On Resources that Remediate Learning in Poor Academic Environments

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INTRODUCTION

Education in South Africa is in a state of crisis. Many schools lack the proper infrastructure, equipment and basic resources needed to operate. An alarming number of school-going children are functionally illiterate and innumerate.[1] In addition, there are distinct inequalities in academic performance between rural and urban schools.[2] According to Nic Spaull (University of Stellenbosch), South Africa has the most unequal schooling system in the world.[3] The legacy of Apartheid's systematised inequality leaves a substantial number of schools across South Africa unequally resourced.[4,5]

The consensus amongst South African studies is that the availability or scarcity of key school resources impacts educational outcomes, with higher levels of resources being linked to better educational outcomes.[6] Therefore, unequal access to resources is one of the key reasons for the state of education in South Africa today. According to a report by Equal Education, "Educational quality will significantly improve and educational inequality will significantly decrease if every school has water, electricity, security, transport, adequate nutrition and sanitation, sufficient textbooks, libraries, laboratories…"[7] It is therefore quite apparent that in order to undo the injustices of the past and remediate learning, it is necessary that all schools have equal access to both basic and academic resources.

Given the breadth of academic resources available, the question remains; which resources are key to remediating unequal and poor academic performance in low fee-paying schools in South Africa. By exploring how Apartheid and the "Bantu" education system led to the current education crisis in South Africa, and then analysing this current state of education in South Africa, we seek to identify the resources, the absence of which, resulted in poor academic achievement and performance. This, in an attempt to identify the type(s) of resources deemed necessary to remediate learning effectively.

In this study, educational resources can be any tool or resource used to enhance teaching and the understanding of teaching content and will be classified into three categories[8]
1) "operational resources" will be viewed as mainly external factors that influence learning and are needed to create a safe space for learning i.e. equipment, facilities and structures that make it possible for schools to perform its functions (this can include, but is not limited to, furniture, laboratories, references and classrooms);
2) "educational resources" are considered as essentials used for teaching and learning and includes, but is not limited to, textbooks, workbooks and other educational material and;
3) "human resources" which refers to any person who can be considered an asset to helping children learn, including teachers, tutors, parents and caregivers.[8]

BACKGROUND

Education under Apartheid

Apartheid was a system created out of strict racial segregation; educational differences between black South Africans and white South Africans were stark. Hendrik Verwoed, prime minister and chief architect of the Apartheid regime, believed that white children were superior to black children. He said that "Natives must be taught from an early age that equality with Europeans is not for them…What is the use of teaching the Bantu child mathematics when it cannot use it in practice?" This ideology informed the separate "Bantu" education system that was established by the Apartheid government. Its sole purpose was to provide black students with only the level of education needed to be labourers.[4] As a result, black students were taught almost no mathematics and science, which today remain critical skills needed in South Africa.[3]

Furthermore, the education spend per pupil was almost 7 times higher for white students when compared to black students. This disparity in spending presented itself in different levels of teachers salaries, teacher-student ratios, as well as, school facilities and supplies, including resources.[4] Knowing that spending on education directly correlates with pass rates for Matric exams, the differences in educational spending for black South African students when compared to their white peers goes a long way to explaining the wide racial disparities in educational achievements.[9] In 1993, among South Africans at age 30, white people had, on average, completed above 12 years of education, whereas black students had, on average, only completed 8 years of education.[4] According to a report from South African Educational Department (2000), the low levels of educational attainment during Apartheid translated into high rates of illiteracy (66% of youth and adults aged 16-34 were functionally illiterate in 1990).[10] Furthermore, while still under Apartheid, out of everyone in Soweto, only 4.8% of candidates gained a matric pass. These statistics unequivocally indicate that unequal access to quality education and lack of resources negatively impact academic performance.[8] Not surprisingly, teachers in Kwa-Mashu schools believed the system of "Bantu" education, which led to years of unfair and unequal access to resources between white and black schools, is at the core of the problems that schools are facing today.[11]

Furthermore, class boycotts that were successfully used to fight against the struggle of South African majorities being oppressed by the minority, added to the negative educational consequences for learners.[8] Previously disadvantaged schools already had limited school buildings, facilities and equipment. The situation for these schools worsened when political instability that led to class boycotts resulted in school disruptions, such as absenteeism and damaged or stolen school facilities, burning of books and stationery, and closing down of schools that were destroyed or damaged. The legacy of these disruptions continue to greatly impact the culture of learning and teaching to this day.[8] This, together with the "Bantu" education system deprived

many schools from equal access to resources and exacerbated the poor academic performance for many black South African learners. Although the system of Apartheid has ended nearly 30 years ago, schools today are still plagued by unequal access to resources which in turn has continued to play a significant role in hindering academic achievement.[4,5]

The end of an era and its impact on academic performance

After Nelson Mandela was inaugurated as South Africa's first democratically elected president, a new constitution was written and adopted in 1996. It provided for a new system of public education with its Bill of Rights guaranteeing all South Africans the right "to basic education, including adult basic education; and to further education, which the state, through reasonable measures, must make progressively available and accessible" (Constitution of the Republic of South Africa, 1996. Chap. 2, sec. 29).[4] By 1996, the drop in learners' achievements in the classroom resulted in high failure rates. Furthermore, at the time of South Africa's first democratic elections, data collected by The World Bank on education drew a bleak picture for the future of education in SA. In light of the many destroyed or closed down schools during the political unrest, an additional 1900 classrooms would be needed to relieve overcrowding. Additionally, there were 850 000 children of school-going age who remained out of the school system and in order to accommodate them 230 000 classrooms or 766 schools would need to be built.[8]

Impact of access to resources on academic performance and achievement

In a league table of education systems drawn up in 2015 by the OECD, South Africa ranks 75th out of 76 countries and remains a country with the most unequal education systems in the world.[3] In November 2015, Trends in International Mathematics and Science Study (TIMSS), a quadrennial test sat by 580,000 pupils in 57 countries, had South Africa at or near the bottom of its various rankings, despite slight improvements since 2011. A shocking 27% of pupils who have attended school for six years cannot read, compared with 4% in Tanzania and 19% in Zimbabwe. After five years of school about half cannot work out that 24 divided by three is eight. Only 37% of children starting school go on to pass the matriculation exam; just 4% earn a degree. [3] Of those that stay in school, an estimated 478 163 learners who enrolled for Grade 10 in 2013 didn't make it to matric in 2015, showing a 41.7% drop out rate.[2] These results are shocking, placing South African children behind children from poorer parts of the continent.

In 2015, the national pass rate fell from 75.8% in 2014 to 70.7%. However, both the Western Cape and Gauteng provinces continued to record pass rates well above the national average, whereas the pass rate in the Eastern Cape was only 56.8%. This gap in test scores was evident in the OECD report, with the top 20% of schools in the country versus the rest of the schools is wider than in almost any other country.[3] This inequality in academic performance could stem from the poor state of resourcing and infrastructure in

these rural schools. In the more urban (richer schools) provinces like Western Cape and Gauteng, less than 1% of their schools lack electricity, water or sanitation and they have the highest teacher to learner ratio in both primary and secondary schools.[2] Furthermore, of 200 black students who start school only one can expect to do well enough to study engineering, compared to ten white students who could expect the same result. [3]

Historically, previously disadvantaged schools, had unequal and inadequate access to the resources needed to run a school properly.[8] According to Mwamwenda (1996), pupils in developing countries perform below those in developed countries because of inadequate and poor facilities.[12] These schools cannot function effectively without equal access to resources such as laboratories, libraries, books, computers and toilets.[8] In order to enhance learning and teaching culture it is important for all schools to have equal access to resources.[8]

UNEQUAL ACCESS TO OPERATIONAL RESOURCES

On 29 November 2013, Motshekga (Minister of Basic Education) complied with a court order and promulgated legally binding Norms and Standards for School Infrastructure, which describes what makes a school a school.[13] These norms and standards had binding timelines by which every school in South Africa had to be provided with water, electricity, toilets, libraries, adequate classrooms, computer facilities and even sports fields.[13] In 2000,

a document compiled by the Education Foundation on the inadequacy of resources found that almost half of all schools in South Africa did not have access to electricity and telephones in rural areas, many water sources were unhygienic and posed a health hazard, and there was an absence of textbooks.[14] Within three years from the publications date of these Norms and Standards, all schools that did not have access to any form of water supply, power supply or sanitation had to be provided with these basic operational resources.[15] In November 2016, Equal Education (EE) visited schools across seven districts in the Eastern Cape, a province with the lowest matric pass rate in the country, to investigate the government's compliance with the regulations relating to Minimum Uniform Norms and Standards for School Infrastructure and its legally binding commitment to fix all schools.[2] The report compiled by EE highlighted the inadequacy in provision of a number of basic operational resources.[15]

Lack of provision of adequate water and sanitation
Many schools lacked access to water sources, requiring them to draw water from nearby rivers. Although one school did have a rainwater tank, when it ran dry, learners would be given the task of collecting water from a nearby river. This is not only physically demanding on school children, but it also reduces the available time that learners have to focus on their studies.[15] In July 2017, EE visited 18 schools in Ga-Mashashane, in the Capricorn District of Limpopo Province, in response to persistent calls for action by EE high school members, known as

Equalisers. These Equalisers insisted that the confident claims made by the Limpopo Department of Education (LDoE) and the National Department of Basic Education (DBE) about progress in the provision of water and sanitation in Limpopo schools did not match the reality within their schools.[13] Lack of access to water and inadequate sanitation posed a significant barrier to the quality of teaching and learning. With no water and few or no functioning toilets at school, learners were left dehydrated and unable to concentrate in class. Furthermore, the lack of access to these two basic necessities makes it hard to maintain a hygienic environment.[13]

Lack of provision of adequate electricity

Some of the schools visited in the Eastern Cape had no access to electricity. Without access to a power supply, these schools cannot perform their core duty of facilitating teaching and learning. In classrooms that are made of mud, natural lighting is very poor and without an alternate power supply, learners struggle to read the teachers chalkboard notes. Furthermore, when its cold, these classrooms aren't able to warm up, which leads to many teachers and learners becoming sick.[15] A lack of electricity also denies schools supplementary facilities that contribute to learning, such as televisions, computers, printers, photocopy machines, projectors and internet connections. School administration is hindered due to the absence of functioning fax machines, intercoms and telephones. For schools that did have access to some form of electricity, it was often insufficient or set up dangerously. To add to the problem, these schools also had poor infrastructure, where ceilings were collapsing and electrical wires were exposed in the walls, which is particularly dangerous when roofs leak and can result in short circuits.[15]

Lack of adequate transport

Many schools in disadvantaged areas were closed down or destroyed because of the damage caused by class boycotts in the 1980s. In addition, schools in disadvantaged communities offer poor quality education. As a result, many high school learners seek a better education in areas further away from their homes, forcing them to travel to get to these schools, often times having to use buses to access more advantaged schools in urban areas.[8] Every year KwaZulu-Natal and the Eastern Cape struggle to provide students who have to walk far distances to get to a school with adequate transport due to a lack of funding. Instead, the daily travels of these students eat into the time that they could be using to study and do homework, and enjoy activities that their more privileged counterparts enjoy.[2]

Lack of adequate nutrition

In South Africa, one in four children under five are stunted in growth, which is a manifestation of chronic undernutrition where inadequate dietary intake and recurrent infections undermine children's growth and nutritional states.[16] Given that South Africa is a middle-income country, this figure is particularly high and remains unchanged over the past 20 years.[16] Stunting has a detrimental impact on children's lifelong health and cognitive development, which impacts their education and employment prospects, as well as increasing the risk of health

problems.[16] In 2017, an American study conducted with teachers, reported that 92% of teachers were concerned about how hunger affects the student's ability to learn, with 80% observing students lose their ability to concentrate when hungry. In addition, teachers noted poor academic performance (76%), behavioural and discipline problems (62%) and sicker and less healthy children (47%).[17] The immediate drivers of undernutrition are rooted in high levels of child poverty, food insecurity, and poor access to health, sanitation and water services.[16] Stunting prevents children's brains from developing as they should and results in damage that is largely irreversible. It leads to low academic achievement and work productivity further perpetuating ongoing poverty. Providing school meals can have a powerful impact on students who are hungry.[18] In an American study, a total of 77% of kids provided with school meals reported that the meals helped them feel better, reducing headaches and tummy cramps. A staggering 74% reported that it helps them concentrate and behave in class, with up to 71% reporting that it helps them with their grades.[17] These results clearly show that hunger hinders students from functioning at school and this negatively impacts their academic performance.

A pathway to equal access to operational resources

Inadequate or lack of access to basic operational resources such as water and sanitation, electricity, transport and nutrition are major factors that contribute to poor academic achievement, yet access to these resources can lead to better educational outcomes.[6] Until access to these basic operational resources improve in rural areas and in previously disadvantaged schools, students will continue to underperform. This, despite the publication of The Norms and Standards for School Infrastructure published in 2013. Civil society relies heavily on organizations like EE that advocate for accountability, particularly with respect to conducting surveys and compiling reports and setting timelines for delivery.

"By 29 November 2016: All schools entirely made of inappropriate materials such as mud, asbestos, metal or wood had to have been replaced by new schools.Schools with no access to water, electricity or sanitation had to have been provided with these basics. By 29 November 2020: All schools must be provided with an adequate supply of classrooms, electricity, water, and sanitation. Electronic connectivity and perimeter security must be provided to all schools. By 29 November 2023: Libraries and laboratories must be features of all schools. November 2030:All other Norms must be completely provided for. This includes school halls, sports fields, walkways, parking lots and disability access." - Equal Education [13]

If all goes as planned, unequal access to these basic resources should be a thing of the past by the end of 2030. In the meantime, community-based organizations can use these Norms and Standards as guidelines for basic operational resources when setting up after-school programs that provide a safe space for learning.

LACK OF ACCESS TO ADEQUATE EDUCATIONAL RESOURCES

Despite the knowledge that availability of adequate learning resources is paramount for achievement of good-quality education, many schools are still under-resourced; this could explain why of Grade 6 students enrolled in schools, only 71% are functionally literate and 59% are functionally numerate.[19,20]

Impact of lack of access to educational resources on literacy

Many countries voluntarily participate in Progress in International Reading and Literacy (PIRL) tests that assess reading and comprehension and monitor trends in literacy at five-year intervals. Learners write a test in the language of learning and teaching in grades 1 to 3 in their school.[21] In 2016, the PIRL test scores revealed that 78% of grade 4 pupils in South Africa fell below the lowest level on the PIRL scale, which essentially means that they cannot understand what they are reading. Furthermore, South Africa was ranked last out of the 50 countries surveyed.[21] Another worry is that there has been no signs of improvement over the last 5 years. In fact, of the boys that were tested, the situation has seemed to worsen. According to the Southern and Eastern Africa Consortium for Monitoring Educational Quality surveys, South Africa performs so poorly that they lag behind poorer African countries, like Tanzania and Zimbabwe in reading and numeracy.[21]

Cognitive neuroscience has helped prove that becoming literate alters the brain. Learning how language is visually represented and the rules for matching sounds and letters developed new language possibilities. It reinforces and modifies certain fundamental abilities, such as verbal and visual memory and other crucial skills. It influences the pathways used by the brain for problem-solving. Thus, failing to learn to read is not only limited to the immediate impact of not being able to comprehend text, it also has a more long-term effect on development of cognition necessary to function effectively in modern society.[18]

Teachers are not effectively trained to remediate literacy

South African primary schools have adopted the "oratorical approach" to reading, where reading is tested on one's ability to read aloud, fluency, accuracy and correct pronunciation. Little emphasis is placed on reading comprehension and actually making sense of the written word. After reading something, children have no idea what they just read. While all the oratorical factors are an important part of reading, they have no value without comprehension.[21] Nevertheless, the oratorical approach to reading has been passed down from one generation to the next, since teachers teach as they were taught. Testing of reading using this approach included memorising sounds and decoding words, but did not include a written assessment of reading comprehension. Over and above the poor literacy performance observed due to how reading is taught in school, learners are further robbed of the joy and pleasure of discovery and meaning-making when reading.[21]

Furthermore, teacher training colleges were closed during 1994 - 2000 and

universities were required to train foundation phase teachers, whilst being ill-equipped to do so, as they previously only trained high school teachers. Whilst teachers remain the key human resource required to remediate learning, pre-service teacher training at universities should include reading as a process that involves decoding and understanding text in its context, not just as a "mechanical skill". Simultaneously, in-service training needs to be tackled, with teachers required to reflect on how they were taught to read, and understand the shortcomings of an oratorical approach.[21] Given that South Africa is a multilingual country, teachers should encourage learners to use all their language resources when decoding the meaning of something. [21] Teachers could be encouraged to continue to develop their own reading through joining book clubs and reading groups.[21] If teachers can access the proper training and resources to overcome the way they have been taught to teach literacy, they can become a key human resource and provide the proper support to learners to remediate poor literacy performance in South African schools.

Lack of adequate reading material and school libraries

On interviews conducted with principals, PIRLS reports that 62% of South African primary schools do not have school libraries, despite the knowledge that access to libraries is essential in providing a learning culture.[21] This is even more crucial in schools in disadvantaged communities where the homes would be under-resourced and less likely to have reading materials available. [22] Lack of access to adequate reading materials and textbooks directly impacts literacy performance. This can be illustrated by how poorly Limpopo performed in literacy tests when compared to the rest of South Africa. Limpopo has been at the centre of an ongoing textbook crisis (which will be discussed in more detail in the following section). No textbooks were delivered to this province at the start of two different school years. In a literacy test sat by Grade 6 learners, it was found that 27% of South African Grade 6 learners were functionally illiterate, whereas a staggering 49% of Grade 6 learners in Limpopo had the same result, further demonstrating the correlation between access to textbooks and academic performance.[23]

While we wait to see all schools equipped with libraries, it is worth exploring other alternatives to remediating literacy that are available to educators. This includes implementing strategies such as "Drop Everything and Read" slots in the timetable, learners book clubs, prizes for reading a target number of books and for writing about them.[21] A number of NPOs are also addressing this need by focusing their activities on early language and literacy development. One such organization is Wordworks, who focus on tried and tested foundation phase literacy and language resources and training. They have 4 key programs focused on different development areas: Every Word Counts helps introduce those who care and look after young children to new knowledge about early learning and practical ideas for supporting language development, early literacy and maths. The Stellar module focuses on resource-based training to strengthen the teaching of language and emergent literacy in Grade R. In their

Home-School Partnerships, Wordworks facilitates a learning space for parents in which to share knowledge and ideas about children's language and early literacy development. The Ready Steady Read Write program is designed to build solid language and literacy foundations and as an early intervention for Grade One students. Every program gives those people in under-resourced communities, who are best positioned to impact on young children's literacy, the training and access to resources that they need to support foundation phase language and literacy development. Each program is tailored to meet the specific needs of children in their age group and with the adult that is positioned to help them, and advocates for access to multilingual, language rich stories and books.[24] Wordworks has also developed a mobile App that gives ideas on how to play, talk, sing and share books with babies and young children. It contains Nal'ibali stories, songs, short video clips, rhymes, and important health messages for the first 1000 days that can be used independently or in groups of parents, teachers and caregivers.[25]

Access to books and a love for reading not cultivated in the home
Sadly, South Africa is not a reading society, with the president, Cyril Ramaphosa, reporting that only 14% of South Africans are active book readers and only 5% of parents read to their children.[23] This is partly due to the fact that many parents themselves are illiterate and that there are very few affordable books in languages other than English, which is not a first language for many South Africans.[18] In addition, middle class families and the

new elite treat reading as a lower order activity, not prioritising spending on this activity. By comparison, South Africans spend twice as much on chocolate each year than they do on books.[18]

Globally, in both developed and developing countries, a consistent proxy used to measure, "parents' commitment to education" is the number of books that they have in the home.[26] The home environment is vital to promoting a reading culture. A PIRLS study showed that children who had parents who read and especially those that read to them do better at reading.[21] Having books in a home helps to create a reading environment, even if the parents are not literate. The Family Literacy Project in KwaZulu-Natal have done amazing work in creating literate family and community environments in very rural areas. If a family can develop into reading assets it could really help to strengthen schools and build a reading nation.[21]

Poor performance in literacy can be remediated if the two key human resources, teachers and parents, are empowered to provide support to children learning to read. Programs aimed at creating a home culture of reading can be made more accessible for parents and caregivers. Furthermore, access to proper reading content, both in school and at home, is imperative. These educational resources are greatly needed to improve literacy across South Africa and to ensure that children read with comprehension, unlocking the key to their future academic success.[22]

Impact of lack of access to educational resources on numeracy

Living in a highly technological world, mathematics education and performance are key resources in global competition.[6] Of the top 100 scarce skills listed, every single option requires one to have done mathematics. Not offering this scarce skill denies students an opportunity to pursue many careers and in turn denies the country the opportunity to develop skills that it needs.[1] Sam Ramaila, a Mathematics lecturer at the University of Johannesburg (UJ) says that many industries in South Africa grapple with dilemmas arising from acute skills shortages because of the country's low standard of mathematics and science education.[5] One in four high schools in South Africa do not offer maths as a subject for grades 10 to 12 due to of lack educational resources, resulting in a lack of critical skills, which ultimately leads to sluggish economic growth.[1,5] A controversial Executive Opinion Survey carried out by the World Economic Forum ranked South Africa's science and mathematics education last out of 148 economies that were surveyed, which is not surprising as only 59% of our grade six aged children functionally numerate.[5,20]

Unequal and inadequate resources needed to teach mathematics effectively has dire consequences not just for academic achievement and career opportunities of students, but also for the economic performance of the country as a whole. Therefore, it is important to identify which resources, whether inadequate or lacking, have led to poor mathematics education and performance in South Africa. Knowing this can help us determine which resources can be used to remediate mathematics achievement.

Shortage of trained mathematics teachers and content knowledge deficits

*Stella Xulu, a former grade nine teacher at a village school in Mthatha, recalls that teaching maths to grade nines was a challenge because there was no Grade 7 nor Grade 8 maths teachers, hence students lacked the foundations required for Grade 9. As a result, students had gaps in their knowledge and could not operate at the appropriate grade level as expected by the education department.[20] This is commonplace in the Eastern Cape, with the majority of grade three learners not achieving above 40% in the annual national assessment (ANAs) for numeracy, placing them at least two grade levels below the grade that are currently in.[20] This is of great concern because mathematics is a progressive subject that builds on concept development to abstract thinking.[20]

Because of the shortage of trained mathematics teachers, many teachers who do teach the subject skim over what they themselves do not understand and students are left with vast tracks of content knowledge deficits.[20] In Gauteng, teachers who are better qualified are placed in higher grades, exposing grade 9 and 10 students to the knowledge deficits, which results in the leakage which is observed in the transition from Grade 9 to grade 10. In 2016, in the absence of adequate teacher development, government started to partner with TeachSA, an NGO that helps place young graduates in schools to teach certain subjects.[1]

Teacher development remains the key resource to remediate numeracy in students. Long-term professional development teaching programs, constructive peer coaching and innovative mentorship programs can all benefit experienced teachers. Further, universities should be tasked with taking the lead in finding ways to improve the overall quality of mathematics and science education. Universities should also seek to nurture schools in their geographic regions to address inadequate learner performance in mathematics and science because upon enrolment they can identify the skills these students lack. An example of such nurturing can be found at The University of Johannesburg. The science faculty of the UJ coordinates a learner enrichment program and a teacher development project with SAIP and UK Institute of Physics at their Soweto Science Centre.[5] Including teacher training in these kinds of interventions is important because learners need empowered teachers to become productive students.

Lack of resources to support numeracy teaching

Though textbooks can be considered as operational, in that it is a piece of equipment needed for a school to operate properly, it is mostly considered educational as it is essential for teaching and learning. In 2012, the Department of Basic Education (DBE) failed to deliver textbooks to learners in Limpopo province resulting in thousands of learners going without textbooks that year, and again in 2014.[23] This shortage of learner and teacher support material (LTSM) is a great cause for concern, according to the Public Service Commission (PSC), shortages of textbooks deprives learners from their constitutional right to a quality education.[27]

In January and February 2016, a snap inspection was conducted to assess the efficiency of delivery of LTSMs across a selection of schools across the country. The inspection determined whether textbooks in particular were delivered by the start of the academic school year in 2016 and whether these were sufficient. The majority of schools sampled did receive their textbooks in time. The Western Cape, North West, KwaZulu-Natal, Mpumalanga and Free State had the highest delivery for all schools (100%), followed by Limpopo (92%) , whereas the Northern Cape and Gauteng experienced a low delivery rate with 50% and 60%, respectively, despite orders being placed timeously. None of the schools in the Eastern Cape received their textbook orders on time. The PSC recommended the DBE should centralise the ordering of the LTSMs, especially textbooks, in order to enhance universal coverage in schools, as well as adopt a "single core textbook" across all grades so as to enhance complete coverage for all learners.[27] This could expedite the textbook delivery for those schools who had to start the school year without textbooks. The systematic challenges in provisioning of LTSM remain cause for concern seeing as majority of schools still experience a shortage of textbooks.[27]

Some of South Africa's foremost researchers on education agree that they have found a positive correlation between access to textbooks and learners' results.[23] Although, education researchers are

reluctant to pinpoint a single cause for poor academic performance, they have agreed that having access to a textbook is an important contributor to improved performance.[23] With a positive correlation between access to textbooks and learners' results, this remains an important contributor to improved performance. In a transnational study involving 15 countries in Africa, including South Africa, Lesotho, Kenya, Swaziland, Namibia and Uganda, Grade 6 students were assigned mathematics and reading tests. Analysis of the data showed that 40% of South Africa's Grade 6 students were functionally innumerate.[23] In addition, students who had their own reading textbooks or who shared with not more than one other student, performed "significantly better" than those who had to share a textbook with more than one other classmate.[23] Though teachers are capable of substituting in the absence of textbooks, many lack the content knowledge in subjects that they need to teach, with only 32% of teachers shown to have the required levels of content knowledge.[23]

In the absence of adequate resources to support the teaching of mathematics in many township and rural schools, many have developed resources to help reach these neglected students. To teach content in an effective way to senior grade students, a group at the Nelson Mandela Metropolitan University (NNMU) have developed digitised programmes and videos for both teacher and pupils, which can be stored locally on computers, so that no internet is required.[20] So far, 200 teachers have received packages with laptops funded by Setas (skills education training authority), and the Eastern Cape

DoE has really bought into this training model. In collaboration with a Swiss university, a group at Rhodes University developed a catch-up program for Grade 10 students. VITALmaths includes a mobile database and dozens of 3-minute silent video clips showing how using natural resources such as stones, matches, and drawings can be used to stimulate mathematical learning.[20] Other digitised mathematics resources available to students include ClickMaths, Khan Academy and Vodacom Mobile Education programme.

Other classical resources include workbooks such as the Answer Series and Pearson workbooks. These guides include material that follows the CAPS high school curriculum, and helps to enrich understanding as well as provide students with essential exam technique practice.[28] Students are able to work independently, or the workbooks can be used as a guide in a larger group setting. Each guide is developed by subject specialists and provides invaluable support for all students wanting to make a success of their matric exams. The Answer Series can be purchased in hard copy and include certain free online downloads.[28] In partnership, the Answer Series seeks to get these workbooks into the hands of the students who need it most, often providing their resource at discounted cost, or even free to disadvantaged students.

"You really have made the (Answer Series) books user friendly for pupils and most comprehensive, not only for pupils to use for revision, but even for teachers to pick up good methods and a better understanding of the new sections of the

syllabus. Congratulations!!! In my view these are your best books ever. It is the only study-aid you can trust to help you with your matric exam." School teacher. [28]

Culture of learning not cultivated at home

Many children that attend previously disadvantaged schools come from low-socio economic backgrounds. These environments are usually not conducive for learning. In Elsies River, matriculants live in council houses, with a single parent and rent out half the house. In Mfuleni townships, lots of children live in shacks. These conditions make studying difficult and often parents are unable to help with homework or train children in fundamental mathematical skills. Thus, they often lack simple understanding, like geometric concepts of the difference between parallel and vertical lines. These spatial orientation skills have not been sufficiently developed. This kind of learning is fundamental and should have been developed informally around the family table and at play.[20] Based on the above analysis it is clear that an alternate after-school safe space, that cultivates a culture of learning, is needed.

As discussed, mathematics teachers are in short-supply and thus many teaching mathematics aren't properly trained and have "content knowledge deficits". This has led to students having huge knowledge gaps. In addition many previously disadvantaged schools don't have equal access to mathematics material. All these factors have ultimately contributed to poor performance in mathematics. In the absence of adequate teacher training, after-school programs with access to study guides such as the

Answer Series or other digitized programs can help to remediate poor numeracy results.

CONCLUSION

The oppressive system of "Bantu"education together with the disruption and destruction from class boycotts, resulted in unequal access to resources in South African schools and in turn this led to unequal and poor academic performance amongst black South Africans. This legacy set-up during Apartheid has continued to produce poor academic results to this day as unequal access to resources continues to be responsible for the negative impact on academic performance amongst our students.[8,11]

The key questions that needed to be answered is: Which resources are key to remediating unequal and poor academic performance in low-fee paying schools in South Africa? Knowing this allowed us to explore possible solutions.

The current state of education in South Africa looks dismal.[1] With studies showing that only 37% of children who start school go on to pass the matriculation exam, it is evident that lack of access to resources has a dire impact on academic results.[2,8] The lack of equal access to resources for all schools deprives children of an environment conducive for learning and the tools needed to ensure that they can access a quality education.

Firstly, many previously disadvantaged schools either lack the necessary "operational resources" needed for a

school to function as a school or the resources that are provided are inadequate. In particular, under-resourced schools had: inadequate access to or lack of water and sanitation, little to no electricity, inadequate transport and lack of proper nutrition, all these factors creates a school environment that is not conducive to learning. [13,15,2,16]

Secondly, lack of access to adequate resources has been the main reason behind South Africa's poor literacy and numeracy performance.[19,20] As discussed above, many South African primary school children perform poorly in literacy tests because by the time they reach Grade 6, they are unable to comprehend what that are reading.[23] The main reasons behind poor literacy performance can be whittled down to 1) that teachers aren't effectively trained to remediate reading, 2) a lack of adequate reading material and school libraries and 3) an absence of reading culture in the home. Furthermore, studies showed that a staggering 40% of our Grade 6 learners were found to be functionally innumerate. Poor numeracy performance can be accredited to 1) a shortage of trained mathematics teach and "content knowledge deficits", 2) lack of resources to support numeracy teaching and 3) an absence of learning culture being cultivated in the home. In short, there are three key resources that we need to address if academic performance in this country is to improve: 1) teachers that have received proper training in their fields of expertise, 2) adequate educational resources to support learning material and 3) a culture of learning that is cultivated both at home and in school.

Therefore, the only way to ensure that learning can be remediated is to work towards equal access to resources for all schools. Fortunately, the EE has made headway to ensure that the proper implementation of operational resources should all be met by 2030.[13] However, waiting 12 years for schools to become a conducive learning space, could mean that many kids today could complete their schooling years in an environment that does not encourage learning.

Nonetheless, we can start to remediate academic performance in South Africa today if we focus on the following:

1) Providing proper training to teachers and those that are in a position to impact on academic performance. Teacher's have been improperly trained to help students read with comprehension and suffer "content knowledge deficits" due to the shortage of properly trained maths teachers. As explored in this essay, the government and universities can provide the adequate training that teachers need to remediate not only their learning(i.e. addressing their "content knowledge deficits"), but how they teach both literacy and numeracy.[21] There are also NPO's, such as Wordworks, are currently addressing early language and literacy development, in a way that encourages a culture of learning in the home. They have programs that give people in under-resourced communities, who are best positioned to impact on young children's literacy, the training and access to resources that they need to support foundation phase literacy and language development.[25]

2) Access to adequate academic resources and learning material is needed to ensure that learners are provided with the proper content needed to excel in their subjects.[23] The importance of having a textbook in-hand should not be overlooked. According to Judge Neil Tuchten of the North Gauteng High Court, in his judgement regarding a court case against the government for failure to deliver textbooks to Limpopo in 2012, "Textbooks have been part of the stock in trade of the educator for centuries. There is something special about a book. It has a very long life, far longer than that of the individual reader. It is a low technology device. It is accessible to anyone who can read the language in which it has been written. During the hours of daylight it can be read (accessed) without any other supporting technology at all. It needs no maintenance except the occasional strip of adhesive tape."[23] Textbooks serve as a guide to teaching and learning of the curriculum. It can play a fundamental role in supplementing teacher knowledge deficits.[23] Furthermore, access to textbooks can remedy the "cultural deficit" (relates to family literacy and practices in homes and communities that can help children prepare for school, as well as exposure and access to books and other printed materials) stemming from lack of access to books in their own homes. Although there is no silver bullet solution to the education crisis in South Africa, textbooks can play a crucial role in some of the broader structural deficits to teaching and learning.[23] Textbooks also allow students can 'catch-up' on concepts from home, thus increasing access to books in the home. Other resources that can be used to supplement prescribed textbooks (or as a replacement in the cases where there are shortages) are the tried and tested Answer Series and Pearsons workbooks (that follow the CAPs high school curriculum).[28] There are also digitised programmes and videos that have been created and are available to both teachers and pupils. These programs such as, VITALmaths, ClickMaths, Khan Academy and Vodacom Mobile Education Programme. [20] This shows that gaining access to adequate academic resources is paramount to academic success.

3) Creating a culture of learning in the home. In the absence of a home culture of learning (i.e. where parents are unable to help with homework), after-school programs could step-in and fill the gap. According to the country's six maths literacy and numeracy chairs, who each work with 10 schools to find solutions to maths education problems, after-school programs and homework clubs are important tools in filling in the gaps in pupils' knowledge.[20] After-school programs are safe spaces for learning where academic support is readily available. Many after-school program can provide children with access to knowledgeable tutors and effective resources needed to remediate learning.

Lastly, as illustrated above, if equal access to resources for all schools is achieved, academic performance in South Africa can definitely be remediated.

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