools in the Johannesburg Central, Johannesburg North and Johannesburg South districts were sampled. In each school, we sampled two Grade 9 mathematics teachers and their principals. In Gauteng province almost 50% of schools are no-fee-paying schools, and, accordingly, we used a 50–50 allocation when sampling schools; that is, we sampled three no-fee-paying schools in the townships and three fee-paying schools, formerly known as Model C schools. All six sampled schools are public schools situated either in the suburbs or townships in Gauteng province. We used the following criteria for convenience sampling in selecting the sample for the study: the districts and schools should be conveniently nearby for cost-effectiveness and time management, and participants should be easily accessible; they should be located within our geographical proximity. The following were criteria for the purposive sampling: we selected three no-fee-paying and three fee-paying schools, and such selection constitutes a 50–50 ratio. The participants were selected based on the qualities they possessed, i.e. they had to be principals of high schools with at least 7 years' experience and Grade 9 mathematics teachers (no specific requirement on the minimum number of years' teaching experience).

The semi-structured interviews were conducted during the coronavirus disease (COVID-19) pandemic, with each interview lasting between 30 and 45 minutes. When participants felt comfortable being interviewed in person, this was done, and the COVID-19 lockdown regulations were strictly adhered to; for example, both the researcher and the participants were expected to wear face masks, take temperature tests before the start of the interviews, follow sanitation procedures and maintain a 2 m distance. However, where the participants felt uncomfortable with face-to-face interviews, virtual interviews were conducted. Where schools were visited in person, observation was done and captured as field notes. All interviews were recorded and transcribed; pseudonyms were used in the transcriptions. The schools are represented as School Site A to F, with School Site A representing school number 1 (A is the first letter in the alphabet) and school site F representing school number 6 (F is the sixth letter in the alphabet). Pseudonyms were assigned to individuals guided by the first letter of their schools' names for easy identification. Pseudonyms with three letters represent principals, and pseudonyms with more than three letters represent teachers. Thematic analysis was employed

(Vaismoradi, Turunen & Bondas, 2013) for data analysis. The codes, themes and sub-themes were generated using the detailed steps by Williams and Moser (2019) and were extensively deliberated and scrutinised by all three researchers involved in the study until consensus was reached on the final set of themes and sub-themes.

### Quality Assurance

Trustworthiness can be established by credibility, transferability, dependability, and confirmability. Credibility was established by providing direct verbatim quotes from the participants, as suggested by Connelly (2016). We provided sufficient information about the research sites and participants and rich and vigorous findings with direct quotations to enhance the transferability of our research findings. For this study, an individual who intends to transfer the results to a different context is then responsible to determine whether the transfer is reasonable. To ensure dependability, we acknowledged that humans are subjective beings, and throughout the research process, we reminded ourselves to be aware of how we perceived the research process and how our own background and paradigm may have influenced our perceptions of the research outcomes. As soon as the transcriptions were available, member-checking was done to ensure dependability. Finally, we demonstrated the confirmability of the study by providing "rich quotes from the participants that depict each emerging theme" (Cope, 2014:89). Thematic saturation was reached, i.e., the sample size was sufficient – by interview number six with principals and interview number 10 with teachers, no new or additional data were found to develop new codes or themes (Guest, Namey & Chen, 2020).

### Ethical Considerations

We obtained ethical clearance for this research study from the Ethics Committee of the University of Pretoria and the relevant educational authority, the Gauteng Department of Education (GDE). Once the necessary approvals were obtained, we proceeded to request permission from the principals and teachers sampled to participate in the study. All the participants were informed that their participation was voluntary, and that they could opt out at any time if they so wished. Moreover, we used pseudonyms to sustain anonymity during the research. The data will be retained for a period of 15 years in accordance with institutional guidelines and data protection regulations. Additionally, principals were requested to sign a confidentiality clause, committing to maintaining the confidentiality of the information shared during the research, both in relation to the participants and the content provided by them.

## Findings

The findings from the study can be interpreted through the lens of Maslow's theory, illustrating how inadequate school infrastructure compromises the safety needs of individuals within the school setting. The lack of proper infrastructure creates an unsafe environment, hindering the fulfilment of the safety needs of principals, teachers and learners. This, in turn, affects their overall well-being and hampers the T&L processes.

A thematic analysis was conducted, and two themes emerged. The first theme was "Physical infrastructure safety challenges in schools" with two sub-themes, namely "Condition of school buildings and grounds" and "Logistical challenges related to schools' physical infrastructure safety." The second theme, "Measures to address physical infrastructure safety challenges in schools", had three sub-themes, namely "Physical infrastructure provision", "Assurance of physical infrastructure safety of teachers and learners in the classroom", and "Possible resolutions to physical infrastructure safety challenges in schools." Both themes are considered and discussed in the next section.

### Theme 1: Physical Infrastructure Safety Challenges in Schools

#### *Sub-theme 1.1: Condition of school buildings and grounds*

Five principals reported that their schools' physical infrastructure and grounds were not safe due to the ageing of infrastructure and the lack of maintenance, among other things. Ned explained:

> *They* [school buildings and grounds] *are not safe because if you look at the grounds, not all the area has been cut* [lawn mowing], *so there's some areas that grass is not being cut. The school building, if you can see, while you are going out, from this side, you will see the structure that side, the zinc* [corrugated iron for roofing] *that has been used for the roof on top was removed by the wind a long time ago.*

This response suggests inadequate maintenance in the school, which poses a risk to all on the school grounds. Ned further pointed out that "*there are some manholes and drainage holes, there are four or three that have been opened. Those things* [the lids] *that are used to cover them have been removed.*" Another principal, Tod, pointed out defective design of infrastructure:

> *The only challenge that affects me and my staff members is our school has asbestos material, and we know, deep in our heart, asbestos is not safe. Yes, that can affect T&L as both teachers and learners might get sick.*

This response suggests that anyone entering a building is at risk since asbestos is associated with chronic lung diseases. Tod also revealed that "*our school was constructed in 1967, long time. They* [DBE] *wanted to change the infrastructure in 1996, but they only managed to do that in few blocks and*

*some libraries and laboratories.*" Tod's explanation indicates an infrastructure backlog that needs to be addressed, considering that the infrastructure challenges at the school had not been addressed since 1996. Only one principal reported no problems regarding the conditions of the school buildings and grounds. Fay stated that:

> *School buildings are safe even in the grounds; they were repaired, the floors. And to protect it, we put a fence around our school grounds so that there is no easy access if there is nobody around the school. I think there will be a huge improvement in terms of results when learners and teachers feel safe.*

Eight teachers explained that their schools' physical infrastructure and grounds were unsafe. Daphne provided the following narration:

> *Not safe at all, I'm not going to say how safe, but as I know the school is very old. We need to revamp the school; if not to refurbish the school. Three months ago, there was a leakage in one of the top classes where water just came out from nowhere. We don't want to experience the Vanderbijlpark* [name kept in transcription because it is public record; Modise, 2019] *story where the building collapses at any time. They've got a negative impact* [on T&L].

This response indicates that some schools should be prioritised for refurbishment as a matter of urgency. The same teacher pointed out that "[the school grounds] *it's not well-maintained. It should be maintained daily, but we are understaffed in terms of the groundsmen.*" This response suggests inadequate personnel resources to maintain the school grounds. Lisbon, from a different school, stated that:

> *Our school is not in a good state. If you go to one class, you will see ceilings about to fall. And the roof is leaking. The school grounds are not safe, the grass is not cut in time, and the playgrounds are not big enough to accommodate all learners.*

Only four teachers reported no problems regarding the conditions of the school buildings and grounds. David stated: "*school buildings and school grounds are relatively safe*." Freddie, from a different school, said:

> *It is safe. But we have broken doors. Unfortunately, we go and teach in classes with no doors and no windows, but that doesn't disturb T&L. Because the area is barricaded with the palisade fencing, so we only have one access to the school premises, which is a controlled access area.*

Through observation we noticed dilapidated school infrastructure, broken windows and broken doors in one of the six schools that we visited, and these observations were captured in our field notes. At the schools we visited, we noticed that the school grounds of all six schools were secured with palisades fencing. One school had a two-story classroom block that was in a state of disrepair, but learners were still expected to attend lessons in an instructional space where the roof could collapse at any time. In addition, the same school had an open maintenance hole that posed a safety concern. Five of the six schools that we visited had infrastructure challenges. For example, one of these schools had cracks on the stairs in one of their classroom blocks, and an unstable floor in another block, which has been repeatedly reported to the GDE, but to date the GDE has taken no action. Logistical challenges related to schools' physical infrastructure safety remain a concern and are discussed next.

#### *Sub-theme 1.2: Logistical challenges related to schools' physical infrastructure safety*

Some of the principals reported that school buildings and grounds were regularly maintained to ensure safety for all at the school. Also, they reported that they employed security guards and fences to protect the school grounds. Dan stated as follows:

> *Every term, the SGB and maintenance committee conduct a whole school evaluation. During the year, we also physically check whether we can see problems. Once we collect that particular information, it goes back to our maintenance policy within the school to say that this is what needs to be followed in terms of the maintenance of the school; this goes to the finance committee and then to the SGB for approval.*

Tod, also a principal, stated that the school's only infrastructure challenges were the asbestos material. He explained that "*the majority of the classes are not safe because maybe 80% of the classes is asbestos. The school grounds are fine. We clean, we cut the grass.*" It is clear that a request was made to the DBE, and yet only one block of classes, a library and a laboratory that were previously constructed with asbestos, were refurbished with safer material. Some principals reported that maintenance was done in schools, albeit not regularly. Fay reported:

> *Until it is broken, then it will be fixed. It's the Department of Education that does everything for us because we are under Section 20* [no-fee-paying schools]. *Our money is controlled. We put a fence around our school grounds so that there is no easy access.*

This narrative suggests that the school does not have complete control of its maintenance budget and that the DBE determines the frequency and urgency of the maintenance needs of the school. Perhaps this lack of control of the budget by schools explains why there are open maintenance holes and storm drains in one of the no-fee-paying schools and an unstable block of classrooms in another. Pam, also from a no-fee-paying school, provided the following account:

> *There is a gap* [crack] *on one of the staircases, which we are not sure about how it happened. We wrote to the Department in 2019; we are still waiting for the engineers to come. We also have one structure, which is also a double story one; when you walk on it, it has a sense of movement.*

This response suggests that school buildings might collapse as the infrastructure is not stable, and some buildings have cracks requiring repairs or maintenance.

Many teachers stated that maintaining school buildings and grounds were done, but not regularly, as there were financial constraints, among other reasons. Daphne explained that although they struggled to maintain the infrastructure, they managed to get it done:

> *We are struggling financially to maintain the building; the infrastructure is very old. But we try with the grant that we are receiving from the Department to maintain where possible. We prioritise actual items, let me say quarterly, because we normally get our grant in May and then in August-September. But also, our school depends on the school fees, which is not much; whatever we are receiving, we try to maintain where things are not okay at all.*

Lisbon stated the following:

> *With the roofs and the ceiling, I can assure you; it's not done at all. The only thing that I know that is done regularly, it's that there are the learners' toilets. Remember, they'll be damaging them daily and, in that case, I can assure you that the SGB is working in that case. They always replace them.*

This explanation suggests that only minor maintenance is done in school and that learners vandalise the school property daily, leaving less available funding to do major infrastructure maintenance. Some teachers also maintained that minor maintenance of school buildings and grounds was done as and when there was a need to ensure safety for both teachers and learners. Floyd, a teacher from a no-fee-paying school, stated that: "*I've been here for 5 years, and I've seen it being done, like 100% full renovations, painting and repairing ceilings. I've seen it happening three times. Also, other things, they* [physical properties] *are repaired as they are broken.*"

This answer suggests that schools' physical infrastructure maintenance is done as and when there is a need, and that major physical infrastructure maintenance is not done regularly, which is in violation of the GDE maintenance policy which dictates that major planned maintenance should be done annually and not as and when there is a need. One teacher, Nancy, reported that she was unsure whether maintenance was done at school, "[maintenance is done] *maybe once a year. I'm not sure*." The logistical challenges experienced by schools need to be addressed and prioritised by the DBE.

There should be measures in place to address the schools' physical infrastructure challenges, and these are discussed next under the second theme, "Measures to address physical infrastructure safety challenges in schools", with three sub-themes, namely "Physical infrastructure provision", "Assurance of physical infrastructure safety of teachers and learners in the classroom" and "Possible resolutions to physical infrastructure safety challenges in schools."

### Theme 2: Measures to Address Physical Infrastructure Safety Challenges in Schools

#### *Sub-theme 2.1: Physical infrastructure provision*

The participants were not asked about the provision of physical infrastructure because all public schools in South Africa resort under the DBE, therefore the responsibility lies with the DBE to provide the much-needed infrastructure. One principal and one teacher commented on the mobile classrooms during the interviews. Liz stated: "*We've been requesting the Department to attend to our infrastructure challenges. They sent us mobile classes, prefabs, just to top up to what we have.*" This explanation suggests that the provision of physical infrastructure in schools remains a challenge and that learners are attending classes in mobile classrooms. Paul, a teacher from a different school, provided the following narration: "*We also have mobile classes, and if you check them, sometimes you see that they are not in good condition*." This narration suggests that learners attend classes in mobile classrooms, which is not conducive to T&L.

#### *Sub-theme 2.2: Assurance of physical infrastructure safety of teachers and learners in the classroom*

Only one principal demonstrated adequate knowledge regarding the principal's role in ensuring that learners were physically safe in the classrooms. Pam explained:

> *Making sure that the classroom is adequate for learning. One, there is adequate furniture. Two, making sure that the classroom is clean, is habitable, and a venue for learning where you come in and say, 'I'm here to teach', and you feel comfortable that you can do that.*

Five principals have shown that they relied on planning and physical monitoring of the physical safety aspects. However, it is unclear what was done after the physical monitoring and inspections had been concluded. Dan stated:

> *It's all about proper planning, done through myself and through the SMT* [school management team] *and the entire staff. The only way you can win is not to be a one-man show but rather to involve all the parties. If you blend together, and you execute duties, and you give clear directions as to who's supposed to do what, and you ensure monitoring, then we always win in that.*

Fay provided the following answer: "*We do the inspection because we also have the committee as well. Sometimes if I'm that busy, the committee is there, then the committee will give reports to me*." This narrative suggests that physical inspection is done, and it is important to identify the physical safety aspects that might pose a danger to learners and teachers in the classroom. However, there is no indication of what is done by the principal to ensure the physical safety of teachers and learners

in the classrooms. Surely, physical inspection and monitoring would not guarantee physical safety if nothing is done about the data collected during such inspections and monitoring.

Only two teachers demonstrated adequate knowledge in this regard. Daphne mentioned:

> *I've got rules on the walls. The 'do's' and the 'don'ts.' But I'm there 24 hours. I cannot leave the kids unattended. I ensure that they sit accordingly, the arrangement of the tables and the chairs, they're not going to harm anyone, yes. And in such a case of a leaking roof or something, we move the kids to another venue, so the repairs can occur.*

From this narration there is a clear indication of Daphne's actions to ensure the physical safety of learners. Paul, teaching at a different school, pointed out that "*just raising awareness to the learners to show them that this place is not safe. And also reporting such an occurrence to the authorities. I make the authorities aware; they should be able to attend to such incidents.*" This response suggests that the teacher's role is to raise awareness and report any safety-related matters to the relevant authorities, which may be essential to avert any safety hazards that teachers and learners might be exposed to if not addressed urgently.

#### *Sub-theme 2.3: Possible resolutions to physical infrastructure safety challenges in schools*

All six principals stated that maintenance of the school infrastructure was a challenge and that the presence of security guards, CCTVs and teacher patrols were the only measures in place to address safety challenges regarding school buildings and grounds. However, only two principals demonstrated attempts to address the challenges. Dan mentioned:

> *Our school is more than 120 years old. And each and every old structure, from time to time, would require a little bit of maintenance. But the quality of the building is quite good, and it just requires little bit of renovations here and there, should the need arise. And in terms of school ground safety, everything is safe. Our fence is very tight; we do have security that is there. In terms of learners' movement, it's also been clearly regulated very well.*

Pam demonstrated that the attempts that she made to ensure the safety of the school buildings were fruitless; however, the school managed to keep the school grounds safe. Pam mentioned the following:

> *We reported structural cracks to the Department in 2019; we are still waiting for the engineers to come. We make sure that it's maintained. Like I was saying, they* [learners] *removed the circuit breakers for room 25–30; we have already procured other circuit breakers because if there are no lights, then it will impact learning. We will replace windows and make sure that there are window handles, and you put them today, tomorrow, when you come, all the handles are gone because they weigh them* [recycle them for cash].

This explanation suggests that problems with infrastructure are reported to the DBE; however, the Department takes its time addressing such problems. Also, maintenance is impacted by the high rate of vandalism incidents in the school, which might render the school unsafe for everyone.

Teachers were asked about possible resolutions to physical infrastructure safety challenges in schools. Seven teachers reported challenges regarding the schools' physical infrastructure. They reported that the security guards, palisade fencing and duty rosters were the only measures or solutions at their disposal to address school buildings and grounds safety challenges. This narration suggests that there are inadequate measures to ensure the physical safety of learners in the school; however, little is said about resolutions to the lack of building repairs and maintenance. Ten teachers have shown that there were little or no measures in place (to their knowledge) to ensure the physical safety of learners in the classroom. David mentioned the following: "*Being present in the classroom and by teaching learners and informing them of the school's rules and protocols, they ensure the safety and security of learners so that the whole system runs smoothly*." This response suggests that the presence of a teacher in the classroom and making rules and protocols known to learners is sufficient to ensure their physical safety in the classroom. However, the roles and protocols may not avert the collapse of the physical infrastructure. Eleven teachers relied on duty rosters, security guards and palisade fencing to ensure safety and six mentioned CCTVs. From the teachers' perceptions, it is evident that schools do not have adequate measures in place to ensure learners' physical safety in the classrooms.

## Discussion

In the following section we present a comprehensive discussion of the identified themes and their corresponding sub-themes. We aimed to provide a thorough analysis of the research findings, highlighting the relationships between the themes, presenting supporting evidence from the data, and offering interpretations based on the information collected.

### Physical Infrastructure Safety Challenges in Schools

Research has shown that challenges regarding the safety of physical infrastructure such as ageing infrastructure, poor school buildings and grounds conditions, and infrastructure safety hazards remain a challenge in schools and negatively influence T&L (Perumean-Chaney & Sutton, 2013).

Regarding the sub-theme "Condition of school buildings and grounds", five participating principals reported that their schools' physical

infrastructure and grounds were not safe due to the ageing of infrastructure and the lack of maintenance; only four teachers reported no problems regarding the conditions of the school buildings and grounds. The overwhelming response that the schools' physical infrastructure and grounds were not safe can negatively influence learner achievement. According to Khumalo and Mji (2014), poor physical infrastructure in schools negatively impacts T&L. Likewise, academic achievement was linked to the condition and adequacy of schools' infrastructure mediated by the school climate (Khumalo & Mji, 2014). Maxwell (2016) discovered that improving the condition of school buildings by renovation had a significantly positive effect on learners' achievements. Filardo, Vincent and Sullivan (2019:27) stated that "student learning is undermined in poorly designed and maintained buildings."

In relation to the sub-theme "Logistical challenges related to schools' physical infrastructure safety", participating principals and teachers pointed to logistical challenges related to schools' physical infrastructure safety, which were described in terms of school infrastructure provision and maintenance, school grounds safety assurances and the health and well-being of everyone in the school. Khumalo and Mji (2014) revealed an urgent need to address poor infrastructure provisioning as it negatively affected the proper functioning of schools. In addition, Ismail et al. (2017) report a high-level risk exposure among the learners and teachers on the school grounds, which contributes to an increase in case accidents. More so, Rodriguez et al. (2013) report unintentional and intentional injuries due to school infrastructure hazards and the level of risk to which learners were exposed.

We now present the findings of Theme 2, which focuses on the measures implemented to address the challenges associated with physical infrastructure safety in schools. By examining the various measures employed by schools, we aimed to shed light on effective practices and potential areas for improvement in enhancing physical infrastructure safety.

### Measures to Address Physical Infrastructure Safety Challenges in Schools

The adequate provisioning and securing of the physical infrastructure of schools might improve safety for both teachers and learners, which could translate into improved learner performance. Thus, it's important to take into account appropriate measures aimed at addressing physical infrastructure safety challenges in schools.

All public schools in South Africa resort under the DBE who is responsible for providing the much-needed infrastructure. Although the participants were not asked to comment on the provision of physical infrastructure, some of the participants commented on the fact that the provision of adequate physical infrastructure in schools remained a challenge. For example, the participants mentioned that in instances where mobile classes were provided, many of these were in poor condition. This being said, some South African schools did not even receive the requested mobile classrooms even though these were promised by the DBE (Parenzee, 2021). Thaba-Nkadimene and Mmakola (2019) established that inadequate school infrastructure was the root cause of poor academic performance, as adequate school infrastructure is necessary for creating a conducive learning environment.

In relation to the sub-theme "Assurance of physical infrastructure safety of teachers and learners in the classroom", we found that the majority of participating principals showed that they relied on planning and physical monitoring of physical safety aspects. However, the teachers did not respond as positively in this regard. Sebastian, Allensworth and Huang (2016), who studied an integrated leadership approach where principals and teachers were connected, stated that the fact that teacher leadership emerges as an important mediator suggests that successful principals rarely address issues of climate alone, but that a key role of the principal in high schools is to guide teachers and give them the authority to address common issues around safety. While an integrated leadership approach is certainly valuable, it is important for principals to assume leadership responsibilities specifically related to safety. This notion is supported by a qualitative study conducted in the Eastern Cape province of South Africa by Mutongoza, Olawale and Mzilikazi (2021). These researchers found that despite resource limitations, principals in rural schools actively promoted school safety through various strategies, which included transparent and effective communication as well as efforts to provide safe and adequate facilities, among others.

Regarding to the sub-theme "Possible resolutions to physical infrastructure safety challenges in schools", the participants seemed to be of the opinion that the maintenance of the school infrastructure was a challenge and provided some ideas for possible resolutions to these problems. A school equipped with high-quality infrastructure facilities is likely to achieve better educational outcomes than those lacking such facilities (Barrett et al., 2019). In addition, Smith (2017) points out that poorly maintained school infrastructure has adverse safety impacts on learners' health and safety, resulting in learners' poor academic achievement. Thus, taking the possible resolutions presented here into consideration is of the utmost importance.

## Conclusion and Recommendations

By incorporating Maslow's Hierarchy of Needs as a theoretical framework, we offer a valuable perspective for understanding the significance of addressing the challenges regarding public school infrastructure in South Africa. The integration of this framework allows for a deeper understanding of the role that safety needs play in the overall well-being of principals, teachers and learners, highlighting how the lack of adequate infrastructure directly impacts these needs. By applying Maslow's Hierarchy of Needs, we provide a theoretical grounding for the findings in our study and reinforce the urgency for policymakers and stakeholders to prioritise and address the current infrastructure deficiencies in South African schools.

Based on the research findings, a summary of the conclusions is provided below.

- Infrastructure provision remains a persistent concern in South African schools, with a backlog that dates back to 1996 in Gauteng.
- Teachers and learners are not safe in many South African schools, expanding on Eberlein and Moen's (2016) findings.
- There is a shortage of and inadequate school physical infrastructure in South Africa, which is further constrained by widespread vandalism and criminal elements such as theft and arson (Barrett et al., 2019; Bhunia et al., 2012; De Jager et al., 2017; Thaba-Nkadimene & Mmakola, 2019).
- There is a lack of knowledge and understanding regarding school safety policy procedures and their application.
- A lack of school safety policy induction in schools affects the correct application thereof when addressing safety-related issues in schools.
- Educators are of the opinion that poor safety conditions are not conducive to T&L (Capule-Navarro & Alampay, 2020; Murillo & Román, 2011).

In conclusion, there is little research in South Africa on how learner achievement can be improved in an unsafe school environment; further research is required to address this research topic. Other recommendations include training sessions for principals and teachers on school safety policy procedures and their practical application, as the findings have shown a lack thereof, and also that newly appointed teachers should undergo induction on school safety policies within their first few days at a new school, as the findings have shown a lack of safety policy inductions. The DBE should address the schools' physical infrastructure backlog as a matter of urgency.

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## Authors' Contributions

MSM conducted the interviews and wrote the initial version of the manuscript. All authors engaged in collaborative efforts to review and enhance subsequent manuscript drafts. MSM was tasked with the initial compilation of emergent themes. To establish the trustworthiness of the qualitative study, MAG and JJRdV independently scrutinised the transcriptions to ascertain that the themes formulated by MSM were unbiased. Following this meticulous review process, consensus was reached among all authors with regard to the finalisation of themes and sub-themes.

## Notes

i. Search string: ( "safety" OR "safety challenges" OR "school safety" OR "school security" OR "school violence" OR "safety measures" OR "learner safety" OR "student safety" OR "teacher safety" OR "principal safety" OR "safety interventions" ) AND ( "infrastructure" OR "school infrastructure" ) AND "south africa" AND "school" AND "mathematics"



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