Establishing mathematics teaching and training institutes in South Africa

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A business venture proposal presented in partial fulfilment for the degree of Master of Business Administration to the Faculty of Commerce, Law, and Management, University of the Witwatersrand

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DECLARATION

I, Mahlogonolo Mashile, declare that this business venture proposal entitled 'Establishing mathematics teaching and training institutes in South Africa' is my own unaided work. I have acknowledged, attributed, and referenced all ideas sourced elsewhere. I am hereby submitting it in partial fulfilment of the requirements of the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. I have not submitted this report before for any other degree or examination to any other institution.

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ABSTRACT

This business venture proposal presents an idea that seeks to scale up an existing entrepreneurial idea that provides mathematics tutoring services and proposes the establishment of mathematics teaching and training institutes in South Africa. The business falls under the private tutor industry, which has a growing market size and an opportunity for the business to gain a significant share. The services offered will be mathematics teaching to high school students and training to both existing and new mathematics teachers (those who are entering the field of education). The project initially reviews literature to gain deep knowledge and understanding of the challenges experienced in the mathematics education of South Africa, and to acquire enabling data for managing a business of this nature. This enables us to design a business that will yield considerable profits and be sustained.

South Africa produces poor mathematics results annually, which is very concerning for multiple stakeholders that depend on good performance in the subject. The government has used several strategies aimed at improving mathematics results in South Africa, but there has not been any improvement realised. This is very concerning for a country whose future depends on the success in technical subjects like mathematics. Studies conducted on mathematics performance indicated that South African students and teachers perform very poorly when compared to their peers in other countries (McCarthy & Oliphant, 2013).

This project used the qualitative research method to gather data from the field to assist in understanding the market, its appetite and opportunities available. Data was collected from three provinces in South Africa: Limpopo, Mpumalanga and Gauteng. The results showed a low pass rate in mathematics, particularly in lower quintile schools, which constitute the highest number of schools and students in the country. Lower quintile areas are an untapped market because most mathematics tutoring services are based in big cities where the affordability is higher. The business will have partnerships with organisations that have corporate social responsibility to serve this market, while also serving the high-income market that pays tuition fees.

The results from the survey conducted indicated an acknowledged gap in mathematics teaching. Most respondents noted that their students perform poorly in the subject, which

they attributed to lack of student commitment and lack of workshops addressing challenging topics, among others. Over 92% of the respondents recommended consistent training for mathematics teachers.

Several marketing strategies will be employed to introduce the mathematics services to our target market, grow the market share and increase the brand awareness. These include advertising on social media platforms, billboards and promotions. The business plans to establish institutions in Gauteng and Mpumalanga in the initial stages, and work towards increasing enrolments year on year. The business is expected to make a net profit of R2.6 million in year one, R5.8 million in year two and R7.5 million in year three. The business will be expanding into other provinces after the initial three years and work towards establishing mathematics, science and technology institutions in the future.

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DEDICATION

I dedicate this research to my awesomely great husband Benedict, who was there for me throughout the journey, who sacrificed much so that I can pursue my MBA on a full-time basis, and ultimately inspired me to tackle this topic. I also dedicate this research to my son Blessing, who has been the manifestation of his name in my life and giving me the reason to complete this task. Furthermore, I dedicate this work to all the students who are struggling in mathematics, despite the hard work and effort they put in, and never giving up.

1 INTRODUCTION

1.1 Context of and background to the business venture proposal

Education is the process of facilitating learning, where knowledge, skills, beliefs, and habits are acquired. South Africa uses education as a transformative tool that will change the country for the better, following an oppressive system that marginalized most black people from the economic system. The country's constitution identifies education as a basic right and it emphasises the importance of making education available and accessible to everyone (Nuffic, 2015). The obligation to provide education has a mandate of addressing issues of inequality, poverty and unemployment in South Africa. The South African government is presently investing more money in education to assist the country's education recover from the unfavourable 1953 Bantu education law. The overall 2019/2020 budget allocation for the basic education department is R24.5 billion, an increase from previous years (Motshekga, 2019); however, the progress made in the education system is still uniformly viewed as insufficient (Macha & Kadakia, 2017).

The education system has adopted several curriculums since 1994. Following the political changes of South Africa in 1994, the traditional skills-based education was replaced with the Outcome Based Education (OBE), a great change in the country which included making mathematics a compulsory subject (Engelbrecht & Harding, 2008), (Simkins, 2010) and (Rasool & Botha, 2011). Making mathematics compulsory was a strategic approach whose aim was to ensure that young people are skilled to solve multidimensional problems and reason effectively (Dependra, 1994). Mathematics further trains students to be analytical, descriptive and solution orientated (Dependra, 1994). The greatest legacy of the OBE system was its inclusive strategy and forward-looking approach of building core analytical capabilities in all students through mathematics; however, with this approach came challenges that resulted in curriculum changes. The OBE system was followed by several revised initiatives that aimed at improving students' learning experience, growth and performance.

The basic education comprises of grades R to 12 which are either privately or publicly owned (Nuffic, 2015). Private schools are independent institutions supported wholly by fee payments, and public schools are state owned and supported by public funds (Diffen, 2014). These are the platforms through which education strategies are implemented, and

are the key areas for measuring growth, development and success/failure of the multiple intervention plans.

1.2 Towards establishing mathematics institutes in South Africa

1.2.1 Problem statement

Less than 23 % of grade 12 students obtained 50 % and above in the national mathematics examination between the years 2016 and 2018, which indicates significant underperformance (Staff, 2019). These poor mathematics results are a concern because they reflect the country's state of analytical skills, which are important skills required to advance and develop the country, and ultimately the ability to solve major social and economic challenges.

According to Jojo (2019), there are major gaps in the teaching of mathematics. These are reflected in teachers' inability to analyse and correctly answer questions based on the curriculum they are teaching. The low-quality mathematics teaching and the absence of enough competent teachers are a major challenge, and a solution to this will serve the purpose of imparting learners with poverty-alleviating skills (Tsafe, 2013).

1.2.2 Purpose statement

The purpose of this project is to create a compelling proposal for a business that will be sustainable, generate profit, and add considerable value to the education department, business and the society. The project will critically analyse and evaluate the mathematics education in the country in order to justify the need to establish mathematics teaching and training institutes in the country. The analysis and evaluation are aimed at determining the best practices to be put in place in addition to the existing practices that are designed to influence mathematics performance.

Proposition

There is an opportunity in the South African education sector to offer services that supplement the existing performance improvement initiatives. The mathematics results published annually indicate a need for fundamental reforms, hence the proposition of mathematics intervention and reform plans. The services to be provided are mathematics teaching and training to students and teachers in South Africa. Mathematics training and

teaching institutes must be established in multiple areas in South Africa to address the mathematics challenges in the country.

1.3 Delimitations and assumptions of the project

The project will only focus on the high schooling level of education. This is because most tutoring services are required at this level hence a higher chance of success for the business. Ideally, the public education system should produce results that are comparable to private schools and, ultimately, schools around the world. The project will thus gravitate towards entering a market that constitute of most students in South Africa (students from lower quintile public schools), while also serving the high-income market (mostly quintile 5 and private schoolers). Much study will be done on public schools, while private schools will be studied with the aim of benchmarking and comparing the gap between the two sectors, although not in a greater detail. The business plan and financial forecasts assume that there will be a good economic environment and does not consider possibilities of any economic downturn that can affect the economic climate.

1.4 Significance of the project

The mathematics performance statistics recorded by both national and international researchers indicate that the performance of both students and teachers from South Africa is very poor (Staff, 2019). The wide performance gap between private and public schools (Fig 1) accounts for the increasing enrolment of students in independent schools where performance is comparable to some other parts of the world. Although enrolling students into private institutions may be viewed as a good move, it marginalises students from disadvantaged backgrounds, who will not afford the high tuition fees in these institutions. Given that the majority of South Africans live below the poverty line, it is important to make valuable contributions to the creation of quality education that will give them opportunities to be economically active, reducing poverty and unemployment.

The reality for most South Africans is that they miss opportunities that will lead to growth and success because of their poor performance in mathematics, thus leaving them in dire poverty with lower growth and development progress. The poor performance also leads them to make substandard decisions, where they choose to drop out of school or follow careers that are not of personal choice. They may also choose to study in higher education institutions that leave them with skills that render them vulnerable to exploitation or

choose to get into jobs that are low paying, have less growth plans for them, and trap them in a cycle of poverty. To curb inequality in the country, all students, rich or poor, should be given equal opportunities and same quality education. This business venture proposal is therefore necessary because it seeks to investigate underlying mathematics problems in South Africa, where and who is mostly affected, why that is the case, and best business and management practices required to set up a sustainable and solution driven business. The understanding of these fundamental issues will allow us to establish sustainable solutions that will benefit the government, business, and civil society.

According to Modisaotsile (2012), much work is required to lift the quality and standard of education, particularly in lower-income communities. This is because of the non-improving annual output rate that questions both the quality of education and standards of teaching in South Africa. Although there have been trends of improving academic results in other learning areas, this is not the case for mathematics, which is of a bigger concern because the subject carries critical skills that are fundamental in the world of work (Modisaotsile, 2012). It is therefore important to carry out this project, so that multiple solutions can be generated and implemented to ensure that young people from all economic backgrounds can be given an opportunity to get high quality education that will allow them to participate in the economy and stir growth.

2 LITERATURE REVIEW

2.1 Introduction to mathematics education in South Africa

A country that seeks to depend on technology and advance in the 4IR era requires greater competency in technical subjects. When analysing the role of mathematics in poverty alleviation, Tsafe (2013) explains that mastery of mathematics is key to success in the modern economy, and it is an essential driver of progress. This means that mathematics plays a critical role in South Africa, a country facing dire challenges of poverty, unemployment, and inequality. According to McCarthy & Oliphant (2013), the teaching of mathematics plays an important role in the advancing of economy and has been deemed to be a solution to multiple socio-economic issues in South Africa.

Skills development in South Africa highly depends on social security and reduced inequality levels, the two areas that are influenced by the standard of education offered (Allais, 2012). This means that substandard education at basic education levels compromises vocational education training and consequently leads to unemployment and skills shortage. This is a clear indication that education, with critical subjects like mathematics, is essential in reducing skills shortages in the country.

Current mathematics performance in South Africa

There is presently a great scale of mathematics schooling deficiency in South Africa, which is reflected in consistent poor performance and low rankings worldwide. Figure 1 shows the performance results of grade 8 mathematics students from middle-income countries. Although it was a test intended for grade 8 students, South Africa was represented by grade 9 students because the test was deemed to be too hard for those in grade 8 (McCarthy & Oliphant, 2013).

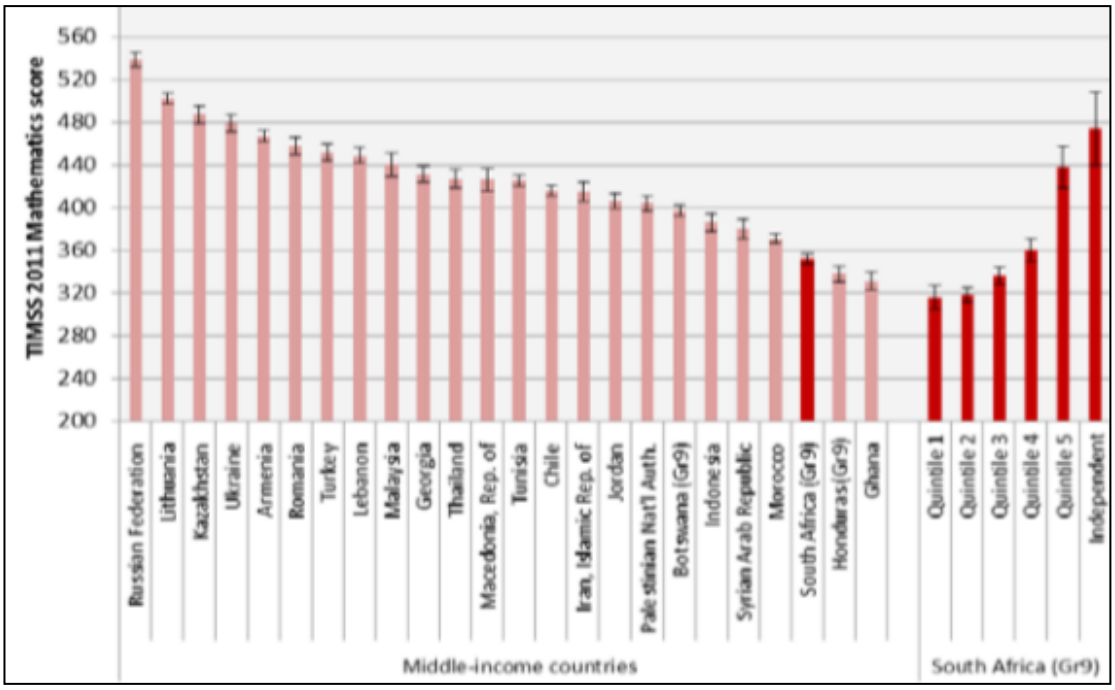

Figure 1: Mathematics performance results for middle income countries (McCarthy & Oliphant, 2013)

South Africa is represented by five quintile groups and the independent group. Quintile groups are the categorisation of public schools based on their socioeconomic status (Ogbonnaya & Awuah, 2019). Quintile 1 represents schools in low-income communities and Quintile 5 represents schools in high-income areas. The independent group represents private schools, which are geographically located in economically advantaged areas and characterised by parents with high average income and high literacy levels.

The grade 9 performance of South Africans is lower than the grade 8 performance of other middle-income countries, with quintiles 1 to 3 performing the worst. Quintile 5 and independent schools' performance is relatively comparable; however, it is difficult to make direct comparisons given the grade differences. An important observation is that these low performances indicate a big knowledge and skills gap in the students. A study by Spaull & Kotze (2015) shows a similar trend of young South African students being levels below their peers, citing that only 16 percent of students perform at their level, while others are up to three grade-levels below. These backlogs, as explained by Spaull & Kotze (2015), affect students' performance in subsequent years.

The poor mathematics teaching within the basic education system filters down and affects students at higher education institutions. Rasool & Botha (2011) raise a deeper and more concerning issue regarding the mathematics standard in the country, citing that the poor standards of teaching and testing students will lower the enrolment rate of technical subjects. Employers from different fields, as explained by Olson & Riordan (2012), cannot find enough employees with required mathematics skills to perform quality work required because of the existing mathematics gap in higher education levels. Students have consistently been requiring more academic support post-secondary schooling. A study made by (Modisaotsile, 2012) shows that 18.5% of South Africa's annual budget is spent on education, an amount that has doubled in five years, in a bid to improve academic results; however, the education system remains in a poor state and shows little to no trends of improvement year on year.

2.2 Causes of the mathematics crisis

Success in mathematics and students' ability to learn and excel in the subject depends on the quality of teaching (Bessong, Ubana, & Udo, 2013). The levels of poor teaching are often unacknowledged, resulting in persisting poor performance. Figure 2 shows the mathematics teachers' performance following a test written by teachers from the Eastern and South African countries. Teachers from South Africa performed the worst compared to those from other countries. This shows that the standard of teaching mathematics in South Africa is very concerning.

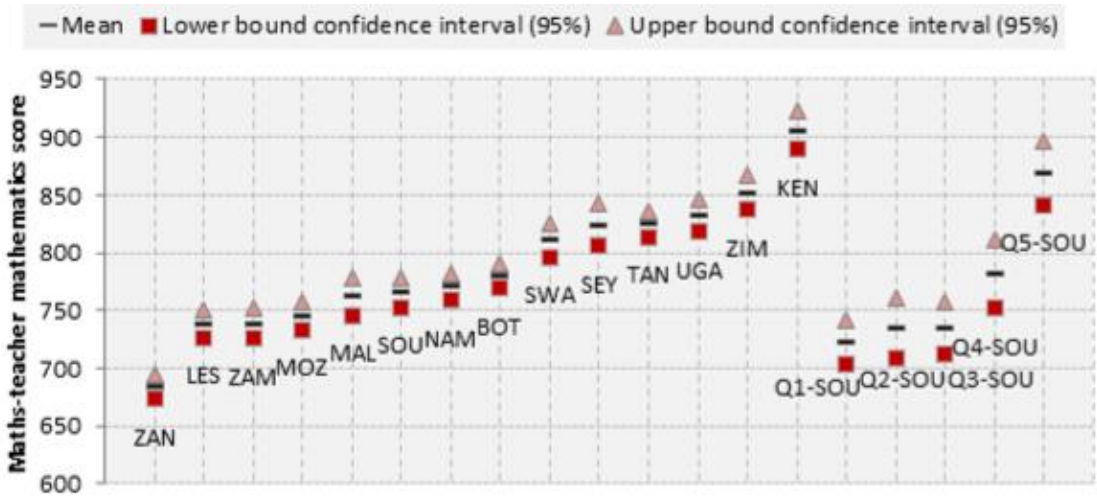

Figure 2: Mathematics teachers' competencies - Eastern and Southern Africa (McCarthy & Oliphant, 2013).

The results illustrated in Figure 2 are competencies of grade 6 teachers in those countries. South African teachers are ranked very lower due to poor performance, with quintiles 1 to 3 performing amongst the worst. This poor teacher performance therefore accounts for the mathematical challenges experienced by students. The annually publicised poor matriculation exam results reflect incompetence that has built up from poor teachings in primary schools. According to Mashile (2019), the biggest challenge when tutoring and assisting leaners in high schools is the absence of basic arithmetic competencies, and this has been a pattern for over 10 years. This meant he had to teach lower grade mathematics to high school students before attempting to teach the students at their level, a method that is time consuming and of great concern.

The teachers were expected to answer questions based on the curriculum they are teacher, but only 23% of them could answer such questions (McCarthy & Oliphant, 2013). A teacher cannot be expected to deliver mathematics material that they do not fully understand, and this has severe consequences on learner performance. High school teachers must fill in the gaps and cover content deficits of primary school work. This does not only frustrate teachers, but it strains students to a point of potential drop-out stage. This is because they are left behind year on year, and they never seem to arrive at the level of their peers. The process of catching up means they are not on par with their level, resulting in poor performances year on year.

According to McCarthy & Oliphant (2013), the emphasis of the national matriculation examinations diverts the intervention strategy plans, making it an urgent and necessary requirement to resolve poor performance challenges at higher grades only. The government, NGOs, and the private sector invest many resources in intervention plans aimed at improving secondary level performances; however, the best way to make a difference in mathematics performances is to focus on improving performance at development stages. This is because, as McCarthy & Oliphant (2013) explained, the gaps in learning during early grades will impact future performance of students.

McCarthy & Oliphant (2013) report a level of teacher complacency that makes it difficult to build teacher competency capacity in South Africa. This is the confidence level of the mathematics teachers shown when they evaluate themselves. Of the grade 9 South African mathematics teachers, 89% felt very confident in teaching mathematics, while those in

performing countries rated themselves relatively lower. Finland teachers rated themselves at 69%, Singapore at 59% and Japan at 36%. This may be a concerning indication that South African mathematics teachers are likely to resist reformation attempts to retrain and reskill them, given their competency confidence.

Not only is the mathematics problem attributed to poor quality teachers, it is also caused by insufficient teachers in the system. South Africa is producing only a third of the country's requirements and particularly few in key subjects such as mathematics (Hofmeyer, 2015) and (Bernstein, 2011). This puts pressure on teachers to deliver quality content to more students, potentially compromising those who are not as fast learning as others. On average, a teacher to student ratio is 1:31, and the value can be more depending on geographic areas and availability of teachers (Machekanyanga, 2017). This questions the capability for one-to-one interactions between students and their teachers and the academic support students can get from their teachers.

Poor mathematics teaching is further attributed to poor teacher training, utilisation and management. According to Bernstein (2011), the poor performance of teachers and consequently of students, is due to poor teacher training. Teachers who are not well-equipped for their intended subject will not produce good results; hence, this is an important consideration when positioning teachers. Bernstein (2011) further explains the poor utilisation of mathematics teachers, where qualified teachers are not teaching despite their will and ability to do so. They are instead made to fill other vacant positions or given positions at schools such as department heads or principals.

2.3 Solutions to the mathematics crises and evaluation of their effectiveness

2.3.1 Private schooling enrolment

Most parents and sponsors have responded to the poor public schooling performance by enrolling students in private schools, while others enrol students in private extra mathematics lessons. This solution caters for the minority who can afford to pay large amounts of money for education. Unfortunately, two thirds of the population rely on government schools due to their economic situation. The impact and influence of the increasing private schooling enrolment will not be enough to change the underperformance statistics in South Africa. As it stands, over 50% of the mathematics

passes come from 400 schools while there are over 20,000 schools in the country (Simkins, 2010).

2.3.2 Reception year

The government has introduced grade R to increase the years children are in school in order to give them a good start before proceeding to grade 1. The grade R enrolment in South Africa has increased from 242,000 in 2001 to 768,000 in 2012 with the aim of reducing failure rates in early grades, but there has not been any evidence of significant improvements (Spaull & Kotze, 2015). This is yet another attempt to improve performance; however, it has not been as effective as anticipated. The biggest impact of this initiative was experienced by other quintile groups except quintile 1, 2, and 3, which had small to zero measurable impact on the supposed education programme introduced (Spaull & Kotze, 2015).

2.3.3 Grade 9 school exit

There are new policies that seek to create multiple pathways for students in the basic education system, with the recent implementation of the grade 9 exit certificate. In a broadcasted interview, the MEC of education in Gauteng explained that countries that are prospering and are at the pinnacle of economic achievement have more students going into technical colleges, and South Africa has to adapt that narrative in order to have doers and implementers in terms of the economy; so this exit certificate gives learners who want the technical option to take that pathway, given their huge benefits (Lesufi, 2019). He further argues that learners will not miss out on any academic work covered in grade 10, 11, and 12 because the content is catered for in the technical schools. This is a concept whose validity requires extensive investigations.

2.3.4 Automatic progression

South Africa has implemented an automatic progression system, where learners can progress to the next grade despite poor performance. The Gauteng MEC explains the concept of automatic progression to provide special attention to students. A learner who fails a grade twice indicates that there is a problem, which may not necessarily be academic (Lesufi, 2019). According to Lesufi (2019), learners have multiple issues that challenge them (adolescence and other distractions), and automatic progression removes them from the distractions and allows them to pick up and progress. This is seen as way to keep

young people within the education system, allowing them to participate in the economy instead of dropping out of school and resorting to criminal activities.

The challenge with this solution is that learners in South Africa are already lagging their peers in other middle-income countries and those in independent schools; so, it becomes another backward move to promote learners who are not prepared for the next grade.

2.3.5 Mathematics literacy

The National Senior Certificate curriculum was designed to ensure that all students take mathematics as a subject, either as pure mathematics or mathematics literacy. Prior this curriculum, mathematics was not compulsory, where learners could choose to do mathematics on either the higher or the standard grade, or not (Parliament Liaison Office, 2012). During the period 2000-2005, about 40% of students did not take mathematics; the majority of those doing mathematics chose standard grade (55%) and only 5% managed to pass higher grade mathematics (Parliament Liaison Office, 2012) and (Mhakure & Mokoena, 2011). High failure rates in mathematics meant that students have less opportunities in tertiary education, prompting the education department to intervene and introduce mathematics literacy, ensuring that all learners get a mathematics education without having to do pure mathematics (Parliament Liaison Office, 2012).

Mathematics plays a big role in national development sustenance and poverty reduction, where entrepreneurship, trading, and business skills development are the underlying motivation (Tsafe, 2013). The introduction of mathematics literacy was to further this development mandate, ensuring that all people are included in this strategy, despite their mathematics ability. Although this is a progressive approach, its implementation has some concerning flaws. According to Graven & Venkatakrishnan (2006), most students taking mathematics literacy were pushed into it, where students with weak grade 9 marks take mathematics literacy while those with good results take mathematics. A critical analysis of failure rates is no longer prioritised because mathematics literacy has become the best option for students not performing. This suggests an automatic assumption that failing students are weak in the subject, thus the problem is solved at that level. When students are given enough time and support, with necessary expertise from mathematics professionals, they will succeed in mathematics (Bessong, Ubana, & Udo, 2013). It is

therefore important to focus on areas that will drive improvement in mathematics instead of working our way around this prevalent challenge.

The education department expressed concerns on the increasing enrolments of mathematics literacy, with mathematics results showing no improvements, recording a 16% decline between the years 2015 and 2019 (Businesstech, 2020). The introduction of mathematics literacy has indirectly become the scapegoat of real mathematics challenges facing the country.

2.3.6 Lowering pass rates

Requirements set for NSC qualification range from a low minimum pass of 30%, which indicates that the expectations set are low, and students master minimum subject content. Although there are concerns about the 30% pass mark, there are several reasons for implementing the idea. The NSC considers the diversity of institutions of which the students will be part; the potential work environment, the individual career plans, entrepreneurial route and not only higher education, which requires higher pass marks (Wedekind, 2013). This pass mark, as explained by Wedekind (2013), gives learners access to different institutions and programmes while considering the requirements of each.

This, however, does not solve the underlying challenges of poor performance, but serve a political and social agenda. The solutions developed barely attempt to directly influence student performance in the subject (Mhakure & Mokoena, 2011). While there seems to be a normal distribution of students performing in the education system, learners remain disadvantaged and excluded from an economic system that requires high performance. Mathematics teachers have highlighted teaching areas they find challenging, including demonstrating mathematical problem solving to students who already have underlying challenges of under-preparedness, lack of basic mathematics skills, and language barriers (Chirinda & Barmby, 2018). This is a clear call for support that mathematics teachers require, whose solution is claimed to possibly result in high performance in the subject. It is therefore necessary for the government to position itself to assist the already identified problem.

2.3.7 Introducing home languages in teaching all subjects

African learners' poor performance in mathematics has been associated with their English language proficiency, hence it was decided that mathematics will be taught in home languages to improve understanding in the subject and performance. Researchers agree with this initiative because it is an opportunity for students to strengthen their mathematical skills while developing proficiency in English (Setati, 2008). Setati (2008) revealed that there is a general preference to teach and learn the subject in English because it provides socio-economic access (employment, higher education). This preference is informed by the context of South Africa where there are economic, political and ideological constraints.

In his study, Howie (2003) investigates language and other factors that affect performance in mathematics. The analysis is based on TIMSS conducted in 1995 and an English proficiency test (for South African students). The results showed that over 70% of students study mathematics in a language they do not speak at home (Howie, 2003). The results further showed that students from Asian countries learning mathematics in a language they do not speak at home still out performed those who did, however, the trends in South Africa showed the opposite results (Howie, 2003). The English test revealed that the wealthiest and most urbanised provinces attain the highest overall scores, a similar trend to the mathematics results.

The inconsistencies in the language-mathematics relationship in different countries illustrate that language is not a justified reason behind poor mathematics performance. What the high performing Asian countries have in common is a culture shaped by the tradition of hard work, resilience and willingness to fight for excellence, anchored by a belief that "No one who can rise before dawn three hundred sixty days a year fails to make his family rich" (Gladwell, 2008).

2.4 Towards teacher training

There is an urgent need for immediate interventions in teaching and training in South Africa. The country cannot afford to underestimate the scale and depth of mathematics challenges prevalent today. Given the country's position, the intervention plan should be across all grades, until all grades are covered and there is a smooth recourse that is part of the basic education system. Although McCarthy & Oliphant (2013) suggest that a stronger

focus should be on lower grades, the country cannot ignore the growing number of innumerate young people already in the system.

A new strategic approach is required to bear greater fruit in the education sector, and as McCarthy & Oliphant (2013) explain, the answer to some mathematics challenges may in practice be resolved by multiple stakeholders, including the business sector. Simkins (2010) agrees and states that the public sector initiatives alone will not be enough response to the problems of such magnitude. The intervention plans required involve some education district contracting with a maths teaching service to enhance quality and reduce inefficiencies in the education system.

To measure the quality of teachers for improvement purposes, it is important to critique the present teacher evaluation system. This will allow accurate diagnosis of mathematics problems per situation, meaning that teachers will not be scapegoats for a large and struggling system or vice-versa. Bernstein (2011) suggests that there must be diverse institutions training teachers of tomorrow. The issue at hand is whether the teachers are trained well; however, including other stakeholders creates good competition and the possibilities of better training for mathematics teachers. The scale of the challenge is relatively big, given that the present training institutions only produce a third of the quantity required. There is therefore opportunity for private sector to play a role in restructuring the education training sector. Charles-Ogan (2015) explains that the private sector must participate in ensuring that mathematics performance improves because it survives and thrives on innovation and technology whose foundations are mathematics and science.

2.5 Introduction to subject knowledge for mathematics teaching - towards the improvement of mathematics performance

Technical subjects have complexities that require teachers to have certification with specialisation (Saderholm, Ronau, Brown, & Collins, 2010). There is an increasing need to focus on teachers' knowledge and its influence on student performance worldwide because improved mathematics outcome demands proficient teaching of the subject (Schoenfeld & Kilpatrick, 2008). The teaching of mathematics requires more than pedagogical knowledge or skills acquired from teacher training institutions, but mathematical specialisation that allows teachers to deliver content that is above average,

allowing maximum participation from students and improving performance. Rowland & Turner (2007) have noted from their research that there is less specialization in training institutions and almost all trained individuals remain generalists. This is amongst the biggest challenges in mathematics education, where there are more generalists than specialists, while the field requires the latter.

Several methods (such as writing tests that would be given to students, interviews, planned task observations, queries, performing tasks and constructing work representative portfolios) have been used to assess teachers' knowledge and quality of their performance, to evaluate their qualifications for teaching the subject and analyse their knowledge (Hill, Sleep, Lewis, & Ball, 2007). These assessments, particularly in the teaching of mathematics, are necessitated by the government's desperate need for highly qualified individuals, because consistent poor results indicated assigning uncertified teachers to teach mathematics (Hill, Sleep, Lewis, & Ball, 2007). This is a clear indication that mathematics teacher training is instrumental to the functioning of teachers in schools.

To meet the mathematical needs required to improve student performance, teachers need to teach for understanding, a function of deeper understanding in mathematics. There are four types of knowledge required to teach mathematics: declarative knowledge, understanding knowledge (characterised by instrumental and relational understanding), procedural and conceptual knowledge (Saderholm, Ronau, Brown, & Collins, 2010). Declarative knowledge, as described by Saderholm et al. (2010) is that which can be learned through memorisation, allowing individuals to break down objects and analyse them independently. Conceptual knowledge is described as a network connecting discrete information to form a relationship, producing defined concepts that enhance understanding, and procedural knowledge deals with processes for deriving solutions (Star & Stylianides, 2013). These types of knowledge allow teachers to effectively deliver mathematics instructions, where students can apply, reflect, and carry out strategies and use knowledge to reason inductively and deductively.

Mathematics teachers' knowledge and teaching proficiency must be known before and during the teaching process because it dictates the type of education students receive, which will be reflected in mathematics performance. According to Chapman (2015), there must be an extensive understanding of what teachers know (their way of thinking and

holding knowledge of the subject) so that they can be assisted in delivering mathematics content; thus, a need for continuous research and implementation of the findings. Among other productive intervention strategies is the three-year professional development program explained by Chapman (2015), which exposes mathematics teachers to improved and efficient teaching strategies, aimed at enhancing teachers' understanding of the changing and advancing mathematics concepts. Specialised training is an important aspect of teacher training over and above the traditional college and tertiary training teachers go through. It is important for teachers to have continuous training, considering the changes that occur during teaching periods, challenges met along the way, and expectations from the education department.

2.6 Key variables in mathematics education

Countries such as England have commissioned the Mathematics Development Programme for Teachers (MDPT) to develop programmes that will address the challenges of having few specialised mathematics teachers in the education system. Such programmes are established in response to poor performance in mathematics and thus seek to intervene because mathematics carries with it analytical skills required to develop societies.

General pedagogical knowledge acquired at teachers training needs to be supplemented by mathematical specialisation to deliver desired results. This means, as Silverman & Thompson (2008) explained, the mathematical content alone is not enough to guarantee expected outcomes; it must be coupled with the knowledge of students' thinking (which is influenced by their background), mathematical reasoning and subject delivery skills. This, according to Thompson (2008) is known as the 'Mathematical Knowledge for Teaching', which is defined as 'the work of teaching mathematics' – referring to the act of extensively explaining mathematical terms and concepts, choosing the best topics from varying textbooks to suit the audience, developing means of building understanding of mathematics, giving relatable examples to represent mathematical concepts, and correctly interpreting students' questions and solutions (Hill, Rowan, & Ball, 2005).

Figure 3 shows the MKT model, which consists of subdomains that enhance mathematics teaching and learning process.

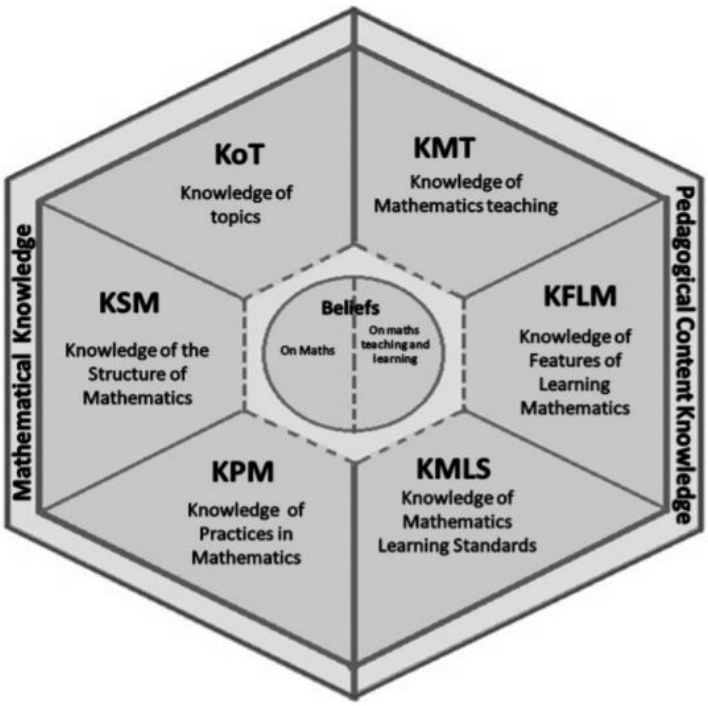

Figure 3: Elements of mathematical and pedagogical knowledge **(Carrillo-Yanez, Climent, Montes, Contreras, & Flores-Medrano, 2018)**

Figure 3 highlights the elements of mathematical and pedagogical knowledge, which link teachers' professional knowledge to the teaching-learning process. Figure 3 differentiates MTSK from general pedagogical knowledge although they are both part of the specialised knowledge required for teaching mathematics. The elements of Mathematical Knowledge (MK) and Pedagogical Content Knowledge (PCK) are shown in Figure 3, where MK focuses on only maths and the PCK on the methods of teaching.

KoT is the actual mathematics content, which includes the curriculum, instructional aids and models, as well as mathematics concepts and principles (Carrillo-Yanez, Climent, Montes, Contreras, & Flores-Medrano, 2018). This is a level of specialisation that is key in mathematics education where teachers know the work they are delivering in greater depth. The KSM, as explained by Carrillo-Yanez et al. (2018), describes the teachers' ability to connect various mathematical items, models and principles, allowing them to simplify complex mathematics items to enhance students' understanding and enable them to address more advanced matters of the subject. Knowing the structure of mathematics enables teachers to build reasoning and analytical capacity in students, where they can explain different phenomena, justify why things happen the way they do, and connect relationships between different items. KPM refers to the interactions that occur during

the teaching and learning process, where the behaviours and reactions of students are subsequent to those of the teacher in the teaching process. Carrillo-Yanez et al. (2018) explain that KPM is defined by the methods and organisation of the mathematics knowledge. The teacher demonstrates, justifies, deducts and makes inductions, triggering a response from students, who make conclusions and statements and ask questions, which subsequently shows the students' level of understanding. This is a type of specialisation where mathematics teachers can apply their knowledge, an ability that simplifies the teaching process and enhances better understanding of concepts.

Pedagogical content deals with the knowledge teachers require to efficiently deliver subject content. KFLM deals with the teachers' knowledge in delivering mathematical content while focusing on the students' capacity to respond to the content, where the teacher is aware of how learners think and address mathematics tasks, observing their strengths and weaknesses and thus delivering the content at a level that offers learning advantages (Carrillo-Yanez, Climent, Montes, Contreras, & Flores-Medrano, 2018). KFLM helps teachers deliver content at a level and standard appropriate for the students' capacity to understand, which then influences the kind of explanation, examples and tasks given. Teachers' task implied by the KFLM is to ease the learning process. KMT, according to Carrillo-Yanez et al. (2018), is based on knowledge that the teacher draws from research and their experience in teaching the subject, which they use together with the mathematics content to design learning opportunities. This allows them to have effective strategies and techniques to teach mathematics. KMLS refers to the tools and instruments used to measure students' ability, as well as the standards at which the students must be taught to ensure that relevant content is taught at appropriate levels.

In South Africa, the government provided a clear guideline to support teachers in acquiring this knowledge, including pace setters, guidelines on learning outcomes, external examinations, marking guides, to mention but a few. This element requires teachers to have knowledge of the administrative processes and requirements put forward by the multiple stakeholders in the education department. These external bodies often seek to standardise education among different schools to ensure that students in the same regions learn the same content, and standard examinations are often given to these students to prove and ensure consistency.

2.7 Developing and evaluating mathematics teaching strategies

The framework presented seeks to develop and evaluate ways in which teachers can be supported to effectively deliver mathematics content in a way that will inspire good performance. This framework acts as a proficient mathematics inclusive problem-solving toolkit, which attends to students' knowledge base, strategies to solve problems, how students must learn and develop, the role of students' experience in mathematics, necessary cognitive skills required, and mathematics beliefs that informs the ease of learning (Schoenfield & Klipatrick, 2008).

Campbell et al. (2007) introduces four components of the framework, which include the academic, cognitive, language and life experiences. Students have prior knowledge and life experiences that often influence cognitive demands; therefore, when teachers are well trained to identify students' positions, they can deliver mathematics content at a level appropriate to the students. This framework thus focuses on elements that influence cognitive demands and ultimately the students' performance.

An important area that leads to the enhancement of students' cognitive development is the learning of mathematics, because it helps students to build connections between different items, blend different processes, critically analyse different scenarios, and further gives students the flexibility to modify concepts and apply them in different situations (Tripathi, 2009). This component speaks to the importance of teachers' understanding of cognitive demands required by different mathematics sections, which implies that they need to know how to plan and schedule work according to the students' ability to grasp different concepts and how long they need to practice such sections. Campbell et al. (2007) explains that, in influencing the performance of students, teachers must not base their material on inappropriate assumptions regarding prior academic preparation, because this increases the cognitive demands.

The second component of the framework addresses mathematics and cognitive processes, which speaks to the cognitive processing skills needed for students to succeed in the subject. Students need to be able to manage the mathematics content delivered to them, however, this process is complex because it depends on the teacher's ability to apply multiple teaching principles. The challenge of managing content is founded on cumulative knowledge that students acquire in previous academic years, which means there

consistently needs to be a well-planned schedule during the students' school lives, which ensures that basic or foundation concepts are covered and taught well within the chain.

Any gap within the value chain perpetuates mathematical deficits, which cumulatively hinders mathematics teaching and learning processes, affecting good performance. The goal of cognitive process is to enable learners to solve mathematics problems through analysis of the mathematics problem. This requires deep conceptual understanding that is delivered through high-level teaching and practicing examples. One strategy that addresses this, as explained by Campbell et al. (2007), involves reduction of goal specificity, where students are trained to apply the mathematical principle implied in the question asked. This reduces the cognitive load, enabling students to use and improve their reasoning capacity in the problem-solving process.

The third component evaluates the relationship between mathematics and language. Although mathematics content is very important, there needs to be an understanding of the influence of language on the subject because the teaching of mathematics encompass more than just the content. This component highlights the role of teachers in delivering mathematics instructions, where they are expected to mediate classroom instruction in order to help students relate to mathematics concepts, supporting the students' learning. This means teachers must encourage student participation so that they can identify gaps and progress made in conceptual understanding of the content delivered. Although students may understand the mathematical content, language can be a barrier/gap that creates cognitive blockages. It can be argued that mathematics teachers are not responsible for language; however, they can support students' comprehension in the process (Campbell, Davis, & Adams, 2007).

The fourth component deals with the role of context in maths, where the aim must be marrying mathematics and where it is applied to assist students in the selection of mathematical procedures (Boaler, 1993). Furthermore, context in mathematics reflects real life scenarios that students can relate to and thus motivates them and makes mathematics interesting and approachable (Boaler, 1993). Unrelatable context tends to confuse the students who have not had similar experiences with the problem stated because they are unable to interpret the question. Performance is thus affected as students spend time trying to interpret the question instead of answering it.

With the understanding of the four components, better decisions will be made when mentoring and coaching the team as we establish the teaching and training institute, ensuring that they are equipped with appropriate tools for addressing actual teaching and learning challenges as well as coupling teachers' formal training with specialised teaching techniques that result in subject matter competency.

2.8 Evaluating mathematics education in South Africa, a conceptual framework

Learning deficits and poor teaching strategies are a concerning feature of mathematics in South Africa. The problems encountered in this subject are not only reflected in poor performance, but also in the health of the economy given that many skills required to build a sustainable economy require considerable mathematics competencies. There are several proposed solutions to the mathematics problems facing South Africa, including the addition of reception year, automatic passes, introduction of mathematics literacy, more enrolments in private schooling and grade 9 exits. There remains a big question of how effective these initiatives are. However, the consistently low NSC mathematics results released annually by the education minister gives an indication of insufficiency in the solutions.

The increasing enrolment of students in independent schools shows performance that is comparable to some other parts of the world showing good performance; however, it is not clearly known the reasons for good mathematics performance in quintile 5 and independent school. It can be argued that these students are not only given special attention by educators, but they may also be enrolled in private mathematics extra classes. These classes are at a high fee, and given the economic status of most South Africans, it can be suggested that only those who can afford (quintile 5 and independent school students) are enrolled in these classes. There is a gap in understanding this phenomenon, thus further research will be done on this important factor. It will give perspective on whether quintile 5 and private school mathematics teachers are extremely proficient, or the extra mathematics classes are playing a big role. The finding will also assist in knowing if the establishment of mathematics institutes should aim at training teachers in lower quintile schools or whether the training should be designed for all teachers across board.

Another important factor is finding out the average age of students who exit school at grade 9 to enrol in technical colleges, to uncover the accurate reasons for early school departure. A legitimate case will be when the exiting students do so at average age of 16, meaning that they have not been indirectly pushed out of the education system but instead made a personal career decision to pursue the technical stream. When students exit grade 9 at ages 17+, it may be an indication that the education sector should strengthen its teaching delivery to keep students in school and ensure that there are no deficits in their education.

The investigation of issues underlying the mathematics underperformance prevalent in the country is important, to establish sustainable solutions that will benefit the government, business, and civil society. The state of mathematics in this country has multifaced implications, which includes the social and economic impact as well as the country's development plans and contribution to the fourth industrial revolution (4IR) course.

2.9 Management theories

A business thrives where there is good management and leadership, hence it is important to study and understand management theories before launching the mathematics teaching and training institutes, in order to have basic theoretic management knowledge that will lead to managerial success and continuous improvement in the organisation.

The business community has raised several concerns about the education standards, stating that they are deteriorating and thus producing people who are limited in innovating capabilities and generating solutions to add considerable value in the business world (Olson & Riordan, 2012). The mathematics training and teaching institute will work towards preparing students to meet the demands of work, build their confidence and further develop their numeracy and creative skills. To do this, there must be an extensive understanding of management theories because they will provide guidance on the best practices and ultimately enable the business to attain its goals.

Managing is described as the human activities required to drive and accomplish organisational goals, ensuring that group efforts are harmonised and different departmental efforts are coordinated (Olum, 2004). The important activities of managers

include strategic planning, leading, organising, and controlling, which lead to efficiency and effectiveness (McGuigan, 2012). Four management theories will be studied in this project, as they are very relevant to and directly affect the venture. Theories are 'perspectives used to make sense of the world and govern operations, giving a true reflection to reality' (Olum, 2004). Theories thus give a more expected outcome for different actions and allow decision makers to make realistic estimates and better plans. The four theories studied here are: The scientific management school, the classical organisational theory school, behavioural school, and the theory of chaos and complexity.

2.9.1 The Scientific Management School

The scientific management theory comprises of the work by Frederick Taylor and Lillian Gilbreth and was designed to eliminate inefficiencies and injustices during the period 1856-1917 when autocratic management was a dominant style (Olum, 2004). It features a systematic training of employees to bring forth expected results in an efficient manner; however, it does not allow personal creativity and independent decision making within the process. Although Taylorism optimised performance and yielded successful economic results, it was criticised for side-lining human contributions and not embracing human capabilities (Olum, 2004). Gilbreth's contribution to the theory was centred around efficiency and sustainability in the organisations. His focus was reducing unnecessary motions and ensuring that every worker has an extensive knowledge and understanding of their work, competent enough to train their successors and ready to take a higher position in the organisation (Olum, 2004).

This theory will be important for the venture because the training of the team that will be training the teachers and students is critical for the success of the venture. The idea is to ensure that there is standardised service delivered, and the competency of the team needs to be comparable, hence the need to go through systematic training. Although human contribution will not be side-lined, every input will be thoroughly investigated to ensure that all contributions align with the brand and contribute to overall high-quality service.

2.9.2 The Classical Organisational Theory School

The classical organisational theory school seeks to attain organisational goals through a bureaucratic model. Bureaucracy refers to the terms and conditions of work, rules and regulations that govern practices as well as the hierarchy of authority (McGuigan, 2012).

The classical organisational theory describes principles that ensure that organisations function in an efficient manner, where the reporting structure is clearly defined, responsibilities are divided accordingly, and systems to identify problems and opportunities are established. This theory is important for the venture because it will allow the company to function like a well-oiled machine. The reporting structures and role definitions direct where and how issues must be escalated, resulting in quicker resolutions. It will also assist career development, as employees will understand key competencies to develop to assume certain positions.

2.9.3 The Behavioural School

Behavioural school is based on Elton Mayo's work that focuses on organisational social systems, group dynamics and teamwork (Olum, 2004). This theory is based on the premise that performance is closely linked to work satisfaction. According to Morrison (1998), there are high benefits to investing in employees because this directly influences productivity. A work environment that embraces people, harnesses trust and openness, and empowers people is likely to be sustainable and yield quality results. Sinek (2017) explains that "teams led by an empowering leader experience higher performance improvement over time because of higher levels of team learning, coordination, empowerment and mental model development". This theory is thus important for leaders to understand because it deals with indirect inputs to creating a healthy and highly productive work environment. It contrasts Taylor's theory that deems science as one best way to obtain the highest productivity (Olum, 2004).

This theory is critical to the functioning of this business venture. Given that the behaviour of employees is influenced by the work environment created by the leaders, the behavioural theory will help the organisation to decide on the leadership styles that must be assumed to yield the best result. The understanding of this theory helps the stakeholders to focus on both human contribution to business success and direct profit-generating initiatives. The purpose of adapting to good leadership styles is to ensure that the organisation is sustained and experiences consistent high performance.

2.9.4 The Theory of Chaos and Complexity

Organisations need a higher level of adaptability because of the uncertain and unpredictable nature of external factors having direct influence on their functioning. The

theory of chaos and complexity enables leaders to manage the ever-changing world and dynamic systems and not expect fixed and stable scenarios (Morrison, 1998). There are several principles that are central to the chaos theory. First, small inputs during development stages can result in major and larger unpredictable outcomes; second, similar inputs can result in completely different outputs; third, diversity may be born from uniformity and regularity; fourth, anything that works for the organisation today may not work in the future; and last, it is not possible to have long-term predictions (Morrison, 1998). This theory allows managers to be open to change, be strategic in their approach, and work towards generating multiple options for the business during planning.

This theory is very relevant to the business given the number of stakeholders involved in the education fraternity. Notwithstanding regulations governing education in South Africa and constant changes to mathematics curriculum, the current COVID-19 pandemic for example, has influenced the traditional teaching and learning styles, forcing the industry to embrace technology and incorporate strategies that will ensure that education continues within the pandemic restrictions. A manager who understands the chaos theory embraces these uncertainties and develops functioning methods to navigate through complexities brought by unplanned and unforeseen circumstances. Although having foresight and conducting research to predict changes that might affect the business is an important role of a manager, adaptability remains a very critical feature in sustaining an organisation.

3 RESEARCH DESIGN, METHOD AND PROCEDURES

3.1 Research Strategy

In order to generate the best practice guides, we need to collect and analyse data. This provides an inside view of the mathematics status in our prospective locations, both from existing performance and teachers' viewpoints of the challenging subject. This study employed the qualitative approach, which reflects on data gathered from published results of 1,435,907 grade 12 students from 2826 schools in the Limpopo, Mpumalanga and Gauteng provinces of South Africa as well as a survey completed by 29 teachers from the three provinces. The published results represent all the public secondary schools in the three provinces and were extracted from the annual records of matriculation results.

Given that the data is published in portable document format (pdf), it was converted to Excel and cleaned accordingly, then the IBM SPSS statistics were used to conduct the analysis. An initial frequency test was run to correct all data entry errors that resulted from the pdf-Excel conversion process. All missing values were accounted for and the frequency, descriptive and correlation analyses were run. This tool (although normally used in a qualitative study), was used because it is easy to use and provides more accurate analysis given the format the data we need was presented.

The study used random sampling in identifying teachers to participate in the survey, where only mathematics teachers participated. The Qualtrics software was used for the survey and analysis of survey results. Schools were grouped into quintiles across the three provinces to ensure that multiple school quintiles are represented in the survey. Table 1 below shows the research population and how it was distributed:

Table 1: Research population

Grade	Quintile	Number of educators
1-3	1	1
4-7	1	2
	2	3
	3	2

	9	2
8-9	1	1
10-12	1	6
	2	6
	3	5
	5	1

The data collection mode used in this study was surveying. The survey questions included closed and open-ended questions. The close questions were structured according to a 5-point Likert scale: Definitely yes, probably yes, might or might not, probably not, and definitely not. The open-ended questions were structured such that the teachers had multiple choices with provision to input their answers and express their feelings. All survey results were recorded for analysis purposes. When presenting and analysing the data, three categories emerged: About teaching mathematics, Performance and Training.

To ensure reliability and validity, test-retest method and construct measures were used. The test-retest ensures consistency of a measure across time. As such, analysis from the year 2014 to 2019 (six years) was done when measuring results from the annually publicised results. Existing theory and knowledge of mathematics education was adhered to in order to ensure high construct validity. Performance graphs were done to evaluate correlations between existing data and this study.

Four ethical considerations were adhered to: informed consent, right to privacy, protection from harm, and involvement of the researcher. All respondents were made aware of the pertinent details of the research and that participation in the study is voluntary. Respondents were not required to provide their personal identity, and all recorded data was saved in a file that is encrypted with password protection. The Wits Business School Faculty Academic Ethics committee reviewed the proposal of this study with its data collection tools and granted ethical clearance before the research was conducted to ensure that respondents are not harmed. The participants were provided with information about the study and the researcher, its aim, objective, and purpose. They were in no way deceived regarding the purpose of the research.

The study was limited by the South African lockdown that was a result of the global pandemic. This resulted in the revision of the methodology of this study where only non-contact methods of collecting data had to be used. The initial research data collection instrument of this study consisted of interviews; the present primary school teacher questionnaire; the present secondary school teacher questionnaire; survey questions for quintile 5 and private school students; and survey questions for students at TVET Colleges. These had to be changed to telephonic interviews and online survey with teachers only.

4 PRESENTATION AND ANALYSIS OF THE FINDINGS

4.1 Mathematics results analysis

Figure 4 shows the total number of grade 12 students doing either mathematics literacy or mathematics in all the schools in Limpopo, Gauteng and Mpumalanga between the years 2014 and 2019. Gauteng records the largest number of enrolled students, followed by Limpopo and Mpumalanga. This is because of the population densities in these provinces. The quintile makeup in the three provinces is showed in Figure 5. About 20% of the schools in Gauteng belong to the quintile 1 and 2 group, while 80% of schools in Limpopo belong to quintile 1 and 2, and about 78% of schools in Mpumalanga are quintile 1 and 2. This indicates that most schools in Limpopo and Mpumalanga are rural schools, associated with fewer resources and many hindrances to good performance.

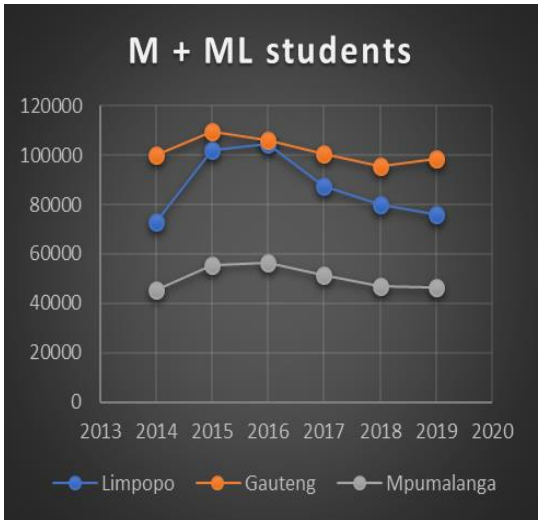

Figure 4: Total number of students

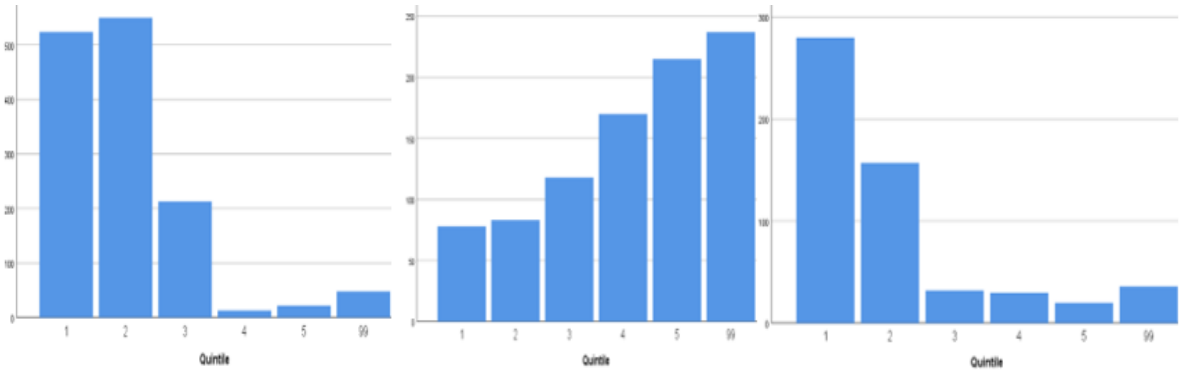

Figure 5: Quintile makeup of schools

The mathematics and mathematic literacy pass rates are illustrated in Figure 6. Both Limpopo and Mpumalanga are trailing lower than Gauteng in the two subjects. The pass rate in mathematics literacy is higher than those in mathematics, with the pass rates ranging from 60% and a reach of over 80%. The mathematics pass rates are low, with Limpopo's performance ranging between 50 and 57%, and Mpumalanga performing

between the ranges 48 and 57%. While Gauteng's results go over 60%, they do not rise above 75%. Given that the pass mark for mathematics is 30%, these pass rates indicate a wide gap in the learning of the subject, thus having implications on the possibility of nurturing an innovative nation lead by machine learning and artificial intelligence, the two prospects anchored by mathematics success.

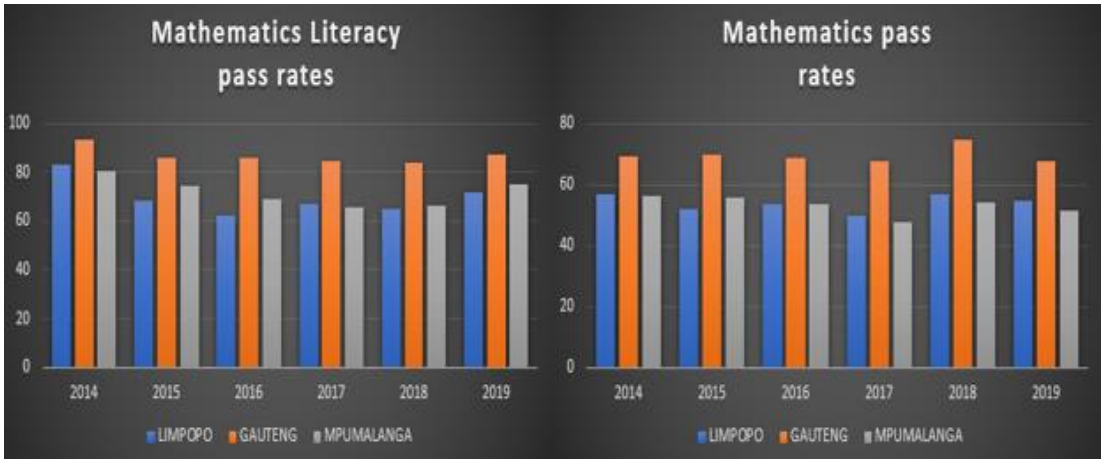

Figure 6: Pass rates

Figure 5 (quintiles) and 6 (pass rates) further show a relationship between mathematics performance and school environment (quintiles). The provinces with more schools in the rural areas perform less than those with more schools in urban and developed environments. This suggests that there are many interventions required for mathematics teaching in such areas. The introduction of mathematic literacy was meant to bring about improvements in mathematics performance; however, Figure 6 indicates that the poorer provinces perform poorly, nonetheless. This observation questions the effectiveness of the solution because the performance gap is consistent in both mathematics and mathematics literacy. This is very concerning because a solution that is meant to be an equalizer does not drastically change the outcome but leaves more students outside a mathematics anchored system that is deemed to be the future of the country. Although there are arguments that some career streams do not require mathematics, there is no reason to compromise the delivery.

A greater concern is the trend of enrolments in mathematics. Figure 7 shows such trends in both mathematics literacy and mathematics between the years 2014 and 2019.

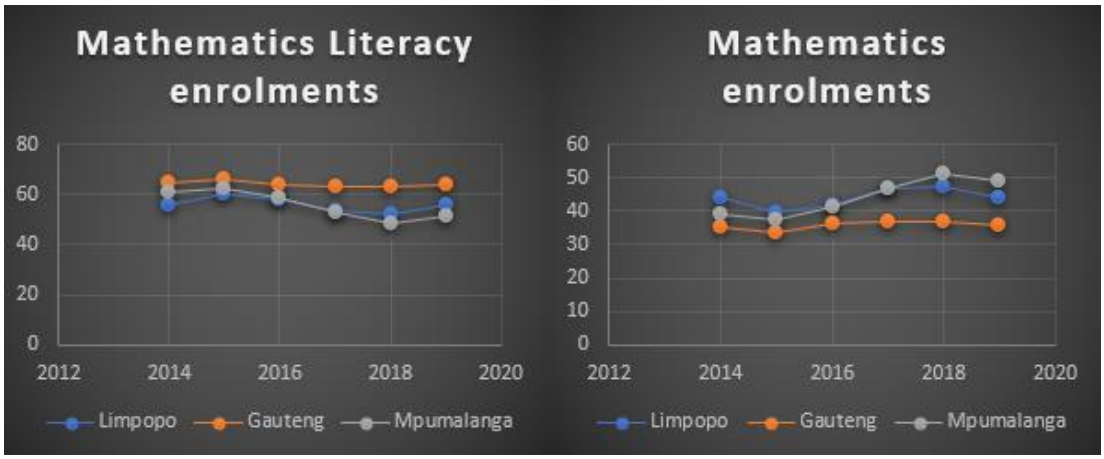

Figure 7: Enrolments

There is a declining trend of enrolments in mathematics in all the provinces. More learners opt for mathematics literacy. Figure 7 shows that the last three years have been consistently recording less students in mathematics. In all the three provinces, less than 50% of students do mathematics, with Gauteng trailing between 34 and 37%. Although Gauteng records the highest rates in mathematics passes, it has low enrolments. Studies have indicated that there is a trend of forcefully enrolling students in mathematics literacy in order to improve mathematics passes, and the results in Figure 7 supports those studies. Given that Gauteng, with more developed schools, records the lowest enrolments in mathematics, it is no longer the poorer provinces that need an intervention, but rather all the provinces. This is to ensure that no students are excluded from mathematics because they are deemed mathematically weak, but rather, means are made to encourage and retain most students in the subject.

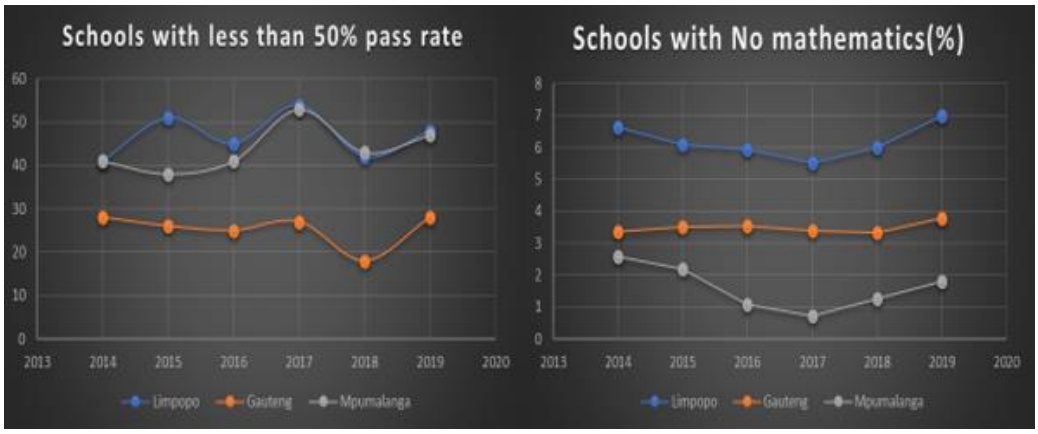

Figure 8: Less than 50% pass rate and no mathematics schools

The quality of results further highlights the depth of the mathematics challenges. A considerably high number of schools produce less than a 50% pass rate, with Limpopo ranging from 41 and 51%, Gauteng between 18 and 28%, and Mpumalanga 38 and 53%. This means a high number of students fail to attain a 30% mark. Not only do we see a trend of decreasing enrolments in mathematics and poor results, there are increasing numbers of schools not offering mathematics as shown in Figure 8. The solution to mathematics challenges should be addressed in all provinces and across all quintile groups given the inconsistencies within the reporting system.

Limpopo has up to 7% of schools only offering mathematics literacy, Gauteng up to 4%, and Mpumalanga recording 2% in 2019. Figure 8 shows that increasing number of schools are deregistering mathematics in the three provinces.

4.2 Survey analysis

Teacher Information

The data about the existing mathematics teachers showed that over 48% of them are aged 50 years and above. While only 7% are aged between 40 and 49, only 2% are between 20 and 29. About 30% of the teachers have over 26 years of teaching experience, while 21% have between 16 and 20 years of teaching experience. This gives an indication of the group we will be training; predominantly people within extensive teaching experience who have adopted teaching methods and styles that might be a challenge to change. Having this information will allow us to prepare and be equipped to deal with the challenges that might come with training the older generation.

All teachers surveyed have gone through some formal education. Over 48% of the teachers having obtained a Bachelor of Education degree and only 2% obtained a Master of Education degree. About 40% of the teachers have qualifications that are not education specific, but they practice in the profession. This is an indication of the much-needed training of teachers, especially those with no education background.

When asked the number of students each teacher has in class, 25% indicated that they teach over 61 students per class, while 3% of them teach between 41 and 50 students per class. This high teacher to student ratio indicates a possible gap in schools, where less attention is given to students, especially those who need special help. Of the respondents 80% belong to quintile 1 to 3 schools, indicating that poorer schools have more students in a class and face possible challenges of teachers not being able to attend to different student needs. When asked about the performance of students, 60% of the respondents indicated that their students obtain below 40% in their examinations.

About teaching mathematics, performance, and training

Top 3 challenges faced by mathematics teachers

The teachers identified three top challenges that hinder good performance in mathematics. These are lack of discipline from students, a high number of students in class, and a belief that students generally struggle with the subject. There is a general believe that mathematics is a hard subject, a perception carried by both teachers and students. This finding, particularly coming from mathematics teachers, indicates that it will not be enough to focus only on delivering mathematics as a subject, but also deal with the poor attitude towards the subject. This means motivation, alongside teaching and training, will be an important aspect of our service delivery. This may assist in dealing with the challenges of discipline. When teachers are trained to teach the subject well, students will gain interest in the subject focus better. As a business, we will not be solving the problem of high student to teacher ratio but we will assist in easing the learning and teaching process by training the teachers and having access to teach the students as per the business plan.

What would make teachers deliver better results?

Over 32% of the teachers think that more commitment from students will assist in improving mathematics results, while 23% think that parental support would contribute

the most, and 20% attribute it to frequent workshops addressing challenging topics. Different stakeholders play an important role in mathematic performance as the respondents have indicated. While we as a business can influence the student commitment and training that addresses different parts of the recommendations stated, parental support is an element that school leaders need to address.

When asked if they think it is possible for all students to succeed in mathematics, 72% indicated that it is possible for a 100% success in mathematics, 20% were not sure, and 8% said it is not possible. With the teachers having suggested items that could make them deliver better results, most respondents indicated that attending to those items will make it possible for a complete success.

Challenges of language in mathematics

The issue of language being a barrier to learning mathematics is an ongoing study with no definitive answer. Only 44% of the respondents said it is a challenge to students, and 56% said it is not.

We plan to deliver the mathematics teaching and training sessions in English, because it is the language used in national examinations. The strategy will be to deliver it in simplicity, ensuring that the examples used are relatable to the students. With information on cognitive ability presented in literature review, we will deliver the teaching and training services such that the language itself will not be a barrier.

Reasons for mathematics literacy enrolments

Most respondent indicated that the reasons students at their school do mathematics literacy is because it is recommended for them due to their poor performance, and the students are found to be struggling with the subject. None of the respondents attributed the enrolment of the subject to career path alignment, while only 8% said it is a subject of choice. The respondents indicated that the students would want to do mathematics, but due to poor performance, mathematics literacy is the alternative.

Basic mathematics skills in early grades

Of the respondents, 56% said that there is not enough emphasis on basic mathematics skills in earlier grades, and 32% indicated that the teaching of basic skills in early grades is

enough. With most teachers having a concern about mathematics standards in earlier grades, it is important to attend to this concern.

Mathematics training for teachers

When asked if the existing training teachers receive is effective, 44% of the respondents said it is, while the 56% either finds it ineffective or do not receive it at all. The professional development teachers receive is expected to be intensive training provided by the department of education; however, 47% of the teachers indicated that much of the professional development received is collaboration with other mathematics teachers, while only 22% said they receive it from the education department. Most of the respondents seem to value the contribution of training to their teaching career as indicated by 92% of them who indicated that they would recommend consistent training to all mathematics teachers.

5 BUSINESS PROPOSAL

Lions Akadimia Mathematics teaching and training institute

5.1 Industry Overview

The mathematics teaching and training institute is part of the private tutoring industry. In private tutoring, full-time students from both private and public schools receive extra lessons after school hours, during weekends and school/public holidays. Mathematics failure rates as well as the natural dislike developed by students has necessitated the need for extra support in the subject, making mathematics tutoring a thriving industry.

Although existing mathematics teachers realise the gap in the subject, they are not allowed to offer extra lessons unless it is within the school set-up and plan. This is done to manage conflicting interests, where a teacher can deliberately offer substandard lessons to get customers outside the school hours. With teachers excluded from participating in this market and the industry having most tutors as freelancers, there is a good opportunity for entrepreneurs to set up in this industry. The potential sustainability in this industry stems from its growing market size, therefore there is an opportunity to set up a thriving business.

Tutoring services have different set-ups. This includes educating people individually, in small groups, in large groups, and in varying quantities through online platforms (the audience quantities determine the levels of interaction). The key factors that contribute to business success in this industry include excellent technical skills (subject matter experts), good management, patience, passion, planning and preparation.

5.2 Company summary and description

The present mathematics performance in South Africa affords us an opportunity to establish mathematics teaching and training institutes in South Africa through Lions Akadimia. Lions Akadimia is a freelancing business that offers services in mathematics tutoring. It presently offers quality mathematics education to high school students in Johannesburg, Gauteng, equipping them with deep subject knowledge, conceptual understanding, and high-level thinking skills that enable them to excel. The team consists of two people who are presently fully employed and work part time. The services were

provided in the following ways: going to the homes of our students to teach them, students visiting our homes to be tutored, and hiring a classroom of a local school during the weekend to host several students. The business proposal is to scale up the existing business and establish mathematics teaching and training institutes. The idea is to grow the existing business into a sustainable business specialising in mathematics.

The business set-up will be such that institutes are established in two provinces of South Africa: Gauteng and Mpumalanga. Four kinds of services will be offered. First, daily afternoon and weekend lessons will be offered to grade 8 to 12 students (different grades on different days of the week, see schedule on appendix 3); second, teacher training will take place every school holiday (training for existing mathematics teachers); third, practical training for education graduates (a one-year internship program) before they report to schools; and fourth, mathematics camps taking place every school holidays targeted at rural areas. The lessons will be highly focused, offered by mathematics specialists who have extensive mathematics teaching experience and a record of exceptional results. The long-term plan is to turn these institutions into institutions of higher education specialising in mathematics, science, and technology.

Lessons offered daily will be both physical and online. This means that students will have an option of attending at the venue or attending online. This strategy will allow students who reside in provinces outside those catering the service to enrol, giving the business access to a larger market. This idea was influenced by the recent COVID-19 restrictions, where mass gatherings are limited, and schools (at some stages) were not allowed to function in a physical form to reduce the chances of spreading the virus.

5.3 Service

Our main service is to offer mathematics teaching and training.

Mathematics teaching:

- Daily afternoon and weekend classes
- School holiday camps

Mathematics training:

- Teacher training during school holidays (existing teachers)
- Practical training for graduates

The mathematics teaching and training offerings supplement the mainstream schooling system. This is a highly focussed offering that supports schools to reach their goals of producing great results. The company will not only rely on its marketing strategy to get customers but will also work in partnership with local schools and government to have a wider reach (to be discussed in the market analysis section).

5.4 Mission and Vision

Our vision is to build a world-class mathematics institution that offers highly competitive mathematics teaching and training services that will become the number one choice for parents, student, government and business in South Africa.

Our mission is to provide quality mathematics education to students. Our business goal is to position our mathematics teaching and training services to become the leading brand in the South African education industry and be among the top five mathematics teaching and training businesses in South Africa within our first nine years of operation.

5.5 Business structure

The success of the business lies its structure and strong operational and management team. Our goal of providing quality services will be anchored on the whole team and hence the importance of employing highly motivated and technically equipped staff. Lions Akadimia will employ professionals and skilled people for the following roles:

- Head of mathematics teaching and training
- Teaching and training team
- Accountant
- Marketing head
- Administrators

The head of mathematics teaching and training will be responsible for providing direction for the business, ensuring that all plans are executed and leading the development and implementation of the business strategy. They will also be responsible for selecting the best teaching and training team whose service is aligned with the business goal of providing high quality mathematics teaching and training. The head will further ensure that the team is developed and trained on any changes in curriculum introduced by the government. Other responsibilities of the head include signing business deals and paying salaries, ensuring collection of tuition fees, evaluating the success of the business, planning

and scheduling, documentation and reporting, maintaining office supplies, meeting with stakeholders and ensuring that the curriculum is aligned with any changes imposed by the education department.

The mathematics teaching and training team will be responsible for providing excellent teaching/training services to students, assessing student progress, ensuring retention of clients, attending to complaints from customers, ensuring discipline, and maintaining good customer experience. The accountant will prepare financial statements, reports, budgets and analyse the financial health of the organisation. They will further do financial forecasts and risk analysis, administer payroll, ensure compliance with tax legislation, handle financial transactions, and develop financial systems and policies.

The marketing head will be responsible for reaching out to new students, creating winning and compelling proposal documents for potential partners, conducting business research and surveys, developing and executing plans for expanding, representing the business in strategic meetings, advertising the business on social media and keeping it updated, attending to inquiries from potential clients, and developing plans to retain customers and grow the business. The administrators will be responsible for providing clients with personalised customer service experience. They will be the first to receive communication from clients and will direct inquiries and follow up on responses. They will also manage administrative duties, ensure correct filing, and consistently provide accurate information to students and business clients.

5.6 SWOT analysis

The industry the business will function in is highly competitive given the existing organisations established and the fact that we are fairly new to the market. The SWOT analysis will help us understand the strengths we have as an organisation that we should capitalise on, the opportunities that exist that we can seize, the weaknesses we need to overcome, as well as the threats that we need to understand and confront. Understanding this will help us to position ourselves in the market so that we can gain a considerable share and realise our business goals.

Strength

Our core strengths include the strong team with good mathematics skills, our existing relationship with some schools, reasonable prices, and our experience in mathematics tutoring.

Weaknesses

We are new in the market, especially the training part of the business; our brand is not widely known so it might take some time to get the brand known and accepted. We will need a buy in from government and business to access one of our target markets.

Opportunities

There are several opportunities that the business can leverage. These include government and business prioritising technical subjects, growing market size of the tutoring industry, considerable number of parents who want their children to perform well in mathematics, and the current gap in the teaching of mathematics (shown by poor results).

Threats

Internal or external circumstances can threaten or potentially destroy the existence of the business. Some threats include the arrival of competitors in the same location, and severe economic downturn that affects people's finances, causing them to not afford tuition.

Although we can anticipate threats and challenges and design plans to overcome them, there are other situations that are beyond our control (such as the economic downturn) and as a business, we will work towards building a resilient business and focus our strengths on leveraging opportunities that grow and strengthen the business in different seasons.

5.7 Market analysis

The market analysis section will provide evidence that there is a niche market that the business will exploit. It provides data on what the market is, who the customers are, where they are, how to reach them, and who the competitors are. This data will be provided through an industry analysis, target market analysis and competitive analysis.

5.7.1 Industry analysis

The business will be affected by the macro-environment, hence the importance of doing this analysis, allowing the business to seize opportunities presented and minimise the threats it is exposed to. Politically, there is government support to improve mathematics results amongst students in South Africa. This is primarily because there is a need to equip students with tools that enable them to be employable, both presently and in the future. The Youth of South Africa is faced with educational, career growth, and employment challenges, with unemployment rates having increased from 26.5% to 29% between 2017 and 2019 (Makgato, 2019). The future of work in South Africa is centred around the fourth industrial revolution and STEM has been identified to be a valuable force that will respond to this changing technological world.

The vulnerability of skills that exclude mathematics gives opportunity for the business to thrive; however, there are several threats that exist in the industry. The use of technological devices has become a need following the recent COVID-19 pandemic governing policies. The limited number of people that can gather in one room means that different strategies must be used in order to gain a wider reach. The lack of basic literacy skills, unaffordability of cell phones/devices as well as data costs are a threat to people in poorer communities where the business plans to partner with other companies to offer mathematics camps.

5.7.2 Target market analysis

The global private tutoring market size is projected to increase from USD 92.59 to USD 171.93 billion between 2020 and 2028 (Baruah, 2020). The increase in this market is attributed to the growing academic support required, particularly in technical subjects like mathematics where performance has been low. The study done by Cambridge Assessment International Education reported that mathematics is the most tutored subject, and of the students surveyed, 66% of them receive private tutoring (Baruah, 2020). There are several factors driving the increase of private tutoring globally, including competitive entrance requirements in gaining access to leading higher education institutions, growing student population in schools, and parents' inability to assist their children academically due to their academic background and/time constraints.

Higher income families spend significant amounts of money on their children's growth, inclusive of coaching and extra academic support. Lower- and middle-class families also spend money in the development of their children's academic growth, although a lower percentage do so. According to Watson (2020), only 6% of working-class parents get private tutoring for their children, while lower-middle class parents constitute 15%, followed by 23% middle class parents and 31% for upper middle class.

Figure 9 shows where the preferred mode of tutoring lies. Although there is gravitation towards online tutoring, there is a bigger portion of tutoring that occurs offline.

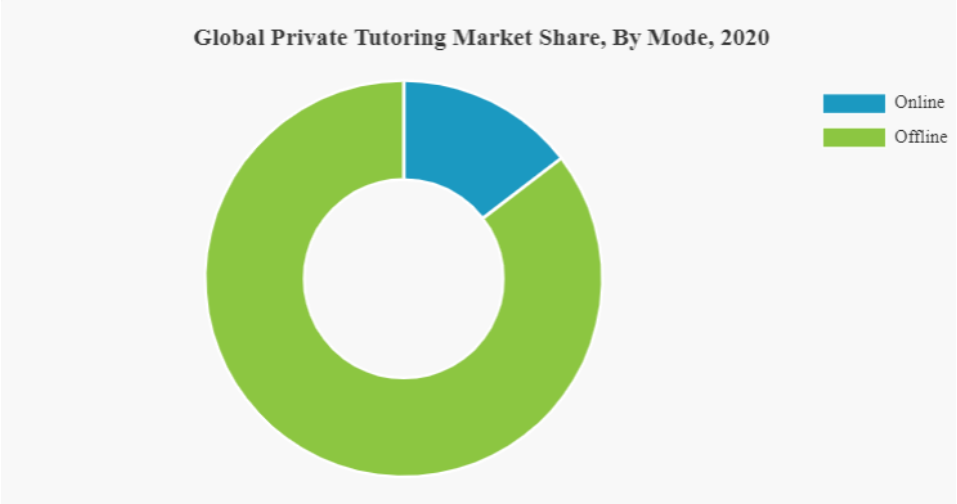

Figure 9:Global private tutoring market share by mode

The business will take advantage of the growing market size in the private tutoring market, with mathematics said to be the most tutored subject, and establish the mathematics training and teaching institutes. Higher income families spend a significant amount of money in supporting their children's education, hence our focus will be providing the tutoring to students from higher income backgrounds. According to Berger (2013), there is a massive untapped market from rural schools. Section 4 of this report has shown a relationship between mathematics performance and school environments, highlighting that schools in lower quintiles perform less than those in higher quintiles. The analysis has further shown that there are more schools and students in the lower quintile groups than the higher. This supports Berger's observation of the existing massive market in rural areas that we can tap into. The obvious challenge in these areas is that it is predominantly the lower income families, whose focus is more on meeting basic needs than spending the little money they have, to give additional support to their children's education.

A different approach will be used to access this market. The strategy that will be used will be partnerships with bigger organisations to fund the mathematics classes. With this market, we will design mathematics camps that will take place during school holidays. We will design a compelling value proposition to the potential partners who have Social Corporate Responsibility (SCR) to the local community, and plan to partner with them to finance the mathematics camps.

The literature review has also highlighted serious gaps in teacher knowledge of the mathematics subject. The analysis in section 4 further showed that although teachers have received some formal education, the performance of their students is predominantly below 40%. This is an opportunity for us to establish the training of both existing mathematics teachers and those entering the field. The training will be centred and focused on mathematics. The challenge may be that teachers will not voluntarily spend their money for further training in the subject, particularly because it may not result in direct monetary benefit to them. The training will be designed for the department of education and costs will be directed to them. The training will be for students exiting university post education studies as well as the existing teachers. There is most likely to be a buy in from the department given the gaps in mathematics knowledge which is seen through poor results annually.

Berger (2013) has identified two categories of demand: the 'battlers' and 'achievers'. The battlers are those who are struggling with the subject and require attention (typically between grade R to 12) while achievers are those who are good in the subject and wish to maintain high grades or improve their marks, aiming to get an 'A' in matric (typically grade 10 to 12) (Berger, 2013). In order to produce efficient and profitable marketing efforts as well as managing marketing and advertising budgets, we are going to target both battlers and achievers; however, the focus will only be from grade 8 to 12.

5.7.3 Competitive analysis

There are several extra maths schools in Gauteng and Mpumalanga, particularly in the big cities, which will compete with our business. Over and above these schools, there are independent mathematics tutors that a play a role in this market, as well as mathematics lessons offered through other platforms, which are easily accessible and cheaper. These include educational features in newspapers, revision programmes on television,

mathematics lessons posted on the internet by universities and professional mathematics teachers.

Our biggest competitor is Master Maths, which was established in 1976 and has centres in all provinces of South Africa. Gauteng has 55 branches and Mpumalanga has 7 branches. Kip McGrath is another big organisation offering mathematics through 60 centres in South Africa (Berger, 2013). These institutions are mostly present in cities, given the affordability in these environments. TV programmes that offer mathematics include LearnXtra, which is broadcasted during weekends on the SABC channels, which are available to anyone who has TV. The mathematics video lessons posted on the internet (Youtube) include lessons by Khan Academy, which has millions of views to date.

There are not a lot of institutions providing focused mathematics training in the country. Previously, the education department had colleges where practical training was done; however, these were closed and incorporated in university programmes which do not have a highly focused plan on training teachers to deliver the subject. Recently, the University of South Africa (UNISA) has introduced a programme in Mathematics Teaching (referred to as the Further Training and Education Band) to respond to the mathematics knowledge gap in teachers. It is a 12-month program that targets teachers and plans to upgrade their qualification in the field of mathematics.

Although players in this market are a big competition to our business, there is an opportunity to obtain a share. Even though there is the presence of independent tutors as well as the well-established tutoring schools, there is a larger unreached market and the present mathematics results still demand increase in extra support in the subject. The pricing model (explained later) of our business supported by our excellent delivery will also give us an upper hand in the market; for example, Kip McGrath charges R285 per 80 minutes while we charge R119 per 60 minutes. While the pricing is obviously competitive, we further have a strong team capable of producing good work that will ensure improvement in our students' grades.

The programmes offered through other platforms such as TV, YouTube and newspapers do not pose a significant threat to our business. This is because they lack the interactive part of lesson delivery, which is critical in mathematics where any misunderstandings must

be cleared, and continuous questions must be asked. The online versus offline market share as shown in figure 12 further illustrates that there is growth potential in the offline market as it is more preferred. The teacher training part of the business has less competition in the market and higher chances of thriving. With many schools across different quintiles producing poor results, there is a bigger opportunity to train teachers and improve results. With the likelihood of a buy in from the education department that desperately needs to produce better results and less role players in the market, the business will have a significant share in this market and thus make considerable profits.

5.7.4 Integrated marketing strategy and promotion decisions

Marketing strategies and promotions are effective ways to produce quick positive results, create brand awareness and encourage customers to try a new product/service. Promotions are also an effective way to get customers to experience one's service and decide whether they will buy in or not. Our business will use effective marketing strategies to gain a share in this market. The following strategies will be used to create brand awareness and get more customers:

- Social media advertising

We will advertise our services on both Facebook and Instagram, which both parents and students use. We will utilise the paid promotional services of these platforms, which will get our data to our target market at a larger scale. Given that these paid promotions run for a week, we will dedicate four weeks of every quarter to do these advertisements for the first year. We will also make sure that our students produce exceptional results, which we will highlight as our success factor on these platforms, ensuring that our work speaks for us. This method will be reviewed annually to measure the impact.

- Billboards

We will use billboards to advertise the business. We will use billboards in areas where there is typically traffic during peak hours to allow our potential customers to read and be able to take our contacts or follow our website or social media pages. This will be done for the first three months and thereafter a review will be done to measure impact.

- Promotions

We will aim to promote our business through giving two free lessons to schools within our target market. We will request to have classes with students after school hours and request the presence of the mathematics teacher as we present challenging topics to the students. The idea is to get a referral from the school for struggling students, and those who seek to improve their marks will ask their parents to enrol for the mathematics lessons we offer. This strategy will work because as it stands, private schools like Curro call in parents of students who are not performing well and request them to give additional support to their children, especially those in grade 9 and the condition is that those who do not get the help and show improvement will automatically be registered for mathematics literacy from grade 10. We will also share two free lessons with the public online. When we have classes with our clients, we will make the lesson available for online students and share the lesson link with the public. We will have no price promotions to ensure that our brand image is not diluted.

The objectives of these marketing strategies and promotions are:

- To introduce our services to the target market
- To attract new customers by increasing brand switching from direct competitors
- To grow the market share
- To increase brand awareness by 40% in July 2022

5.8 Business analysis

The business analysis section investigates and evaluates the viability of the entrepreneurial idea in an environment characterised by resource limitation, intense competition, technology influence, uncertainty and rapid growth. The analysis includes the realness of the opportunity (business model canvas), its durability, marshalling of resources, pricing decision, financial forecast, venture management and venture harvesting.

5.8.1 Realness of opportunity

Table 2: Business model canvas

<table>
<tr><th colspan="5">BUSINESS MODEL CANVAS</th></tr>
<tr>
<td rowspan="2">Key Partners
-Humanitarian organisations
-Universities
-Donors
-Private Schools</td>
<td>Key Activities
-Develop partnerships
-Identify and train
-Facilitate teaching and training of mathematics</td>
<td rowspan="2">Value Propositions
-Training
-Teaching
-Mentoring
-</td>
<td>Customer Relationships
-Expert resource on mathematics education
-In-depth training & coaching as well as co-creation of lessons
-Peer coach and lesson sharing
-Community of practice facilitated by Lions Akadimia</td>
<td rowspan="2">Customer Segments
-School administrator & agencies that set budgets and approve teacher development
-Students (secondary)
-Donors (individual and organisation)
-Government (education department)</td>
</tr>
<tr>
<td>Key Resources
-Education facilities
-Mathematics content
-Mathematics specialists
-Equipment
-Course administrators, instructors, and coaches
-Start-up funding</td>
<td>Channels
-Marketing: direct mail, educational conferences, social media, promotion, advertising
-E-Learning</td>
</tr>
<tr>
<td colspan="3">Cost Structure
-Human resources
-Equipment
-Business operation</td>
<td colspan="2">Revenue Streams
-Endowment
-Donations and sponsorship</td>
</tr>
</table>

5.8.2 Durability of the opportunity

This section analyses the education sector and the internal capability of the business to evaluate the inimitability of the idea and other possible threats that may be posed to the business.

Table 3 illustrates multiple stakeholders that have an influence on the business and the strength of such influence.

Table 3: Sector analysis

Factor	Strong	Moderate	Weak	Motivation
New entrants			●	The business is not capital intensive; however, it is largely dependent on technical skills that act as a barrier to entry.
Suppliers		●		There are many suppliers of resources required, which gives the business many options, but price changes in the industry will force the business to buy nonetheless.
Buyers		●		The skills offered by the business are highly required, giving buyers many opportunities including entering competitive and rewarding labor markets. However, people are price sensitive, and this can affect the customer base.
Substitution			●	Mathematics enables individuals to predict, decide, control, interpret, describe, and explain complex economic issues and bring solutions. There are minimal/no substitute to the mathematics skill itself.
Competitors			●	The existing high failure rate requires more and more service providers, of which there is a shortage in the country, mainly because of the mathematics skill shortage.
Regulators		●		Education is a highly regulated industry, meaning much compliance must be done. Regulation changes including curriculum changes will require the business to make major changes
Digitisation			●	Digitisation requires strong analytical skills, which are founded in mathematics. Digitisation strengthens the need for mathematics

The stakeholders and other potential threats influencing the business inform the competitive power of the business. Many players in the industry have weak influence on the business because of its capability and resources. The business has potential to

predominantly function on a sustained competitive advantage, meaning that the strategy employed will yield considerable profits for a long period.

5.8.3 Marshalling resources

The business will have dual payment methods designed to accommodate those from both privileged and disadvantaged backgrounds. South African companies are committed to the development of its economy and have created Corporate Social Responsibility (CSR) programs that support initiatives that add value in the country, especially education. The business will propose to provide service to companies that contribute to their host communities in the form of education. As a result, students will be offered services at the expense of these companies. The department of education will also be approached to finance students, particularly from poorly performing schools, while a teacher training program is underway. The sponsorship classes will be limited to disadvantaged communities, while others will incur fees as per table 4.

The business will be piloted in Gauteng and Mpumalanga provinces. This is because of the existing footprint that the business has in the provinces, particularly relations with a few schools and the education department. Mathematics teaching and training institutes will be established in these areas, where the following activities will take place:

-Mathematics teachings for grade 8-12 students scheduled every Saturday

-Training for post-graduates before they start the teaching careers in schools. These will take place during the school calendar days (January to December)

-Teacher training scheduled every school holidays

-Sponsored mathematics camps targeted at students from rural communities.

5.8.4 Pricing decisions

Table 4 illustrates the pricing model of the business and how revenue will be generated. According to Berger (2013), the costs of mathematics tuition are uniform across the country, ranging from R150 to R200 per hour with extremes being R120 and R300 per hour. Our pricing model is within these price ranges. The quantities presented in table 4 are based on the designed capacity of the institution during the initial stages of the project. These will increase in the following years, allowing the business to have increased profits. The pricing is for both the camps and the weekly lessons. The rates are presented in hours/annum.

Table 4: Business pricing model

Description	Quantity (No of students)	Annual hours	Unit price/h (R)	Amount (R)
Mathematics camp students	150	96	119	1 713 600
Mathematics teacher training	150	106	150	2 385 000
Mathematics lessons	150	100	119	1 785 000
Mathematics lessons-postgraduates	150	110	300	4 950 000
Total	600			10 833 600

The camps are based on four days of six hours per session during school holidays and/or public holidays, see appendix 3 for the schedule. The grade 8 to 12 classes will take place once a week for two hours per grade and teacher training will take place for one week every school holiday. Part of the training will include on-the-job training where teachers are evaluated while teaching at their respective schools to evaluate whether or not the lessons learned are implemented. The teacher training sessions will occur concurrently with the training of future Lions Akadimia tutors.

5.8.5 Financial forecast (2022 – 2024)

Years Ending: **2022, 2023 and 2024**

Revenue	**Year 1**	**Year 2**	**Year 3**
Sales revenue	R10 833 600	R16 800 000	R23 600 000
(Less Cost of Sales)	R2 500 000	R4 360 000	R6 235 000
Gross Margin	**R8 333 600**	**R12 440 000**	**R17 365 000**
Gross Margin %	**76.9%**	**74.0%**	**73.58%**
Expenses			
Advertising	R35 000	R43 000	R45 000
Depreciation	R40 400	R10 240	R15 850
Employee benefits	R64 800	R72 500	R76 800
Insurance	R16 200	R18 700	R20 400
Interest expense	R90 800	R104 700	R120 440
Maintenance and repairs	R8 200	R8 820	R9 380
Office supplies	R60 000	R51 000	R42 900
Rent	R450 000	R472 500	R490 540
Research and development	R10 000	R12 200	R12 900
Salaries and wages	R3 200 000	R4 220 000	R6 800 400
Software	R280 000	R0	R80 200
Travel	R56 400	R65 300	R72 500
Utilities	R62 000	R64 800	R76 090
Web hosting and domains	R60 000	R72 000	R81 440
Total Expenses	**R 4 433 800**	**R5 215 760**	**R7 944 840**
Net income before taxes	R3 899 800	R7 224 240	R9 420 160
Income tax expense	R1 241 464	R1 400 800	R1 900 500
Income from Continuing Operations	**R2 658 336**	**R5 823 440**	**R7 519 660**
Net Income	**R2 658 336**	**R5 823 440**	**R7 519 660**

5.9 Managing the venture

The model explained in previous sections is limited to two provinces with a limited footprint at the piloting stage, which will take place for three years. The stage is very important to the business mainly because of the school is registered as a private company and will systematically scale-up to gain a larger footprint. The team will also register a non-profit organisation to cater to and marshal resources for the disadvantaged students. Figure 10 illustrates the business growth plan and the stage at which it may be sold to a strategic financial buyer.

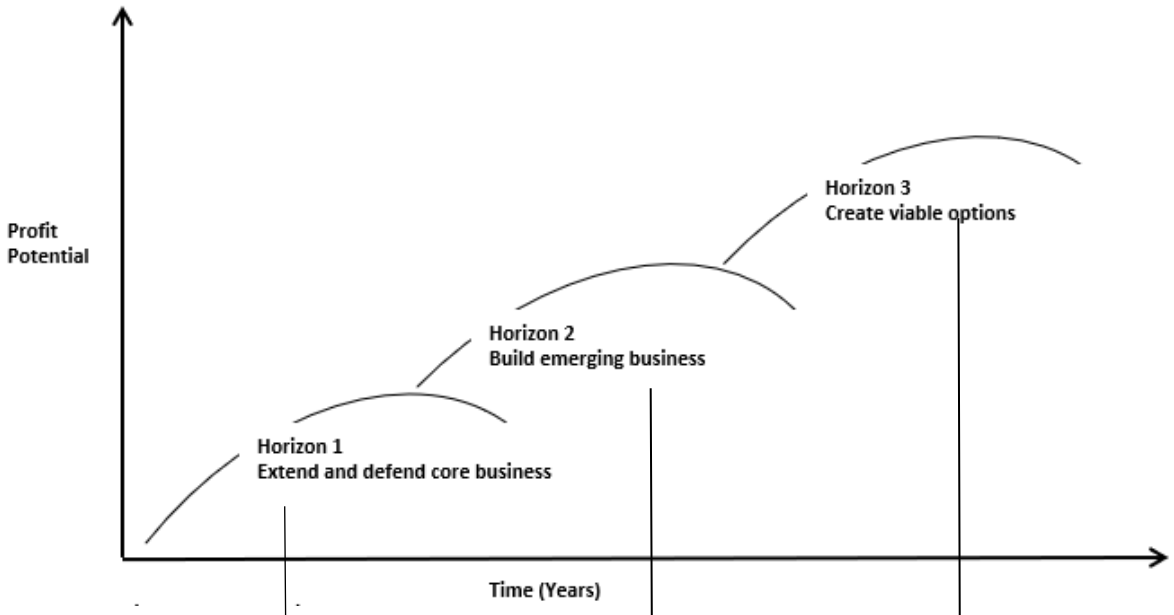

Figure 10: Business growth strategy in preparation for harvesting

Horizon 1

-Training teachers and offering mathematics lessons in Gauteng and Mpumalanga. This is the piloting, preparation and developing phase of the business. The growth in this horizon will involve increasing customers in the established institutions

Horizon 2

-Extend the footprint of the existing business in other parts of the country. The team will predominantly emerge from trained individuals from horizon one.

Horizon 3

-The institutions will systematically transition into mathematics, science and technology training centres, while others are transitioned into schools. The team will evaluate these options based on the needs of the country at the time.

With the first horizon taking up to three years, the second horizon may take between five to seven years while the third may take up to thirteen years. The business may consider selling part of it after that period should the management decide. Although it is generally difficult to hand over a personal project that has been impacting you for a long period, one must make a decision that is best for business growth.

5.10 Capability profile

Lions Akadimia has an existing footprint in mathematics education. The groundwork has been done and solutions to challenges have been established. An understanding of the business environment will allow the business to function better. Furthermore, the school has developed several established relationships that will assist the business' functioning. These include relationships with schools and education departments, mathematics teachers, and a network of mathematics professionals.

As a director of Lions Akadimia, I am an engineer with a good track record of mathematics and science. I also have business skills, both from home experience and learned in the academic space. I can plan, design and strategize business operations and I find more joy in supporting business and operational mandate. I am a good team player and leader who uses inclusive strategies to encourage participation, gain trust and motivate people. Although I can teach, I will add more value in supporting the business through planning, marketing, strategizing and finding financial partners. The co-director is a computer scientist and specialised mathematics tutor with over 10 years of mathematics teaching experience. Both our roles in the professional space included leading and managing, skills that will help the organisation thrive.

5.11 Challenges anticipated

Entrepreneurship has challenges especially when partnerships are involved. The following are challenges that I anticipate in the business:

- Financiers wanting to influence the business strategy, which does not totally align with the business plan
- Discomfort of teachers doing on-the-job training because it is uncommon
- With most South African mathematics teachers having high confidence in mathematics teaching and relegating poor student performance to other causes, they may not be interested in the training
- Students not willing to attend weekly classes during school holidays
- Higher grade students (e.g., grade 10 to 12) who have been performing poorly in the subject may struggle to learn basic principles that they have missed in earlier grades
- Students' mindset of mathematics being a difficult subject may hinder good performance

To overcome these challenges, we will have to frankly explain our value proposition to the financiers, communicate what we want to achieve, be open to their contribution to the business, plan to align their ideas to the business strategy, and strategically win them over so that we are all aligned. Given that we will be investing in our future staff when rendering the service, we will need to explain to trainees the necessity of our training strategy and give them a bigger picture of the direction we are taking and the impact it will have on their careers. Career guidance and motivational events will be arranged for students to impact their mindset, encourage seriousness in their careers, and allow them to see the impact of commitment.

6 CONCLUSIONS

The success of a business depends on the magnitude of the problem the business idea addresses. This project has shown that in South Africa, there is an unacknowledged level of poor teaching that results in persistent poor performance. The inability of teachers to answer questions about the content they are teaching is a clear indication of deficiencies in the students' knowledge of mathematics and consequently their performance.

Most high school teachers agree that the biggest challenge is teacher proficiency, with most attributing the learners' poor performance to the lack of basic mathematics skills that should be acquired in lower grades. A concern to the teachers is training and support they receive on the job. There needs to be a refocus and increase in academic and pedagogical support instead of administrative support, an activity that can potentially improve performance. Although they have workshops during the year, they are deemed ineffective, particularly because they do not address the changing needs of teachers nor incorporate their input and build on their current knowledge.

The proposal to establish mathematics teaching and training institutes aims to solve the mathematics challenges in the country and add considerable value to the education sector of South Africa. The business has potential to have a significant share in the private tutor market which has an exponentially growing market size. Although the business will be established in two provinces in the initial stage, it will expand to other provinces in the subsequent years and realise drastic profit increase. The quality service that will be rendered, with well trained professionals, will ensure that the business grows, retains customers, and becomes sustainable. The business has potential to see considerable growth as it will be accessing an untapped market that consists of students from previously advantaged communities.

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APPENDICES

Appendix 1 Data collection instruments

- Survey

Appendix 2 Ethics documentation

- Consent form
- Survey ethics information

Appendix 3 schedule

- Saturday and weekly schedule
- Camp schedule

Appendix 1 Data collection instrument(s)

Survey

The survey will have a format to assist the researcher keep focus, not miss direction, and cover important content.

Information required

1. In which age category do you fall?
2. What is your highest qualification?
3. For how long have you been teaching mathematics?
4. Which grades are you teaching?
5. On average, how many students do you teach per class?
6. Which province does your school belong to?
7. Which quintile does your school belong to?

Questions

1. On average, how are your students performing in mathematics?
2. What are your top three challenges as a mathematics teacher?
3. What would make you deliver better results as a mathematics teacher?
4. Do you think it is possible for all students to succeed in mathematics?
5. Do you think language is a challenge to mathematics students?
6. Why do students at your school do mathematics literacy?
7. Do you think mathematics literacy is helpful to the students?
8. Do you think there is enough emphasis on basic mathematics skills in the early grades?
9. Do you think mathematics teachers receive enough training?
10. Do you recommend consistent training for mathematics teachers?
11. Is the training/workshop you are receiving effective?
12. Which types of professional mathematics development initiative have you participated in during the past two years?
13. As a teacher, would you like to participate in the development and design of mathematics curriculum and resources?

Appendix 2.1 Consent form

Consent Form to participate in the research study: "Establishing mathematics teaching and training institutes in South Africa"

Name of researcher: Mahlogonolo Mashile

I, …….., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous	YES	NO
I agree that the researcher may use anonymous quotes in her research report	YES	NO
I agree that the information I provide may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	YES	NO

…… (signature)
…… (name of participant)
…… (date)

…… (signature)
…… (name of person seeking consent)
…… (date)

Appendix 2.2 Ethics documentation

About the research

This proposal seeks to get in-depth understanding on the mathematics issues in South Africa. The country is consistently ranking the lowest in performance following multiple international tests. In a quest to improve mathematics performance, the researcher wishes to diagnose the real problems underlying this matter through conducting a survey with maths teachers in three provinces of South Africa and establish a business that is centred around solving the mathematics problems identified on the field.

Ethical considerations when collecting research data:

Research ethics means doing what is morally and legally right in research. As a researcher, I am obligated to ensure that this research is conducted with honesty, objectivity, and integrity. None of the information provided by you (the participant) will be published without your consent. I am further obligated to take care of your confidentiality and personal information or identity as per your choice. This interview will pose no threat to you as a participant or myself as the researcher.

As the participant, you have the exclusive right to give consent to participate, withdraw from, or refuse to take part in this research project. You have the right to seek confidentiality and stop personal information or identifiable data from being published or shared.

Appendix 3.1 Saturday Classes

Saturday Classes - Grade 9, 10 and 11

January 2020			
Date	Grade 9 slot	Grade 10 slot	Grade 11 slot
11/01/20	08H00-10H00	10H30-12H30	13H00-15H00
18/01/20	08H00-10H00	10H30-12H30	13H00-15H00
25/01/20	08H00-10H00	10H30-12H30	13H00-15H00

February 2020			
Date	Grade 9 slot	Grade 10 slot	Grade11 slot
01/02/20	08H00-10H00	10H30-12H30	13H00-15H00
08/02/20	08H00-10H00	10H30-12H30	13H00-15H00
15/02/20	08H00-10H00	10H30-12H30	13H00-15H00
29/02/20	08H00-10H00	10H30-12H30	13H00-15H00

March 2020			
Date	Grade 9 slot	Grade 10 slot	Grade 11 slot

07/03/20	08H00-10H00	10H30-12H30	13H00-15H00
14/03/20	08H00-10H00	10H30-12H30	13H00-15H00

April 2020			
Date	Grade 9 slot	Grade 10 slot	Grade 11 slot
04/04/20	08H00-10H00	10H30-12H30	13H00-15H00
18/04/20	08H00-10H00	10H30-12H30	13H00-15H00
25/04/20	08H00-10H00	10H30-12H30	13H00-15H00

May 2020			
Date	Grade 9 slot	Grade 10 slot	Grade 11 slot
02/05/20	08H00-10H00	10H30-12H30	13H00-15H00
09/05/20	08H00-10H00	10H30-12H30	13H00-15H00
16/05/20	08H00-10H00	10H30-12H30	13H00-15H00
23/05/20	08H00-10H00	10H30-12H30	13H00-15H00
30/05/20	08H00-10H00	10H30-12H30	13H00-15H00

June 2020

Date	Grade 9 slot	Grade 10 slot	Grade 11 slot
06/06/20	08H00-10H00	10H30-12H30	13H00-15H00

July 2020			
Date	Grade 9 slot	Grade 10 slot	Grade 11 slot
11/07/20	08H00-10H00	10H30-12H30	13H00-15H00
18/07/20	08H00-10H00	10H30-12H30	13H00-15H00
25/07/20	08H00-10H00	10H30-12H30	13H00-15H00

August 2020			
Date	Grade 9 slot	Grade 10 slot	Grade 11 slot
01/08/20	08H00-10H00	10H30-12H30	13H00-15H00
15/08/20	08H00-10H00	10H30-12H30	13H00-15H00
22/08/20	08H00-10H00	10H30-12H30	13H00-15H00
29/08/20	08H00-10H00	10H30-12H30	13H00-15H00

September 2020			
Date	Grade 9 slot	Grade 10 slot	Grade 11 slot
05/09/20	08H00-10H00	10H30-12H30	13H00-15H00
12/09/20	08H00-10H00	10H30-12H30	13H00-15H00
19/09/20	08H00-10H00	10H30-12H30	13H00-15H00

October 2020			
Date	Grade 9 slot	Grade 10 slot	Grade 11 slot
03/10/20	08H00-10H00	10H30-12H30	13H00-15H00
10/10/20	08H00-10H00	10H30-12H30	13H00-15H00
17/10/20	08H00-10H00	10H30-12H30	13H00-15H00
24/10/20	08H00-10H00	10H30-12H30	13H00-15H00
31/10/20	08H00-10H00	10H30-12H30	13H00-15H00

Appendix 3.2 Weekday Classes

Weekday Classes, Grade 8 and 12

January 2020			
Date - Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
13/01/20	17H00-19H00	16/01/20	17H00-19H00
20/01/20	17H00-19H00	23/01/20	17H00-19H00
27/01/20	17H00-19H00	30/01/20	17H00-19H00

Amount payable			
Date – Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
03/02/20	17H00-19H00	06/02/20	17H00-19H00
10/02/20	17H00-19H00	13/02/20	17H00-19H00
24/02/20	17H00-19H00	27/02/20	17H00-19H00

March 2020			
Date – Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
02/03/20	17H00-19H00	05/03/20	17H00-19H00
09/03/20	17H00-19H00	12/03/20	17H00-19H00

April 2020			
Date – Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
30/03/20	17H00-19H00	02/04/20	17H00-19H00
06/04/20	17H00-19H00	16/04/20	17H00-19H00
20/04/20	17H00-19H00	23/04/20	17H00-19H00

May 2020			
Date – Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
04/05/20	17H00-19H00	07/05/20	17H00-19H00
11/05/20	17H00-19H00	14/05/20	17H00-19H00
18/05/20	17H00-19H00	21/05/20	17H00-19H00
25/05/20	17H00-19H00	28/05/20	17H00-19H00

June 2020			
Date – Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
01/06/20	17H00-19H00	04/06/20	17H00-19H00
08/06/20	17H00-19H00	11/06/20	17H00-19H00

July 2020			
Date – Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
06/07/20	17H00-19H00	09/07/20	17H00-19H00
13/07/20	17H00-19H00	16/07/20	17H00-19H00
20/07/20	17H00-19H00	23/07/20	17H00-19H00
27/07/20	17H00-19H00	30/07/20	17H00-19H00

August 2020			
Date – Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
03/08/20	17H00-19H00	06/08/20	17H00-19H00
17/08/20	17H00-19H00	13/08/20	17H00-19H00
24/08/20	17H00-19H00	20/08/20	17H00-19H00
31/08/20	17H00-19H00	27/08/20	17H00-19H00

September 2020			
Date – Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
07/09/20	17H00-19H00	03/09/20	17H00-19H00

14/09/20	17H00-19H00	10/09/20	17H00-19H00
21/09/20	17H00-19H00	17/09/20	17H00-19H00
28/09/20	17H00-19H00		

October 2020			
Date – Mondays	Grade 8 slot	Date - Thursdays	Grade 12 slot
05/10/20	17H00-19H00	01/10/20	17H00-19H00
12/10/20	17H00-19H00	08/10/20	17H00-19H00
19/10/20	17H00-19H00	15/10/20	17H00-19H00
26/10/20	17H00-19H00	22/10/20	17H00-19H00
		29/10/20	17H00-19H00

Appendix 3.3 Mathematics camps

Mathematics camps

Description	Time	Hours/day	No of days	Camp hours	Unit price/h (R)	Amount (R)
March Camp 2020						
Mathematics Camp-Grade 12 students 21-26 March	8H00 -16H00	8	5	40	119	4 760
Mathematics Camp- Grade 11 students 27-28 March	8H00 -16H00	8	2	16	119	1 904
June Camp 2020						
Mathematics Camp-Grade 12 students 13-18 June	8H00 -16H00	8	5	40	119	4 760
Mathematics Camp- Grade 11 students 19-20 June	8H00 -16H00	8	2	16	119	1 904
September Camp 2020						
Mathematics Camp-Grade 12 students 24-26 September	8H00 -16H00	8	3	24	119	2 856
December Camp 2020						
Mathematics Pre 2021 Camp-Grade 11 students 12-16 December	8H00 -16H00	8	4	32	119	3 808

Mathematics Pre-2021 Camp-Grade 10 students 17-19 December	8H00 -16H00	8	3	24	119	2 856

Note: The dates were set using the 2020 calendar year. They will be adjusted year on year, particularly because of the uncertainty of the school calendar year in years coming due to COVID-19 pandemic on the education system.