



GAUTENG

**MATHEMATICS, SCIENCE &
TECHNOLOGY EDUCATION
IMPROVEMENT STRATEGY**

2009-2014

GAUTENG DEPARTMENT OF EDUCATION

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY	4
2. RATIONALE FOR THE MST IMPROVEMENT STRATEGY	8
2.1 The State Of MST Education In South Africa And Gauteng.....	9
2.2 Strategies to Improve MST Education In South Africa	16
2.3 The Scope Of The Gauteng MST Improvement Strategy.....	19
3. VISION AND MISSION OF THE STRATEGY	20
3.1 Vision of the Maths, Science and Technology Improvement Strategy.....	20
3.2 Mission of the Maths, Science and Technology Improvement Strategy	20
4. POLICY CONTEXT.....	21
4.1 The Accelerated and Shared Growth Initiative for South Africa (ASGISA)	21
4.2 The National Human Resource Development Strategy.....	21
4.3 The National Skills Development Strategy	22
4.4 The ANC's Education Roadmap.....	22
4.5 The Medium Term Strategic Framework.....	23
4.6 Government's Plan of Action.....	24
4.7 The Gauteng Growth and Development Strategy	24
4.8 The Gauteng Social Development Strategy.....	25
4.9 The Gauteng Strategy for Sustainable Development.....	25
4.10 The Gauteng Human Resources Development Strategy (HRDS)	25
4.11 GDE Five Year Strategic Plan 2009 – 2014.....	26
5. PRINCIPLES AND OBJECTIVES OF THE STRATEGY.....	27
5.1 Feasibility, Affordability and Manageability.....	28
5.2 A Provincial Partnership.....	28
5.3 Dynamic Monitoring, Evaluation and Adaptation	28
5.4 The Objectives of the Gauteng MST Improvement Strategy	29

6.	OBJECTIVE 1: IMPROVING MST TEACHING	31
6.1	The Centrality of Teachers in MST Education	31
6.2	The Strategy for MST Teacher Pre-Service Education and Training	35
6.3	The Strategy for Teacher In-Service Education and Training	36
7.	OBJECTIVE 2: IMPROVING MST RESOURCES.....	41
7.1	The Role of Resources in Improving MST Education.....	41
7.2	The Strategy for Improving MST Resources in Schools.....	42
8.	OBJECTIVE 3: IMPROVING LEARNER ACHIEVEMENT	45
8.1	A Focus on Learners in MST Education	46
8.2	The Strategy for Improving Learner Achievement in MST	48
9.	OBJECTIVE 4: IMPROVING MST MANAGEMENT	51
9.1	Managing the MST Educational Environment.....	51
9.2	The Strategy to Improve MST Management.....	51
10.	FINANCIAL IMPLICATIONS.....	54
11.	OUTPUTS AND INDICATORS.....	56
12.	IMPLEMENTATION AND MANAGEMENT OF THE STRATEGY	67
12.1	Management and Co-ordination.....	67
12.2	Risks and Mitigation	68
	REFERENCES.....	71

GAUTENG DEPARTMENT OF EDUCATION

MST IMPROVEMENT STRATEGY 2009-2014

1. EXECUTIVE SUMMARY

Quality in mathematics, science and technology (MST) education is an ever increasing requirement for the development of skills needed in modern economies. South Africa has for many years struggled to deliver an acceptable quality of MST education at primary and high school. As the hub of the South African economy, Gauteng needs to ensure that school leavers entering into higher education and industry are adequately prepared in these subjects. A review of the current situation in MST education shows that we face daunting challenges. There is a wealth of evidence that shows that our school system is failing our children in respect of MST education and that, while South Africa has indeed made progress in repairing an education system that was severely damaged by Apartheid, we are still far short of international standards in these areas.

Over the past 15 years, there have been major efforts to improve the quality of MST education in South Africa, including the National Strategy for Mathematics, Science and Technology Education in General and Further Education and Training and the Dinaledi project, which has made an encouraging contribution so far. The transformation of the national curriculum has sought to address the challenges of MST education but in many ways, this has exacerbated the situation by overloading schools and teachers with too many changes in a very short period of time.

Gauteng has been contributed to the national initiatives and has sought to bring about improvements in MST in its schools. The Gauteng Department of Education has adopted four strategic goals that will guide its activities over the next five years. These are linked to the national plans of action relating to education and to Gauteng's vision, mission and provincial priorities. GDE's vision is to ensure that every learner in Gauteng does well at school and leaves our institutions with the knowledge, skills and qualifications that will give them the best chance of success in adult life. In order to achieve this, GDE's mission is to ensure quality learning and teaching take place in the classroom every day. The four Strategic Goals are the following:

Strategic Goal 1: To ensure that Gauteng has effective schools and learning institutions

Strategic Goal 2: To ensure that GDE head office and district offices provide relevant, coordinated and effective support

Strategic Goal 3: To enable young people to make the transition from school to further education and or work that provides further training opportunities

Strategic Goal 4: To strengthen GDE's partnerships with all stakeholders, resulting in education becoming a societal priority.

The national policy framework that forms the backdrop for these goals includes Accelerated and Shared Growth Initiative for South Africa (ASGISA) and the raft of national policies that focus on human resource and skills development in South Africa. The Strategy is fully aligned to government's commitments to growth and development and to the improvement of education and opportunities for the country's youth.

The improvement of MST forms part of these goals. The MST Improvement Strategy is drawn from the strategic goals and leans on current GDE plans and activities in these areas. The strategy seeks to address a cluster of MST subjects and learning areas. Included in the scope of the strategy are the following areas:

Numeracy

Mathematics

Mathematical Literacy

Natural Science

Life Science

Technology, including General technology at GET level and Civil, Electrical, Mechanical and Engineering & Graphic Design at FET level

Information and Communications Technology (ICT) and Computer Applications Technology (CAT)

Higher Education in allied areas

MST Teacher development

The MST Improvement Strategy will seek to achieve the following four Objectives:

Objective 1: To strengthen MST teaching in all Gauteng schools.

This objective focuses firstly on the initial professional development of teachers or pre-service training and secondly on in-service training and on continuing professional development of teachers. The World Bank report states that: *"The most consistent finding across a wide range of investigations is that the quality of the teacher in the classroom is*

one of the most important attributes of schools. The MST Strategy adopts the training and support of MST teachers as its central activity. A range of interventions are listed in the Strategy that seek to address both the recruitment and training of new MST teachers (Pre Service Teacher Education & Training) and the continuing professional development of those already in our schools (In Service Teacher Education & Training). The Strategy seeks to establish a formal InSET policy and structure that will guide all activities relating to teacher training. It lists a series of training and support interventions that offer a broad basket of professional capacity building and skills improvement opportunities to MST teachers.

Objective 2: To improve the provision of MST resources.

This focuses on plans to identify and distribute MST textbooks and other Learning and Teaching Support Materials (LTSM) to schools. The Strategy aims at a greater distribution and use of ICT in schools as well as the provision of basic MST resources to all schools, including those that serve learners with special needs. The value of textbooks is recognised in the Strategy and interventions to provide learners with basic texts are included in the Strategy.

Objective 3: To provide programmes of learner support in MST.

This strategy includes a range of initiatives to improve learner achievement through both in-class and supplementary programmes aimed at improvement learner achievement in the short and long term. The Strategy lists a range of interventions that focus directly on learners. This includes supplementary tuition in MST, participation in a range of MST activities, events, competitions and other opportunities that are designed to improve not only knowledge and skills but also attitudes to post-school careers in science, engineering and technology. This objective includes career education as a component.

Objective 4: To improving the management of MST teaching and learning.

The strategy aims to ensure that there is a positive and conducive environment for MST education in schools and districts. The range of interventions in this part of the Strategy aims to improve the teaching and learning environment and the management of MST education in schools. The Strategy recognises that there are many examples of excellence in Gauteng schools. The goal is to identify and then replicate this excellence by creating opportunities for collegiality and sharing amongst teachers and school managers. The Strategy also makes provision for MST facilitators who are teachers whose role is to provide peer support in MST. Included in this objective are interventions to stimulate and encourage schools to set targets and to achieve improvements in MST.

The proposals in the MST Improvement Strategy require a budget of R263 million, of which R143 m is allocated for facilities and resources. The Strategy budget estimates exclude funding for teacher training as it is assumed that these funds will be allocated as part of the normal Human Resource and Development budget.

The Strategy will be managed and coordinated through the appropriate line functions and directorates at GDE but the Sci-Bono Discovery Centre will play a strong coordinative role in bringing together a wide range of other role players to support the GDE. An advisory committee of skilled and experienced MST educators from schools, universities and NGOs will help to plan and monitor the implementation of the Strategy.

The Strategy inevitably involves some risks. These have been identified and mitigation strategies sought to manage them. The risks and challenges include ensuring a general buy-in and support for the Strategy at all levels and the challenge of achieving and maintaining high levels of participation. It is also recognised that the implementation of the GDE's five year plan implies high levels of transformational activity throughout the school system. This increases the need for effective coordination, management and communication.

2. RATIONALE FOR THE MST IMPROVEMENT STRATEGY

Education is critical for the development of a continually improving society and is the engine of democracy. The quality of education has an impact on economic growth and development. The World Bank report on Educational Quality and Economic Growth (World Bank, 2007) states that “*Educational quality...has powerful effects on individual earnings, on the distribution of income, and on economic growth.*” In a world that requires citizens to apply higher order thinking skills and the capacity to use and manage technology that is rapidly becoming more sophisticated, the quality of mathematics, science and technology education has a particularly significant effect on development. The World Bank concludes that “*The measure of the quality of education is a simple average of the mathematics and science scores... (and is) a proxy for the average educational performance of the whole labour force...*” The quality of our education system, as a whole, may be indicated by our capacity to deliver quality mathematics and science education and the achievement of our learners in these subjects. More significantly, the quality of maths, science and technology (MST) education is one of the determinants of the national capacity to grow the economy, create jobs and wealth, compete in the internationally and achieve social equity.

It is beyond debate that South Africa has had an ongoing crisis in Mathematics, Science and Technology education at least since the introduction of Bantu Education in 1953. Since 1994, there have been significant efforts to repair the damage of Apartheid education and to establish a successful education system that produces school leavers who are effectively prepared to enter an increasingly technologically sophisticated economy and society. The demands of the modern workplace and society are nowhere more evident in South Africa than in Gauteng. Likewise, the efforts to deliver quality MST education are nowhere more evident than in Gauteng. Despite some important improvements in education and some significant accomplishments by the Gauteng Department of Education, the achievement of a sustained, general and significant improvement in MST teaching and learning throughout the public school system in Gauteng continues to be an elusive goal. The maths and science results of the 2009 Grade 12 final exam are further evidence of this. A significant amount of funding and time has been applied to efforts to raise the quality and results of MST education over the past 16 years but the problem has been largely resistant to change. The impediments to success and the reasons for the poor pace of progress are complex and only vaguely understood.

Gauteng continues to strive for a major improvement in the quality of MST teaching, learning and achievement in its schools in order to ensure the development of the skills needed for

economic growth, to halt the tragedy of the annual waste of human potential and to make good on government's promises to the electorate.

2.1 The State Of MST Education In South Africa And Gauteng

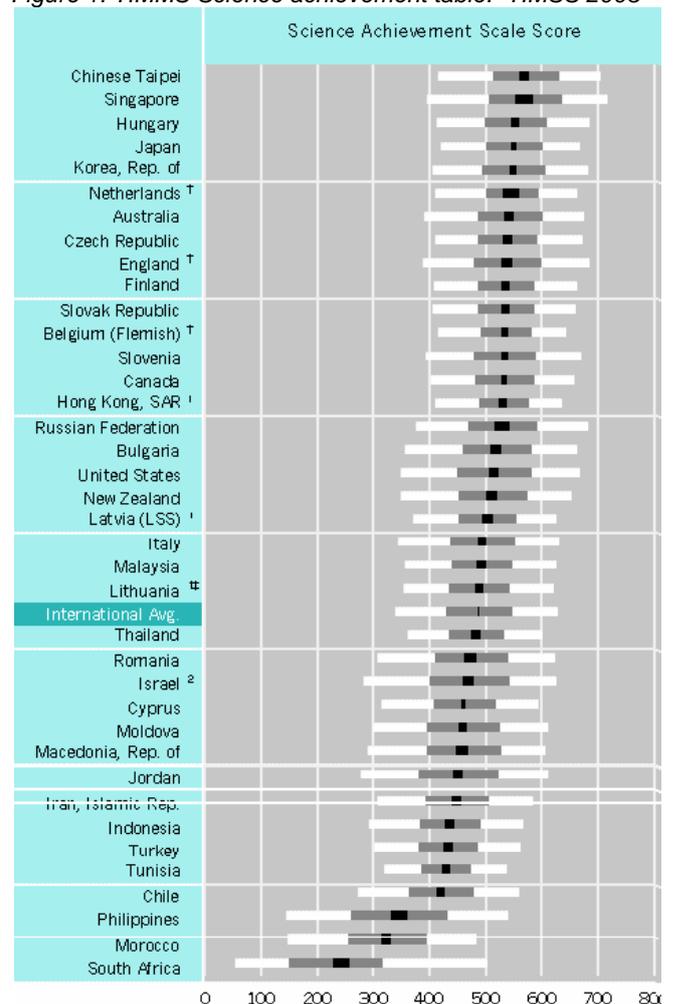
There is an abundance of evidence that shows the poor state of mathematics and science education in South Africa. Besides an abundance of local research data, there are international comparative studies that show that the majority of South African children are achieving performance levels well below those of their peers in Africa and throughout the rest of the world. These include the following studies:

- The National Systemic Evaluation (NSE) of the National Department of Education
- Trends in Mathematics and Science Study (TIMSS), an international study
- Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ).
- Progress in International Reading Literacy Study (PIRLS)
- Monitoring Learner Achievement Study (MLA)

The following facts that emerge from the studies indicate the state of the problem facing MST education.

- The 2003 TIMSS study shows that 77% of Grade 8 learners achieve less than 50% in science. The mean score for maths was 33%. The study shows South African learners as the worst performing learners in the study. More recently, the Third International Mathematics and Science Study Repeat (TIMSS-R) study showed that South African Grade 8 learners again performed poorly compared with those of other countries. The South African performance was lower than other African participants, Morocco and Tunisia.

Figure 1: TIMSS Science achievement table. TIMSS 2003



- Prior to 2008, the top 11% of schools accounted for 71% of Higher Grade maths passes. The bottom 81% of schools produced 16% of Higher Grade maths passes. (i.e. an average of 1 pass per school). The situation persists, although national policy no longer differentiates between Higher and Standard Grades at FET level.
- The National Systemic Evaluation conducted by the Department of Education in 2005 found the mean scores of Grade 6 learners to be 37% for mathematics.

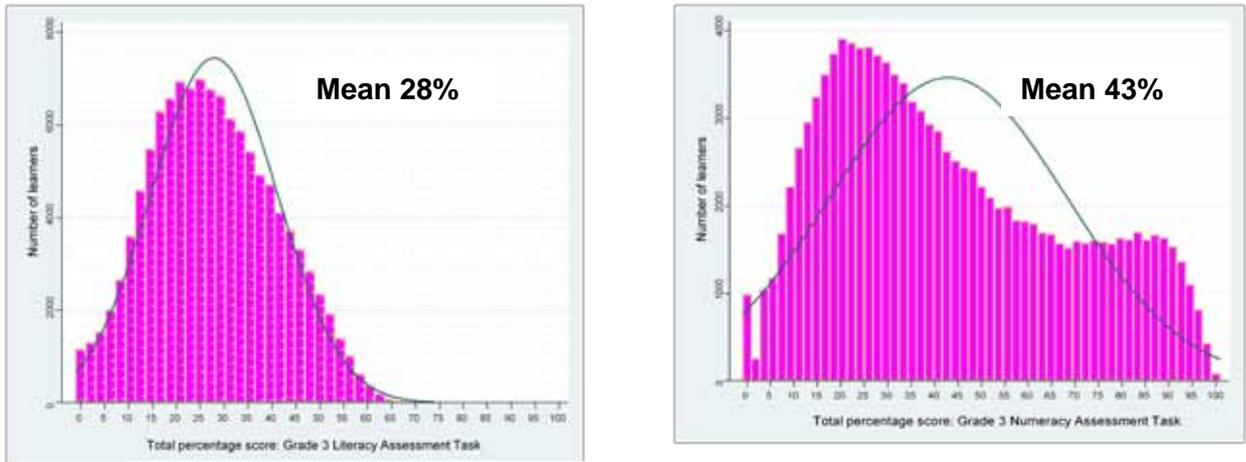


Figure 2: 2008 Gauteng Grade 3 literacy and Numeracy Scores

Source: GDE 2009

- Grade 3 Numeracy and literacy rates fall far short of target. (See Fig 2 above) Currently, 350 Gauteng primary schools have Grade 3 numeracy rates of under 30% and 480 have Grade 6 maths achievement rates under 30%.
- The studies show that about 83% of learners in Grades 6 and 8 do not achieve at the minimum standards for their grade.
- Around 80% of South African grade 6 learners in the study reached the lower half of eight levels of competence in mathematics on the SACMEQ continuum. The SACMEQ study shows that 52% of Grade 6 learners achieve maths scores at a Grade 3 level or lower.
- The UNESCO-UNICEF Monitoring Learning Achievement Project revealed that more than 10 000 South African Grade 4 learners scored an average of only 30% for numeracy, with a large proportion of them scoring less than 25%.

The Final Report of the Primary Mathematics Research Project (Schollar, 2008) comments that “... over 90% of learners (are) being promoted (i.e. assessed as having ‘sufficiently’ mastered the required content) from Grade 5 to Grade 6, at the same time

that the National Department's own Systemic Evaluation was showing that 80% of them were actually below the minimum expected standard for Grade 6". The same report asserts that "the only national measure of the outcomes of the school system has been the matriculation examinations; the class of 2006 was particularly interesting in that it was the first 'post-Apartheid' cohort of learners that has passed through the school system since 1994. A total of 1 676 273 learners were enrolled in Grade 1 in 1995. These learners were in Grade 4 in 1998, the year that Outcomes Based Education was introduced in the form of Curriculum 2005.

- § 528 525 learners (31,5%) survived to write the matric exams in 2006
- § 330 513 learners (19,7%) wrote the mathematics exam
- § 25 217 learners (1,5%) achieved a pass at Higher Grade in mathematics"

The Data-Informed Practice Improvement Project (DIPIP) is an initiative of the Gauteng Department of Education (GDE) and the School of Education at the University of the Witwatersrand which was established in 2006. The goal was to improve teaching and learning in mathematics. In 2006 and 2007 selected schools wrote the International Competitions and Assessments for Schools (ICAS) tests. The performance levels were low across all grades and learners.

In the 2008 matric exam, South Africa produced 63 035 passes above the 50% mark in mathematics and 33 453 passes above 50% in natural science in the Grade 12 exams. This represents a great improvement over the number of 25 000 learners who achieved Higher Grade passes in 2007. (See Table 1)

SCORE	MATHS	PHYS SCIENCE
0 – 29	162 168	98 060
30 – 39	46 715	57 293
40 – 49	26 754	28 987
50 – 59	20 715	16 112
60 – 69	16 781	9 584
70 – 79	12 902	5 292
80 - 100	12 637	2 555

Table 1:2008 Grade 12 Maths and Science Results Source: DoE

However, based upon an assumption that universities require a minimum matriculation mark of 50% as the basis for admission to science, engineering and technology related studies, the number of qualifying school-leavers is hopelessly inadequate for the needs of the South African economy.

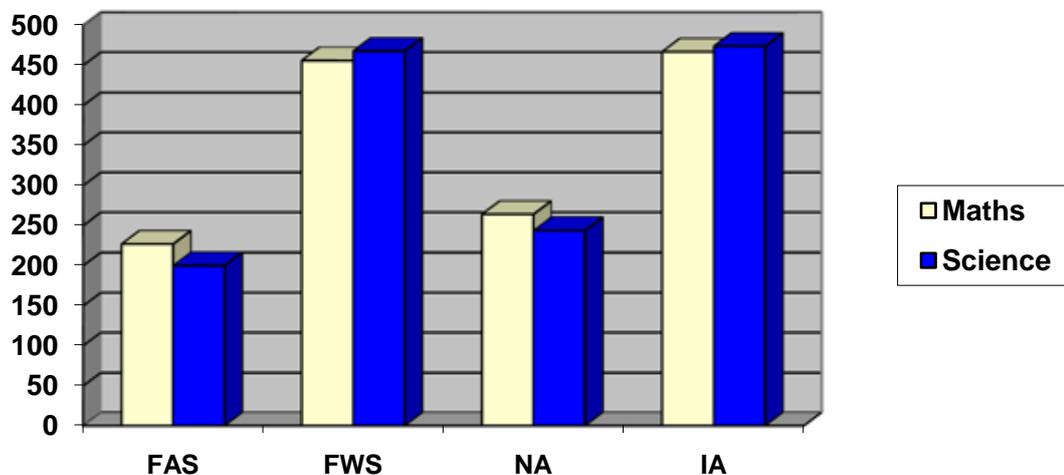
The results for 2009 show no change in the trends. An analysis of the Gauteng maths and science results is shown in table 2 below.

	Maths	Physical Science
Candidates	47 567	39 688
Passed	55,7%	42,6%

Table 2: Gauteng 2009 maths and science results

The statistics shown by the tables conceal the fact that the system remains highly inequitable and that the quality of schooling in schools in disadvantaged communities lags seriously behind that of the urban and economically advantaged schools. The majority of maths and science passes are still from independent and former Model C schools. African learners who commute to these schools from the townships are achieving the same scores as their classmates. Nearly double the numbers of SET graduates come from formerly whites only schools as from former African schools.

The challenges faced at primary and high schools in respect of maths and science education have predictable consequences in higher education. Former white universities produce over double the number of SET graduates as former African universities. (See fig 3 below)



FAS= former African school. FWS= former White schools NA= National Average IA= International Average

Figure 3: SET Graduates by High School background

Source; HSRC

A similar pattern is indicated in a comparison of science, engineering and technology graduate rates in historically black universities between historical universities and historically white universities. Figure 4 below shows that there are many more enrolments historically white universities. Graduation rates are low throughout the system.

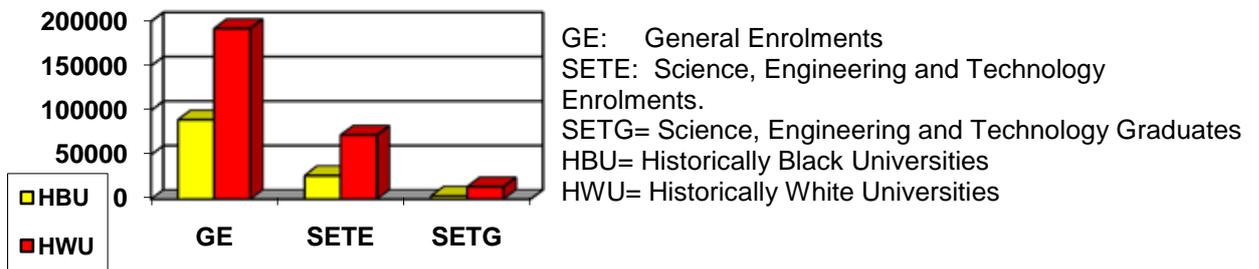


Fig 4: South African Graduate Profiles Source: HSRC

Inequity patterns extend beyond education and into the World of Work. Evidence shows that most unemployed science and engineering graduates are African and female. Figure 5 below shows that the ratio of unemployed African women SET graduates is exponentially higher than any other group, with coloured, Indian and white male graduates showing radically lower unemployment rates than other groups.

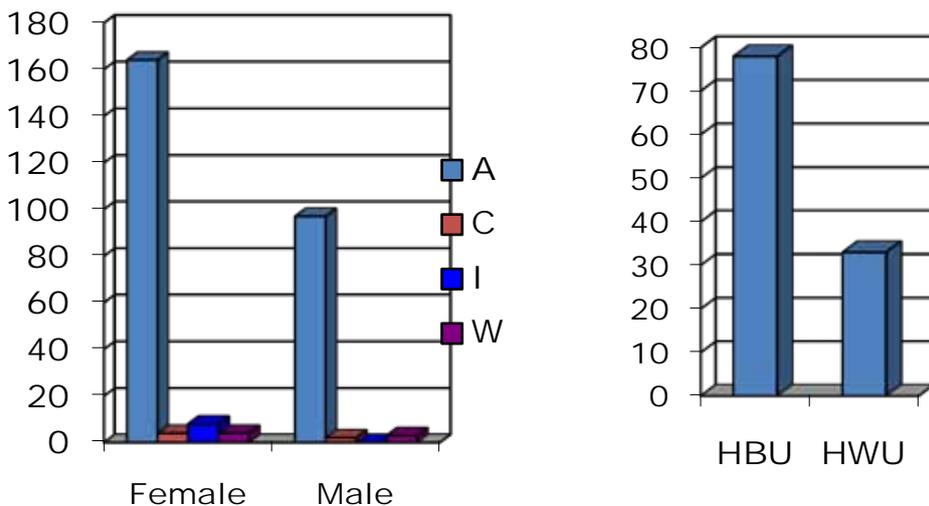


Figure 5: Unemployed Science & Maths Graduates Source: HSRC

Similarly, the legacy of many years of inadequate schooling has had a predictably negative impact on the production of maths and science teachers. South Africa needs to improve the quality and quantity of MST teachers. Statistics indicate that we are not attracting sufficient numbers of school leavers into the teaching profession. Surveys of teachers and teacher qualifications were conducted in 2008 and 2009. The surveys (See figure 6 below) involved just over 106 000 maths, maths literacy and science teachers. Of these, 30% are qualified and teaching; 16% are qualified and not teaching; 7% are teaching without appropriate qualifications.

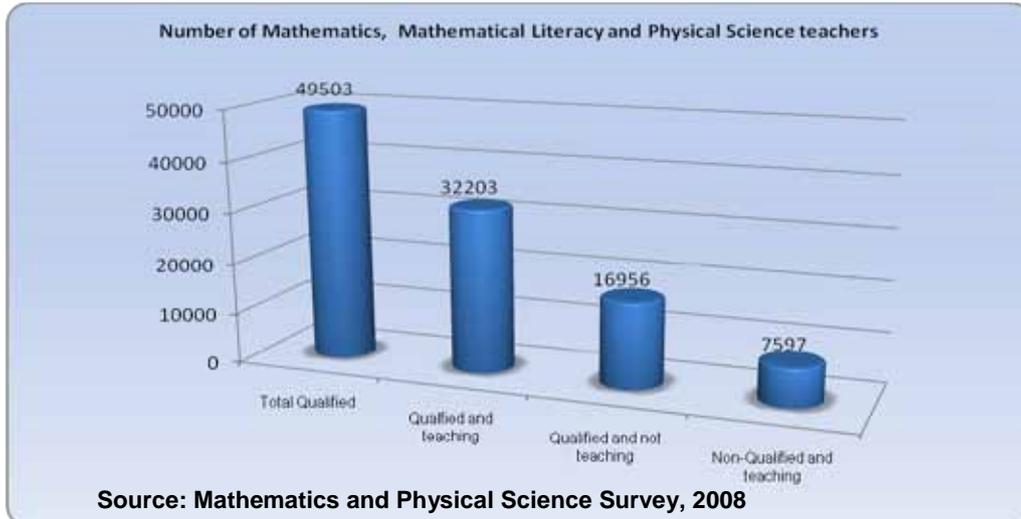


Figure 6: Maths, maths Literacy & Physical Science Teachers

In 2008, the Department of Education and Council for Higher Education identified the following challenges in teacher education.

- No teacher education policy framework.
- Inadequate supply and demand information for planning teacher education.
- No coherent strategy to upgrade under-qualified teachers effectively.
- No comprehensive data on the levels of literacy in primary schools across all 11 official languages, nor an explanation of the anticipated poor levels.
- Ineffectiveness in the training of teachers to teach reading and numeracy.
- Shortage of quality materials to be used by teacher-educators in key areas.
- Paucity of evidence-based research to inform policy and practice on teacher education in South Africa.

	Math Lit	Math/ MST	Science Ed/ Physical Sc	Life Sciences
Registrations	876	3542	389	201
Programmes	9	30	10	5
Total Registrations In ACE Programmes			43 803	

Table 3: Registrations on ACE programmes in mathematics and science across 22 HEIs offering teacher education and development programmes 2008

Table 3 above indicates that we are not attracting sufficient numbers of new teachers into the system. There are about 395 000 teachers in South Africa and the Centre for Development and Enterprise estimates that natural attrition rate is about 5% p.a. At the

end of 2006, only 6 000 new MST teachers were expected to graduate. The situation is also worrying in respect of continuing professional education in MST. Table 2 above shows that only 11.5% of ACE registrations in 2008 were in MST.

These issues apply directly to the critical gateway subjects of maths and science and represent some of the main causes of the problems in these areas. The lack of a comprehensive standardised In-Service teacher education and training policy and structure is clearly a concern at national and provincial level and addressing this will be a major focus of this MST strategy.

The crisis in MST education cannot be understated. It cannot be left unsaid however that South Africa has made significant progress in repairing the damaged education system that was the legacy of many years of oppression.

Summary of outcomes of the matriculation examinations: 1996 to 2006

Year	Candidates: all subjects	Failed (%)	Pass with exemption (%)	Math candidates	Pass HG (%)	% of math candidates	% of all candidates
1996	518 077	44,6	15	214 720	31 545	14,7	6,1
1997	538 189	50,8	13	252 618	31 590	12,5	5,1
1998	552 862	50,6	13	279 702	28 849	10,3	5,2
1999	511 474	51,1	12	281 304	27 187	9,7	5,3
2000	489 941	42,0	14	284 017	24 877	8,8	5,1
2001	449 371	38,3	15	263 945	19 504	7,4	4,3
2002	443 821	31,1	17	260 989	20 528	7,9	4,6
2003	440 267	26,7	19	258 323	28 693	11,1	6,6
2004	467 985	29,3	18	276 094	24 143	8,7	5,2
2005	508 363	31,7	17	303 152	26 383	8,7	5,2
2006	528 525	33,4	16	330 513	25 217	7,6	4,8
Total	5 448 875	39,1	15	3 005 377	288 516	9,6	5,3

Sources: EMIS Reports of National Department of Education, CDE, CEPD, Ministerial Statements

Table 4: Matriculation in maths. 1996 to 2006

It is also easy to ignore the fact that in 1990s, the number of African Higher Grade passes in Mathematics and science was in the hundreds. In 1996, a total of 31 545 learners passed Higher Grade maths and it is estimated that less than 2 000 of these were African learners who achieved levels that would allow them access to science or engineering studies at university. (See table 4 above) The matriculating class of 2008 had 63,038 learners who passed mathematics at the 50% level or higher. This stands in contrast to the 25,000 who passed Higher Grade mathematics in 2007. A further 207,230 learners passed mathematical literacy, most of whom would not have done any mathematics in the previous system. A total of 16,557 passed mathematical literacy at the level of 80% or higher.

2.2 Strategies to Improve MST Education In South Africa

National Strategy for MST Education in General and Further Education & Training.

In 2001, the state adopted the National Strategy for Mathematics, Science and Technology Education in General and Further Education and Training. The strategy laid out three main thrusts:

- To raise participation and performance by historically disadvantaged learners in Senior Certificate mathematics and physical science;
- To provide high-quality mathematics, science and technology education for all learners taking the first General Education and Training Certificate and Further Education and Training Certificate; and
- To increase and enhance the human resource capacity to deliver quality mathematics, science and technology education

The strategy has been periodically reviewed and was updated in 2007 into an expanded MST strategy.

Gauteng MST Strategy

The National MST Strategy initiated by the National Department of Education resulted in the Gauteng Department of Education designing its own version of the strategy (Gauteng MST Strategy). In November 2002 a team of five project managers was appointed to oversee the implementation of the MST Strategy in the Gauteng Province.

Conceptualized as a three-year intervention, the MST Strategy is aimed at achieving three goals:

Goal 1: To increase and enhance the human resource capacity to deliver quality mathematics, science and technology education for all learners.

Goal 2: To increase the participation and performance of learners in mathematics, science and technology in the GET and FET Bands, giving special attention to black learners, female learners and learners with special education needs.

Goal 3: To provide and encourage optimal use of appropriate resources to deliver quality mathematics, science and technology education for all learners.

The project achieved some success but did not lead to a significant or sustained improvement in MST teaching, learning and achievement.

The Dinaledi Project

The Dinaledi project is the national flagship MST improvement project. It aims:

- To increase the number of learners studying mathematics and physical science in grades 10-12.
- To increase the number of higher grade learners in these subjects – especially girls and formerly disadvantaged learners. To increase the pass rate and achievement in mathematics and science in these grades.
- To develop the capacity of the mathematics and physical science teachers.

Initially 102 African schools, who were achieving reasonable success rates in maths and science, were selected for participation but this number was increased to nearly 500 in 2007. The project has generally achieved its goals and can be considered as successful, having contributed 24% of the total number of learners with passes over 50% or higher in mathematics and 27% of the total number of learners who achieved 50% or higher in science. Gauteng has 101 Dinaledi schools. About 20% of the total Dinaledi maths passes and 22% of Dinaledi Science passes were from Gauteng. While the project has been one of the most successful to date, part of its success lies in the fact that it has focussed on institutions with a track record of success and has been limited in scale.

The National Curriculum Transformation Process

Perhaps the largest impact on MST education has been the ongoing curriculum transformation process that began in 1997. The key elements of the process include the following:

- The introduction of Technology: A HEDCOM project called Technology 2005 was launched in 1995 to introduce Technology as a mandatory GET learning area.
- The introduction of Curriculum 2005: The first national curriculum revision, the first to introduce Outcomes Based Education, was initiated in 1997. The new approach sought to align to international standards and to the new competence-Based approach to education. Flaws in the curriculum became apparent almost from the beginning and a revue was commissioned by the then Minister of Education, Kader Asmal.
- The work of the Chisholm commission that reviewed the curriculum in 2000 lead to the overhaul of the national curriculum and the introduction of the Revised New Curriculum Statements that redefined the structure and simplified some of the complexities of the first version of Curriculum 2005 that had undermined the delivery of the GET and FET curriculum. The Revised National Curriculum Statements were completed in 2002 and introduced in 2004.
- The school system has now had some years of experience of the new curriculum and can base future curriculum policy on evidence. The latest review of the national curriculum was commissioned by the Minister of Basic Education, Angie Motshekga,

and an NCS Report has been submitted to her. This report recommends further changes and adaptations to the national curriculum, based on experience in the school system.

The Foundations for Learning Strategy

This four year long initiative was launched in 2008 in order to improve literacy, language, numeracy and mathematics achievement by not less than 50% by 2011, when a national evaluation of Grade 3 and 6 learners will be conducted.

Draft GDE MST Strategy 2009-2014

The GDE curriculum unit developed a draft Mathematics, Science and Technology (MST) Strategy to address the challenges of improving learner achievement in these areas. The approach is also outlined in the cabinet memo drafted on 27th October, 2009. The strategy document has been recently revised to align to the Strategic Goals. It identifies three key 3 goals:

Goal 1: To increase and enhance the human resource capacity to deliver quality mathematics, science and technology in GET and FET.

Goal 2: To increase the participation and performance of learners in mathematics, science and technology in GET and FET, giving special attention to African learners, female learners, and learners with special educational needs

Goal 3: To provide and encourage optimal use of appropriate physical resources in the delivery of quality mathematics, sciences, technology in GET and FET.

There is general agreement amongst educational experts that the extent and pace of educational transformation in South Africa since 1995 has been extremely challenging. Perhaps one of the most difficult aspects has been that the transformation has not been from one functional education system to another, but from an extremely dysfunctional system that entrenched low standards and inefficiency. Simply repairing the damage of Apartheid education would have been a strong challenge without simultaneously seeking to introduce a sophisticated approach that requires high levels of skill and confidence in the teaching community.

Changes in the professional attitudes and behaviours of educators remain the most important challenges in education and the *sine qua non* for the improvement of maths, science and technology education in South Africa and Gauteng.

2.3 The Scope Of The Gauteng MST Improvement Strategy

Whereas most of the previous MST strategies have focussed exclusively on mathematics, mathematical literacy, natural science and technology education, there is a need to expand the scope of an improvement strategy. This need emanates from the need to ensure that primary and secondary education effectively prepares learners for post-school education, training, employment and their roles as citizens, community members and consumers.

The strategy seeks to address a cluster of MST subjects and learning areas. Included in the scope of the strategy are the following areas:

- Numeracy
- Mathematics
- Mathematical Literacy
- Natural Science
- Life Science
- Technology, including General technology at GET level and Civil, Electrical, Mechanical and Engineering & Graphic Design at FET level
- Information and Communications Technology (ICT) and Computer Applications Technology (CAT)
- Higher Education in allied areas
- MST Teacher development

The Strategy will seek to recognise and react to the needs of special schools and learners with special needs in respect of MST education. The strategy also recognises that there is a continuum of educational development wherein success in each stage of development and in each grade is dependent on quality of achievement in the previous stage. Each grade of schooling serves as the platform upon which the next grade must build and so inadequate education in the early years of schooling will have a permanent negative effect on all future education and training. There is evidence that many of the problems faced in high school are caused by an inadequate basic education in primary schools and the failure to build a solid platform in the early years of schooling. For this reason the strategy seeks to address longitudinal continuity between early childhood education, primary secondary and higher education.

3. VISION AND MISSION OF THE STRATEGY

The vision and mission for the Gauteng MST Improvement Strategy derive from those of the Gauteng Department of Education's overall strategic vision and mission. GDE's vision is:

"Ensuring every learner in Gauteng does well at school and leaves our institutions with the knowledge, skills and qualifications that will give them the best chance of success in adult life."

In order to achieve this, GDE's mission is:

"To ensure quality learning and teaching take place in the classroom every day."

The provincial vision and mission are embodied in four core Strategic Goals. These are the following:

Strategic Goal 1: To ensure that Gauteng has effective schools and learning institutions

Strategic Goal 2: To ensure that GDE head office and district offices provide relevant, coordinated and effective support

Strategic Goal 3: To enable young people to make the transition from school to further education and or work that provides further training opportunities

Strategic Goal 4: To strengthen GDE's partnerships with all stakeholders, resulting in education becoming a societal priority

The purpose of the Gauteng MST Improvement Strategy must be to give effect to the GDE's vision and mission and to service the four core strategic thrusts, particularly as these relate to broad delivery of mathematics, science and technology education. To this end the Strategy adopts the following vision and mission:

3.1 Vision of the Maths, Science and Technology Improvement Strategy

Our vision is to ensure that all learners leave our institutions with the mathematical, scientific and technological knowledge, skills and qualifications that will give them the best chance of success in adult life and the ability to participate in an emerging knowledge-based economy that supports sustainable development.

3.2 Mission of the Maths, Science and Technology Improvement Strategy

The mission of the strategy is to ensure quality teaching and learning of science, mathematics and technology in General and Further Education and Training in Gauteng.

4. POLICY CONTEXT

This section contains a brief summary of relevant policy and planning documents. These documents help to describe the broader economic policy context in which the MST Strategy will unfold.

4.1 The Accelerated and Shared Growth Initiative for South Africa (ASGISA)

The challenge of the struggle against poverty and underdevelopment rests on three pillars:

- Encouraging the growth and development of the First Economy, increasing its possibility to create jobs;
- Implementing programmes to address the challenges of the Second Economy and
- Building a social security net to meet the objective of poverty alleviation.

ASGISA aims to increase economic growth to 6% and halve poverty and unemployment by 2014.

The focus of the policy is on initiatives that are labour absorbing, poverty alleviating and which promote growth and sustainability. Infrastructure development is central to the initiative. In addition, particular sectors have been identified for accelerated growth, namely:

Business process outsourcing	Metals and metallurgy
Tourism	Wood, pulp and paper
Chemicals	Agriculture
Bio-fuels	The creative industries and textiles

4.2 The National Human Resource Development Strategy

The National Human Resource Development Strategy (NHRDS) aims to promote lifelong learning and to improve the coordination of HRD policies across departments. The objectives of the NHRDS are as follows:

- Improving the foundations for human development;
- Improving the supply of high-quality skills (particularly scarce skills) which are more responsive to societal and economic needs;
- Increasing employer participation in lifelong learning;
- Supporting employment growth through industrial policies, innovation, research and development; and
- Ensuring that the above strategic objectives of the HRD system are linked.

4.3 The National Skills Development Strategy

The National Skills Development Strategy (NSDS) is intended to radically transform education and training in South Africa by improving both the quality and quantity of training to support increased competitiveness of industry and improved quality of life for all South Africans. The vision of the NSDS is skills for sustainable growth, development and equity. The NSDS identifies five strategic objectives:

- To prioritise critical skills for growth and development.
- To stimulate quality training for all in the workplace.
- To provide employability and sustainable livelihoods through skills development.
- To assist new entrants into the labour market and self-employment.
- To improve the quality and relevance of provision.

4.4 The ANC's Education Roadmap

The report identifies a roadmap that seeks to build on recent achievements and to address future challenges. The plan involves the following 10 points of action:

- 4.4.1 Teachers to be in-class, on time, teaching using the textbooks.
- 4.4.2 Improving the quality of early childhood education and primary schooling, including implementing the Foundations for Learning Campaign.
- 4.4.3 Annual external testing of all Grade 3 and grade 6 learners.
- 4.4.4 Ensure effective evaluation of all teachers based on learner performance, with results influencing occupationally specific dispensation pay for teachers.
- 4.4.5 Recruitment of quality teachers and strengthening teacher support.
- 4.4.6 Strengthen management capacity to ensure working districts and schools, through bringing in external management capacity.
- 4.4.7 Increase the use of ICT in education, including audiovisual teaching.
- 4.4.8 Improve national-provincial alignment and efficiency of education expenditure, through procuring textbooks nationally and allocating resources to improve district capacity.
- 4.4.9 Develop a social compact for quality education and a National Consultative Forum dedicated to clarifying the "non-negotiables" and performance targets for key stakeholders. Mobilise communities at all levels
- 4.4.10 Implement poverty combating measures that improve the environment for learning and teaching.

4.5 The Medium Term Strategic Framework

Included in the MTSF is **Strategic Priority 4: Strengthen the skills and human resource base**. There are 9 elements of this priority.

- improving learner outcomes by 20% in the key education indicators by 2014
- Increase participation in and improved quality of ECD services, with universal access to Grade R and double the number of 0 – 4 year-old ECD learners by 2014.
- Expand access to and capacity of secondary education with a view to increasing enrolment rates to 95% by 2014 and ensuring that as many young people as possible are able to access and complete secondary education.
- Creating conditions for effective school management, including monitoring and evaluation;
- Broaden access to post-secondary education and improve Higher Education throughput rate by 20% by 2014, including access by people with disabilities;
- Ensuring that training and skills development initiatives in the country respond to the requirements of the economy, rural development challenges and social integration.

In discussions that unpack specific outcomes of the MTSF the following goals have been described as desirable:

- Improve Grade 3 literacy and numeracy to a national average of 65% and Grade 6 Mathematics and English to a national average of 75%;
- Ensure that learners in these grades are assessed every year independently, using internationally benchmarked tests
- Provide every learner in the worst performing 80% of schools with learning materials
- Ensure that all teachers to have work plans for every day
- Visit every school at least once annually to measure curriculum coverage and functionality of the school.
- Increase Grade 12 passes in Mathematics, Science and Computer Science to 50% for those who register for University entrance.
- Increase number of Grade 12 passes so that 250 000 learners are able to enter University.
- Conduct exit proficiency tests among a sample of those that pass Grade 12 with a University entrance certificate.
- Improve retention rate between Grades 8 and 12 by 20%.
- Address teacher and principal quality issues; consider a basic qualification for principals.
- Improve school infrastructure starting with basic services and minimum functionality.

- Improve school safety, learner transport and extent of school nutrition.
- Empower school principals to improve discipline and management.
- Improve institutional and management capacity at national, provincial and district levels.

4.6 **Government's Plan of Action**

In the Human Development Cluster section of the Governments Plan of Action the following commitments, which are relevant to the MST Improvement Strategy, are listed:

- Train Maths and Science teachers and provide additional resources to Dinaledi schools. The indicator for this is an increased number of Maths and Science passes in National Senior Certificate;
- Provide support to matric learners as indicated by the number of schools supported;
- To provide all learners with suitable Learner Teacher Support Materials
- To increase participation in and improved quality of early childhood development services and to Implement Foundations for Learning Guidelines for resourcing and delivery of Grade R;
- Expand access to and capacity of secondary education with a view to increasing enrolment rates and that more young people are able to access and complete secondary education

4.7 **The Gauteng Growth and Development Strategy**

The Gauteng Growth and Development Strategy (GDS) objectives are:

- Halving unemployment – ensuring high levels of labour absorption, economic growth contributing to reduced inequality and the development of the province, nation and continent
- Halving poverty – growing secure and prosperous communities with jobs, schools, clinics and other services in a safe and healthy environment which supports active social, cultural and volunteer activities
- Provision of social and economic infrastructure and services that will build sustainable communities and contribute to halving poverty
- Accelerated, labour absorbing economic growth that increases per annum and that will
- create long-term sustainable jobs and contribute to halving unemployment
- Sustainable socio-economic development
- Enhanced government efficiency and co-operative governance

- Deepening participatory democracy, provincial and national unity and citizenship
- Contributing to the successful achievement of NEPAD's goals and objectives

4.8 The Gauteng Social Development Strategy

The draft Gauteng Social Development Strategy (GSDS) outlines the following vision and strategic objectives:

- Enabling faster economic growth and job creation
- Fighting poverty and building safe, secure and sustainable communities
- Developing healthy, skilled and productive people
- Deepening democracy and nation building and promoting constitutional rights
- Building an effective and caring government

4.9 The Gauteng Strategy for Sustainable Development

The Gauteng Strategy for Sustainable Development (GSSD) identifies four sustainable development priorities:

- Promoting capacity building and human recourse development for sustainable development.
- Strengthening intergovernmental and societal relations.
- Promoting economic development for sustainable development.
- Promoting sustainable human settlements and recourse use.

4.10 The Gauteng Human Resources Development Strategy (HRDS)

The GPG HRD mission is to facilitate the development and integration of HRD initiatives within Gauteng to address key provincial socio-economic imperatives in line with national policy frameworks. The Gauteng HRDS proposes five "systemic breakthroughs" as follows:

- Accelerate improvements in the education foundations (ECD and Schooling)
- Create a skilled, adaptable and employable workforce.
- Support the eradication of poverty and unemployment.
- Expand the national systems of innovation within the province.
- Develop GPG's capacity to drive HRD and skills development.

4.11 **GDE Five Year Strategic Plan 2009 – 2014**

The core of the Strategic Priorities of the Department is to Deliver Quality Education in the Classroom, everyday. The focus of the Department will be shifted to concentrate on four strategic thrusts:

- To ensure that Gauteng has effective schools and learning institutions
- To ensure that GDE head office and district offices provide relevant, coordinated and effective support
- To enable young people to make the transition from school to further education and or work that provides further training opportunities
- To strengthen GDE's partnerships with all stakeholders, resulting in education becoming a societal priority

5. PRINCIPLES AND OBJECTIVES OF THE STRATEGY

The Gauteng Department of Education has adopted four strategic goals as the provincial education priorities for the following 5 years:

Strategic Goal 1: Ensuring that Gauteng has effective schools and learning institutions.

Strategic Goal 2: GDE head office and districts – Providing relevant, coordinated and effective support.

Strategic Goal 3: Enabling young people to make the transition from school to further education and/ or work that provides further training opportunities

Strategic Goal 4: Strengthen partnerships with all stakeholders, resulting in education becoming a societal priority

These provide the backdrop to and the platform upon which the Gauteng MST Improvement Strategy is built and against which the Strategy is measured.

Similarly, the development of the Strategy has been guided by the findings of international and local research into what leads to successful transformation in schools and particularly in respect of improving maths, science and technology education. It has also been guided by a process of consultation that has included key actors within the Gauteng Department of Education, local school principals and teachers and a broad range of academics and educational experts from local universities, NGO service providers in MST and experts in MST educational evaluation. The accumulated experience of those involved in the discussions and consultations represents hundreds of years of working in schools throughout Gauteng, South Africa and the continent as a whole. It is therefore striking that there is a high level of agreement between all those involved about what needs to be done to improve MST in Gauteng. There is also a strong positive correlation between the suggestions and recommendations made by those consulted and implications of research findings.

While there is unanimity about what needs to be done, there is also a strong recognition of the political, social, industrial relations and economic challenges that need to be faced in the implementation of an MST improvement programme.

The following principles and assumptions, which have emerged from the research and consultations, are therefore noted as underlying the MST Improvement strategy.

5.1 Feasibility, Affordability and Manageability

A feature of almost all previous efforts to resolve the challenges of improving MST education is that they accurately identified what needed to happen but were unable to effectively implement the actions needed in a sustained way that was uniformly implemented throughout the school system. The Strategy will seek to implement interventions that are feasible and affordable and which have a reasonable probability of success. Many of the challenges that need to be faced will only be feasible once some of the key uncertainties have been clarified and certain risks have been mitigated.

Secondly, MST teachers are part of a larger community of teachers. Policies and strategies that apply to all teachers apply equally to the teachers that will be impacted on by this MST Improvement Strategy. These issues will also need to be managed. The Strategy will rely on the GDE to assist in this.

5.2 A Provincial Partnership

The impact of inadequate achievement in MST at school level has clear ramifications for higher education, the public and private sector and on the long term economic growth of the province. It is therefore in the general interest of all stakeholders that the MST Improvement Strategy is widely supported. It is intended to invite participation in and support for the various interventions that make up the strategy. To this end, the Strategy will seek to fashion opportunities and benefits for a range of partners in order to strengthen the capacity for implementation and the probability of success of the matrix of activities in the Strategy.

5.3 Dynamic Monitoring, Evaluation and Adaptation

A number of hard lessons have been learned from previous initiatives aimed at improving MST in the public school system. The first is that even when successful interventions are implemented in one or more schools, there seems to be impediments to scaling these up into large numbers of schools. There are factors such as the individual personalities of teachers, principals and district officials that play a role in this. Secondly, the public school system in Gauteng has many pockets of excellence and a strong element of the Strategy is to find and replicate these. This, too, may indicate the building of relationships between clusters of schools in some cases, rather than a mass change in the system. Thirdly, the system is not static and is in a continuous state of change. There are various interventions planned in this Strategy and these may impact on each other in different ways.

For this reason, the Strategy and all its interventions need to be closely monitored so that emerging issues can be quickly recognised and reacted to. As is the case with all change strategies, there are risks of unintended consequences. The Strategy therefore will seek to adopt a dynamic management approach that allows for adaptations to the planned interventions. The role of constant and accurate communications between all role payers is therefore crucial.

5.4 The Objectives of the Gauteng MST Improvement Strategy

The model adopted by the Gauteng MST Improvement Strategy is shown in figure 7 below:

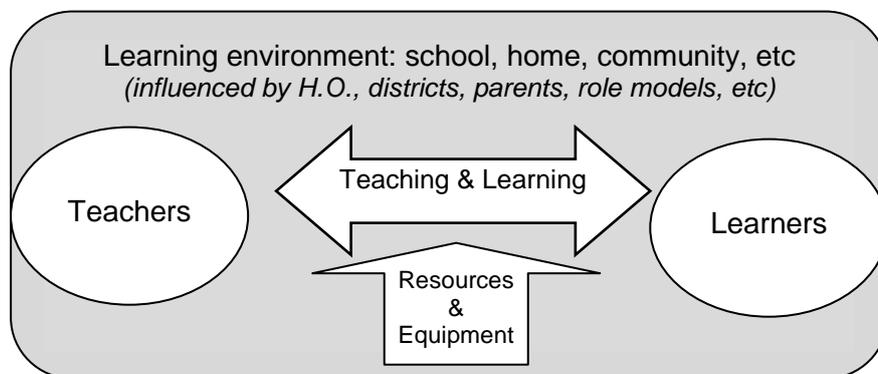


Figure 7: The Intervention Model for the MST Improvement Strategy

The model sees teachers and learners as the primary actors in MST education, supported by but not entirely dependent on resources and influenced by a range of learning environment factors and role players. The model works from an assumption that the nature of the teaching and learning behaviour of teachers and learners determines the success of any education system more than any other factor. Other factors such as resources and the learning environment are important but not definitive. While some of these factors, such as poverty and school governance are not within the mandate of the MST Strategy to address, their impact must be acknowledged. Other factors, such as the involvement of the community and the private sector can be managed so as to play a positive role.

The Gauteng MST Improvement Strategy focuses on teachers, learners, resources and MST management. The Strategy therefore adopts the following four key objectives:

Objective 1: To strengthen MST teaching in all Gauteng schools. This objective focuses firstly on the initial professional development of teachers or pre-service training and secondly on in-service training and on continuing professional development of teachers.

Objective 2: To improve the provision of MST resources. This focuses on plans to identify and distribute MST textbooks and other resources to schools;

Objective 3: To provide programmes of learner support in MST. This strategy includes a range of initiatives to improve learner achievement through both in-class and supplementary programmes aimed at improvement learner achievement in the short and long term.

Objective 4: To improving the management of MST teaching and learning. The strategy aims to ensure that there is a positive and conducive environment for MST education in schools and districts.

6. OBJECTIVE 1: IMPROVING MST TEACHING

The GDE's Strategic Goal 1 is to ensure that Gauteng has effective schools and learning institutions. In order to achieve this goal, the department's five year plan defines Strategic Objective 4 as enhancing "*teacher development that ensures quality learning and teaching.*" The MST Improvement Strategy aligns to the 5 year plan and recognises the centrality of teachers in the improvement of MST in Gauteng.

6.1 The Centrality of Teachers in MST Education

"The quality of an education system cannot exceed the quality of its teachers." This has become an accepted educational maxim. There is overwhelming evidence that teacher competence is by far the single most critical factor influencing the quality of MST education in the school system. The World Bank report states that: *"The most consistent finding across a wide range of investigations is that the quality of the teacher in the classroom is one of the most important attributes of schools. Good teachers, defined in terms of student learning, are able to move the achievement of their students far ahead of those of poor teachers."* (World Bank, 2007). This view is echoed in the report by the British Office of Standards in Education (OFSTED) on achievement in mathematics education. (OFSTED, 2008). The McKinsey report on the world's best school systems, (McKinsey & Co, 2007) confirms teacher quality as a common feature of all the best performing school systems in the world. The report identifies two critical aspects:

- Getting the right people to become teachers (The report shows that the top performing schools systems in the world recruit teachers from the top 30% of the school leaving cohort) and
- An ongoing process of professional development to develop teachers into quality instructors

There is wide agreement that this applies in South Africa and in Gauteng, as much as elsewhere. Some of the issues that emerge strongly from local discussions are the following:

6.1.1 Building a Strong Teacher Profession

An effective MST teaching and learning system needs a sufficient number of effective teachers at all levels. South Africa and Gauteng continue to suffer a shortage of adequately trained and prepared teachers. The natural attrition rate of teachers is estimated at between 5% and 6 % annually. Amongst the important objectives that the Strategy must address are the following:

- The number of high calibre school leavers that are attracted to become maths and science teachers must be increased. This will require the strategy to both market and incentivise MST teaching in order to make the profession appealing.
- The public education system has worked from an assumption that new teachers enter the system in a work-ready state. Experience shows that there is a need for a proper induction system for new MST teachers. The Strategy will seek to design a feasible approach to induction.
- There a number of Higher Education Institutions that train new teachers. Each has its own curriculum and approach. An effective system should deliver new teachers who have a standardised set of instructional skills and a uniformly high level of mastery of MST. The Strategy will seek to establish a provincial standardised coherent PRESET curriculum as a condition for funding.
- The lack of a coherent, structured, planned and managed In-Service policy and structure has undermined much of the effort that has gone into teacher development. The Strategy will focus strongly on developing, implementing and managing an In-Service policy and implementation plan, involving the appropriate institutions and role players. The Department of Education’s National Framework for Teacher Education included a recommendation to... *“Establish Provincial Teacher Education Liaison Committees. The core membership of these committees should be the PDE and the HEIs that offer teacher education in that province. The main functions of these committees would be to create a climate of trust between the (main) employers of school teachers and the main providers, to consider system needs on an on-going basis, and to ameliorate rival conceptions of teacher education”.* (DOE, 2006)

6.1.2 Instructional Skills, Content Mastery and Attitude

In the same way that the content design of all education and training curricula revolves around a balance between skills, knowledge and attitudes, the MST strategy recognises that the professionalism of teachers too is a balance between a set of professional instructional skills, mastery of the content to be taught by the teacher and a set of positive attitudes in the teacher as these are all inextricably linked in determining professionalism in teachers. According to the World Bank “the identification of good teachers has been complicated by the fact that the simple measures commonly used – such as teacher experience, teacher education, or even meeting the required standards

for certification—are not closely correlated with actual ability in the classroom.” The impact of teacher attitudes to teaching and to working with children cannot be underestimated. The strategy therefore needs to address all three aspects in growing teacher competence and confidence. The following recommendations have been made:

- There is evidence that teacher training courses that offer both instructional skills development and content mastery confuses teachers. Training should focus on one or the other;
- Experience shows that the conventional week-end training courses are not popular with teachers, attendance is poor and that such training rarely leads to significant widespread change in the classroom. While there is a role for weekend development work, a more intensive form of In-service training should be explored.
- Most teacher development has focussed on skills and content mastery, the hard technical MST issues, while avoiding the soft issues such as morale and attitudes of teachers. The MST Strategy will need to include the boosting of morale, the development of aspirations, commitment and the enjoyment of teaching in MST teachers. Without a shift in attitudes towards being willing and enthusiastic participants in an MST Improvement Strategy, the chances of success are diminished.

6.1.3 The Role of Teacher Unions

Education has historically been a site of struggle in South Africa. It has been difficult to reverse this situation and schools continue to be sites of contest to some extent, although the nature of the contestation is now often to do with industrial relations than with politics. The role of teacher unions in schooling is an important element in any discussion about in service training and the unions will be strong catalysts for or retarders of change. Any strategy that requires teachers to commit to skills development will need to take the attitude and actions of teacher unions into account. The gap between professional issues and industrial relations issues is well defined in many countries but is often blurred in South Africa, as evidenced by the inability to implement the Integrated Quality Management System effectively. A key assumption underpinning any teacher development plan is that teachers and their unions will recognise, approve of and participate in the plan as part of professional development. Any confusion between development and monitoring on one hand and performance management on the other will severely undermine the success of professional development activities. The confusion between professionalism and labour relations has also lead to a lack of accountability, both in teachers and in school management. Unless there is a general

acceptance and agreement of what is expected of everyone in the school system, from parents, to learners, to teachers to school managers, and unless there is responsibility and accountability across the school system, any improvement strategy may well falter.

6.1.4 Managing and Measuring Teacher Competence

A campaign that seeks to improve the quality of teaching relies on accurate data in order to establish what and where improvement is needed, what kind of interventions are necessary and whether interventions are making a difference. There is no baseline data currently available on MST teacher competence. The MST Improvement Strategy will need to include systems and processes that enable effective research, monitoring and evaluation. The measurement of teacher competence may carry certain challenges but there are successful local models for how these may be managed.

6.1.5 The Planning Matrix

The Strategy will aim to plan annual programmes of intervention for teachers in all areas of MST and will include MST teachers of learners with special needs. The planning matrix in figure 8 below indicates the grade levels and the subject range that need to be addressed in planning a comprehensive teacher training programme.

<u>Subject</u>	Numeracy	Maths Lit	Maths	Nat Science	Life Science	Technology	Civil Tech	Mech Tech	Elec Tech	Graph Design	ICT	CAT
<u>Level</u>												
Found.												
Intermed.												
Senior												
Grade 10												
Grade 11												
Grade 12												
ACE												
Grad												
Post-Grad												

Figure 8: Teacher Training Planning Matrix

It is clear that the planning and delivery of teacher training and support will involve a large team of head office and district officials as well as from HEIs and NGO service providers.

The process of planning, implementing and managing the programme will need to be flexible, adaptive and dynamic.

6.1.6 A Long Term View

Teachers, like all other people, develop competence and confidence over time. It must be acknowledged that teacher development is a long term process and that a sustained improvement in teaching quality relies on a sustained programme of continuing professional development. Transforming and bedding down changes in the content of a curriculum takes many years and there are many international examples of 5 and 10 year long strategies for this. Achieving a permanent change in a teaching culture and in what is accepted as professional teaching behaviour can be even more of a challenge and may take as long if not longer to achieve.

The primary objective of the Gauteng MST Improvement Strategy is to strengthen MST teaching in all Gauteng schools through the implementation of a programme of teacher development, training, support and monitoring. This objective is divided into two categories:

- Teacher Pre-Service Education and Training (PreSET) and
- Teacher In-Service Education and Training (InSET)

The specific interventions proposed are detailed below.

6.2 The Strategy for MST Teacher Pre-Service Education and Training

The following interventions are targeted for Initial Professional Education for Teachers:

6.2.1 A Standardised IPET Curriculum

The GDE will engage with all higher education and training institutions and other role players to agree a single standardised curriculum so as to ensure that all new teachers have a minimum level of competence in respect of MST teaching. This will apply specifically to initial training and not to post-graduate training. The strategic interventions for this will involve commissioning a committee from GDE, local higher education institutions and other selected experts to propose a new teacher training curriculum. The target will be to implement a standardised curriculum by 2013.

6.2.2 Increase the number of MST Teachers

The GDE's five year plan commits to "*the recruitment of teachers with a view to meeting the demands of school.*" particularly in MST, literacy and numeracy. In support of this

commitment, the MST Improvement Strategy will seek to increase enrolment of new MST teachers. The target will be to increase the number of qualified and deployed MST teachers in Gauteng by at least 5000 by 2014. The strategic interventions for this will involve:

- 6.2.2.1 Increasing the provision of bursary funding for IPET teacher training and improve awareness of the Funza Lushaka bursary scheme in Gauteng schools.
- 6.2.2.2 Implementation of an advocacy and marketing campaign to attract high achieving school leavers and B. Sc. Graduates to take up teaching careers;
- 6.2.2.3 Attracting unemployed graduates through organisations such as TeachSA and the South African Graduate Development Association
- 6.2.2.4 Creating an incentive scheme to attract new recruits into MST teaching.
- 6.2.2.5 Implementing an MST internship programme. This will involve identifying, training and deploying unemployed graduates who have studied maths or science as part of their undergraduate studies as teaching assistants.

6.2.3 An Induction Programme for New MST Teachers

The GDE will work with higher education institutions to develop a programme to assist new teachers to integrate effectively into the school system. This will involve reviewing current PreSET school placement practices and investigating a support system for new MST teachers. A standardised school- based induction that includes on-site mentors for newly employed first time teachers will be explored.

6.3 The Strategy for Teacher In-Service Education and Training

While the continuing development and support of MST teachers is a critical element of the MST Improvement Strategy, it must be recognised that there are national and provincial initiatives that focus on teacher development in general. Similarly, the development of the Continuing Professional Teacher Development (CPTD) system by the South African Council for Educators (SACE) will have an impact on the actions planned as part of this document. The MST Strategy will need to align and coordinate with and these initiatives and with existing and new policies and programmes in respect of teachers. The following interventions are targeted for Continuing Professional Development of MST teachers:

6.3.1 A MST Teacher InSET Policy, Plan and Consultative Structure

While it is generally acknowledged that InSET is a critical factor in improving MST education, there is no provincial policy, plan or structure for this. The MST Improvement Strategy will seek to put these in place. To this end, the MEC will convene a task team that will develop and propose a cohesive provincial MST InSET draft policy, structure and plan. The task team will be made up of MST teacher education experts from within GDE, the higher education institutions and other agencies. Once the task is completed, the task team may be converted into an informal special advisory panel to assist in advocating, implementing and monitoring the policy and plan.

6.3.2 Increased Relief Teacher Programme

The Relief Teacher programme has been set up to allow MST teachers to be released from schools for intensive training. The MST Improvement Strategy will seek to expand the number of MST teachers that benefit from the programme. Actions emanating from the Strategy will include the following:

6.3.2.1 Recruiting and training additional relief teachers. The target will be to establish a pool of at least 200 relief teachers by 2014.

6.3.2.2 The target will be to release teachers for an average of 1 500 days of training per year between 2010 and 2014.

6.3.2.3 Implement a specialised training programme for relief teachers.

6.3.2.4 Raise private sector funding for the programme.

The system will require teachers to either apply through their schools to attend training or for principals or district officials to apply on their behalf.

6.3.3 A Programme of Increased Teacher Training

The GDE will seek to expand the quantity and nature of MST teacher training opportunities offered to teachers in Gauteng. The strategy will involve developing a basket of different opportunities and approaches that will allow and encourage teachers to participate in a wide range of capacity building activities and events. The basket will include formal HEI based courses as currently offered by these institutions as well as short courses. The Strategy will adopt the following approach:

6.3.3.1 Training Incentives and SACE CPTD Points: The Strategy will seek to build a culture of professional development in the MST teaching community. To assist with this it is planned to identify and offer a range of non-financial incentives and benefits to teachers which will be appealing and useful and which will assist in optimising the voluntary participation of the highest number of MST teachers. The approach will seek to build a growing pool of teachers who willingly participate in training in order to create a momentum that will attract others.

The Strategy will seek to incentivise teachers to accumulate CPTD training points. The nature of these incentives will be explored with a range of role players. The GDE will liaise with SACE in respect of awarding points for training.

The Strategy will also seek to create an incentive package for schools in order to gain support for staff members to participate in training programmes.

6.3.3.2 Needs Reactive Training: Training will react to the needs of teachers and to needs identified by data. GDE head office and districts will implement a process to monitor teachers' needs.

6.3.3.3 Block Release Training: The target will be to release groups of teachers for up to 15 days of intensive continuous training through the Relief Teacher programme described above. Funding will be provided to HEIs and other service providers to deliver intensive training to selected groups of teachers.

6.3.3.4 Vacation training programme: The Strategy will offer a training programme of at the start of at least 3 school vacations. There will be multiple training venues and teachers will be invited to register to participate in training at specific venues.

6.3.3.5 Training Providers: The Strategy will make use of a range of training providers, including HEIs, NGOs and other service providers who will be invited to tender for approved training programmes, events and activities. Service providers that tender to deliver training will need to provide a follow-up plan for post-training support and monitoring. A database of approved providers will be created and maintained. A quality assurance process will be instituted to ensure consistency and high levels of training effectiveness.

- 6.3.3.6 **Master Trainers:** The GDE will also identify and expand the pool of master trainers. These will be MST teachers from Gauteng schools who have a track record of significant success who will be invited to act as trainers and mentors.
- 6.3.3.7 **Differentiated Training:** Training will be differentiated so as to separate instructional skill development from content as far as possible and will remain specific in terms their focus on bands or grades.
- 6.3.3.8 **Best Practice Training:** The Strategy will attempt to identify and spread best practice from district offices, schools and classrooms where learner achievement is high to other offices, schools and classrooms where improvement is needed. The purpose and goal will be to raise the benchmark for what constitutes a minimum level of acceptable professional practice in teaching, assessment and classroom management. This activity will involve a series of short Saturday courses run by master teachers and experts on selected topics.
- 6.3.3.9 **Support Programme:** The InSET programme will include activities and events aimed at improving teacher attitude and morale. This will include study and field trips to industry and other sites, conferences for MST teachers, teacher forums and other activities that have been successful in the past. The Strategy includes a programme that will assist and facilitate visits to class by a range of MST and SET role models from industry, science councils and university research units, to help teachers to deal with challenging topics and to link classroom teaching and learning to real applications.
- 6.3.3.10 **ICT Training:** A programme of training in basic ICT skills and computer literacy will be offered to all MST teachers in Gauteng. This will provide training either at the DELL ICT Centre at Sci-Bono or in district venues or even at schools. The training will lead to accredited qualifications.
- 6.3.3.11 **Participation Targets:** The Strategy will seek to achieve to an average participation profile as follows:
- A total average annual participation rate of at least 45% of all MST teachers in the public school system between 2010 and 2014;
 - An annual average participation rate of 50% of MST teachers based in schools serving disadvantaged communities;

- A focus on GET teachers, particularly but not exclusively on Foundation and intermediate Phase in 2010 to 2012.

6.3.4 MST Teacher Data

There is a need to establish and maintain an accurate database of MST teachers in Gauteng. This will allow for proper planning and management of training and for the measurement of its impact. The actions that will need to be considered include the following:

6.3.4.1 **MST Teacher Database:** Compile and update a provincial MST Teacher database, using existing provincial and national data. This will require an initial audit of teachers and subject facilitators to be completed. A process will then be out in place to update the database annually.

6.3.4.2 **Competence Database:** In order to plan training that addresses teachers' needs, the GDE will undertake a needs analysis. This will involve the development and conducting of competence tests for teachers in respect of curriculum content at various levels. All teachers will be encouraged and incentivised to take regular competence tests as part of training. The tests will be used only for planning and not as part of performance management. It will be made continuously clear to teachers that there are no penalties or risks involved in their participation. The tests will be used for planning training.

The incentives and benefits for teachers may include access to resources, invitations to participate in event, conferences and study tours, preference in respect of the Teacher Laptop project or other initiatives, SACE points. A positive training and testing record may even play a role in promotion.

7. OBJECTIVE 2: IMPROVING MST RESOURCES

7.1 The Role of Resources in Improving MST Education

The Gauteng five year plan commits to the provision of adequate and appropriate Learning and Teaching Support Materials (LTSM). The MST Improvement Strategy sees this as a crucial element in the achievement of its objectives.

There is a general acceptance that resources impact on the quality of MST teaching and learning. While there is evidence to support this, it is tempting to overstate the significance of MST resources and its ability to independently achieve improvements in achievement. The World Bank points out that *“Overwhelming evidence shows that expansions on the input side, such as simple physical expansion of the educational facilities and increased spending per student, generally do not seem to lead to substantial increases in children’s competencies and learning achievement... Simply providing generally increased resources or resources along the lines commonly suggested, such as reducing class sizes or across-the-board increases in teacher salaries, is unlikely to lead to substantial changes in student performance.”* (World Bank, 2007) The Strategy accepts the need for adequate resources for each learner. There is general agreement that, aside from materials for certain topics and for topics only recently included in the curriculum, there is no shortage of competent and affordable MST teaching and learning materials. There is consequently some but not a huge need for large scale development of additional materials containing the content to be taught and learned. More effort is needed to ensure that teachers can identify, access and use the available materials effectively. There is support for basic resources such as quality lesson plans to assist teachers in planning what materials to use and how to use them.

While it is important to avoid blaming a lack of MST achievement mainly upon a lack of resources, there is much evidence to support the contention that achievement is greatly facilitated when every learner has a competent textbook and access to the equipment needed for the study of MST. The use of effective textbooks is a major element in improving teaching and learner achievement. In a JET report on what works well in schools, Taylor states that *“...If teachers used a good textbook every day, they could teach themselves much of the work and cover the curriculum.”* (Taylor, 2008) Where it is not possible to provide a good text book to every learner, there should be a competent and comprehensive set of worksheets. It has also been suggested that in the case of certain selected topics that pose particular challenges to MST learning, the provincial department should produce and

distribute a series of open source units so that no school and no learner is disadvantaged by not having adequate text material.

The strong international trend towards the inclusion of ICT as a basic resource for MST education needs to be considered. There are very few successful model education systems where teachers are not reliant on ICT as a basic resource for planning, implementing and managing their daily practice and the initiation of the Teacher Laptop programme must be supported by the MST Strategy. The GDE has included the provision of e-learning in its five year plan and this is included as an element of the Gauteng Human Resource Development Strategy. The improvement of the GDE's capacity to offer basic training in ICT and the more advanced CAT in schools as well as its ability to increase the number of learners engaged in this and allied studies is set as an outcome of the strategy. The MST Improvement Strategy will therefore need to align and coordinate with the other educational policies and initiatives such as that for eLearning.

Science and technology education pose special challenges in that they are especially resource and equipment intensive. They ideally require special spaces and have special needs in terms of safety and resource management. This notwithstanding, there are successful local examples of the use of micro and small scale kits that have proved to be cost effective and which stimulate achievement in these subjects. There are also opportunities for sharing resources and the use of mobile resources that must be explored in ensuring that all schools have access to what is needed.

A vexing issue related to resources is that of the security needed to ensure that proper storage, maintenance and use of resources. The level of theft of ICT resources from schools is a stark indication of how inadequate security undermines resources provisioning to schools. It is an inescapable reality that minimal security conditions will need to be in place to protect school resources.

7.2 The Strategy for Improving MST Resources in Schools

The Strategy includes the following interventions in respect of MST resources for schools.

7.2.1 MST Resource Data Base

The Strategy will include the development of a comprehensive checklist of minimum MST resources needed at both primary and high school level for the successful implementation of the relevant curricula in maths, maths literacy, natural science, life science, FET Technology

subjects, CAT and IT. An additional list will be compiled for these subjects in special schools. These lists will be based on existing lists at national and provincial level. Each school will be asked to update their status in respect of the list. A provincial plan to ensure that all schools have the minimum requirements will be drawn up and implemented.

7.2.2 ICT Resources

Modern MST education cannot be divorced from ICT resources. The GDE's Strategic Goal 2 is for GDE head office and districts to provide relevant, coordinated and effective support. The goal includes Strategic Objective 9 which commits to "*A more effective approach to the use of ICTs in schools.*" The Strategy will seek to improve the level of ICT resources and usage in schools and to support the actions planned as part of the overall strategy for ICTs and e-learning initiatives. It will need to align to the various initiatives such as the Teacher Laptop project and the Gauteng OnLine initiative to ensure that all MST teachers not only benefit from these initiatives but that adequate training is provided. This will include the provision of teaching resources such as data projectors and other equipment not included in the plans for providing ICTs to schools. The Strategy will aim to improve digital literacy and the extent that schools, teachers and learners are able and willing to make use of email, internet, FTP and software for MST learning.

7.2.3 Small Scale Equipment

The Strategy advocates the distribution to schools of micro science kits or other small scale resources rather than the provision of conventional large scale facilities and laboratories. The GDE will review the situation in schools and then seek to provide such resources where needed.

7.2.4 Learners with Special Needs

The strategy must pay attention to the resource needs of learners with special needs. A campaign to review and upgrade resources and facilities for these learners will be conducted between 2010 and 2014 for this purpose.

7.2.5 Text Books and Worksheets

The Strategy accepts the notion that each learner must have a competent textbook for maths and science. For this reason the Strategy will seek to provide guidance on the selection of textbooks and to provide adequate textbooks to all schools. As part of the Strategy, the GDE will engage with materials developers and publishers to agree on the format and approach to the production of new textbooks.

In line with the approach taken by the Foundations for Learning initiative, the Strategy will build on what has been produced to date in respect of maths and science lesson plans for FET. The Strategy will continue to produce and distribute basic lesson plans and materials for schools. It is also planned to develop teaching and learning modules and worksheets for selected MST topics, based on data from assessments and exams about where MST teaching and learning is proving most challenging. These resources will be open source and made freely available.

7.2.6 District Offices and Resource Centres

The Strategy will develop a plan to ensure that all district MST officials are provided with the basic resources needed to support schools. This will include ICT resources.

As part of the culture of professionalism in MST, the Strategy will seek to promote the sharing of resources and a culture of resource borrowing from central sources. It is intended to upgrade and supply a stock of loan MST equipment and resources at one Teacher Resource Centre per district, as part of the GDE's five year plan.

7.2.7 Refurbishment of Laboratories and Special Rooms

There are many schools in Gauteng that have laboratories and other facilities that should be used for MST education but which need refurbishment and or upgrading in order to meet the needs of the new curricula or of FET technology studies. This will include the issue of security and safety in respect of resource storage and use. The Strategy will seek to address this issue and to encourage support from the private and public sector for this purpose.

8. OBJECTIVE 3: IMPROVING LEARNER ACHIEVEMENT

In its Programme of Action, government has made a number of commitments that are relevant to the MST Improvement Strategy: These include commitments to:

- Create a culture of achievement and improving learner outcomes with an overall improvement in key subjects like Maths and Science;
- Provide support to matric learners;
- Implement Foundations for Learning Guidelines for resourcing and delivery of Grade R.
- Expand access to and capacity of secondary education with a view to increasing enrolment rates and that more young people are able to access and complete secondary education;
- Expand access and capacity of secondary schools by 95% by 2014.

A World Bank comparative figure (see Table 4 below) shows why these commitments are so important.

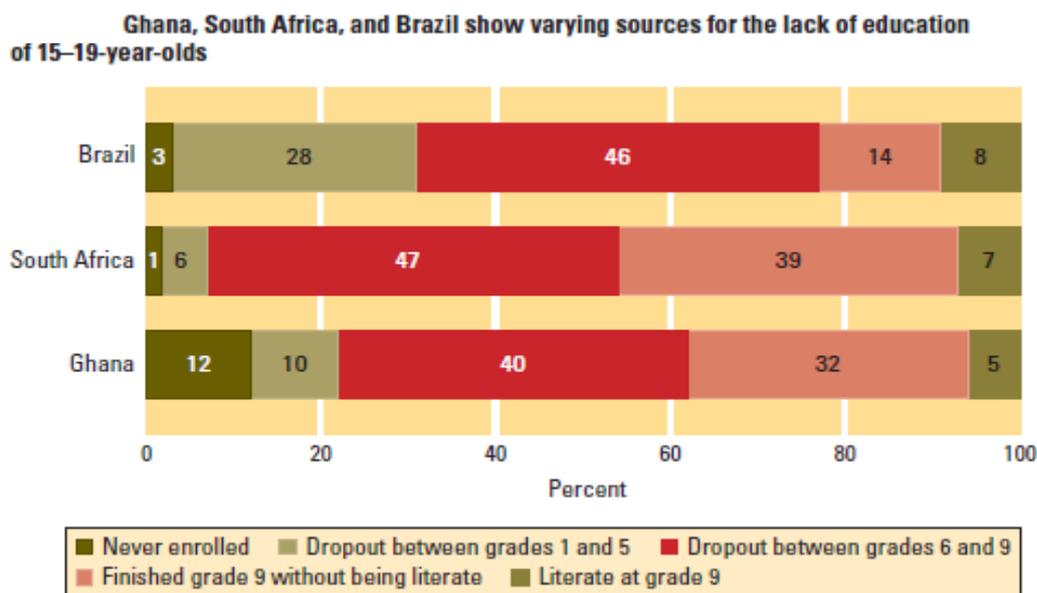


Table 4: Education Participation in 15 to 19 year olds in Brazil, South Africa & Ghana World Bank 2008

These commitments are reflected in the Strategic Goals of the GDE which include aims in Strategic Goal 3, “To enable young people to make the transition from school to further education and or work that provides further training opportunities.” There is little doubt that a successful transition from school to the modern technical economy requires an amount of MST literacy.

8.1 A Focus on Learners in MST Education

While teachers are central to an improvement strategy, the primary focus of any education system cannot but be on its learners. The purpose of the MST Improvement Strategy is to permanently raise the standards of MST achievement in all schools in the province for the benefit of individual learners, their communities and the province as a whole. A number of key issues have been raised that will need to be part of the strategic approach.

8.1.1 Improving Learner Achievement

One of the major challenges in MST education is how to achieve equity in both the provision of education and in the levels of achievement across the school system. Gauteng can boast of excellent achievement in many of its schools and can annually point to many learners who have achieved high levels of success. In general and for historical reasons, achievement is good in formerly white schools while the bulk of under-achievement is evident in township schools. It is therefore inevitable that the MST Improvement Strategy must focus on where the need is greatest. The Strategy must focus on improving achievement of African and girl learners. There is also a need to sharpen the focus on the levels of MST achievement of learners with special educational needs.

8.1.2 Focusing on Foundations

There is abundant evidence that successful learner achievement requires a solid foundation in early childhood education and that inadequacy in teaching and learning in early grades tends to accumulate and present obstacles to success later on. The national Foundations for Learning programme seeks to address this. The Strategy will seek to support that programme strongly and to ensure that challenges in the Foundation and Intermediate phases are addressed.

8.1.3 The Role of Shadow Schooling

International and local research into what improves success in MST education reveals the important role played by 'shadow schooling', which can be described as the supplementary parallel support interventions that schools and parents provide in order to improve learners' achievements. Examples of local shadow schooling interventions in Gauteng include Master Maths, Kumon Maths or the many extra lesson programmes offered by schools or individual maths and science teachers. These have a clear positive impact on both mastery of content and on the levels of confidence of those learners who are fortunate enough to benefit from access to these programmes. The MST Improvement Strategy should seek to provide shadow schooling opportunities to supplement what happens in class. There is a possibility

that this would provide for relatively quick changes to the level of achievement of many learners. The Strategy should seek to offer supplementary tuition to as many learners as possible.

8.1.4 Differentiated Levels of Potential and Achievement

An issue raised by the research studies and confirmed by many MST teachers is that we have widely differing levels of potential and achievement in learners and that many of our classes are, in fact, multi-grade classrooms. In many of our classrooms there are learners who have been promoted despite not meeting the minimum levels of achievement for exiting the previous Grade. A more rigorous approach to promotion is needed if we are to improve MST educational achievement. This poses a number of political and logistical challenges that will be difficult to resolve. Even if implemented, it would allow the problem to be worked out of the system over time but would not assist those learners currently in school. Many experts have made a case for a two-track solution where teachers would plan to cope with at least two levels of learner – those who cope well and those who need additional attention. The World Bank report indicates that there is a need to ensure that all learners receive adequate attention but that there are benefits to ensuring that the capacity of high potential learners is developed. The report states that “...*both education for all and the share of top performers seem to exert separately identifiable effects on economic growth... different dimensions of the quality of education seem to have independent positive effects on economic growth. This is true both for basic and top dimensions of educational performance and for the math and science dimensions.*” This is impractical in large classes, particularly if teachers are not specially trained for multi-grade situations and where teacher assistants are not available. There is nevertheless a need to both recognise that we are dealing with a pyramid of potential and achievement and a need to lift the entire pyramid.

8.1.5 The Role of Language in MST Education

The challenges are exacerbated by issues of language in our schools. Research indicates that language may be the one of the single most important factors undermining achievement in MST education. The Strategy will need to address the issue of how to improve both teaching and learning in a context of multilingualism. There are a number of models that may provide solutions to the issue and these will need to be tested.

8.1.6 MST Talent Development

The majority of school learners in Gauteng are in schools in economically disadvantaged communities and so, statistically, the largest group that represents the provincial pool of potential future scientists, engineers and technologists are in schools in those communities. Given that there are more challenges in respect of MST education in those schools than in

the more affluent schools, it is a tragic inevitability that we waste much human potential with each generation of school leavers that suffers as a result of poor MST education. There is a need for early talent identification, nurturing and development of this talent. The Strategy must include a plan for supplementary and informal extramural programmes that will contribute to the management of Gauteng's talent pipeline strategy.

8.2 The Strategy for Improving Learner Achievement in MST

The Strategy will involve the following interventions for learners:

8.2.1 Foundation Phase Support Projects

Strategic objective 1 of the Gauteng Strategic Goal 1 above is *“to focus on efforts to improve the quality and sustainability of ECD and primary education, including the early identification of and intervention for learners with special educational needs.”* The MST Improvement Strategy will seek to support the Foundations for Learning programme by implementing support projects for Foundation Phase in selected schools. The projects will run extramurally and will aim to (a) improve literacy and numeracy in learners and (b) to improve teacher competence. The project will seek to involve parents and community members. It is planned to secure additional support for this project from the private sector.

8.2.2 FET MST Supplementary Tuition Programmes

Gauteng's Strategic Objective 2 focuses on the quality and sustainability of secondary schools and FET, in particular. The MST Improvement Strategy aligns its activities with this and will seek to improve achievement in maths and science as part of the approved provincial action plan. It is intended to offer supplementary tuition in FET Maths and Science for Grades 10 to 12 during the June and September vacations. A central location will be identified in each district and learners will be invited to attend. The programme will involve presentations by Master trainers on selected curriculum topics and learners will have opportunities to practice problem solving in these topics under the guidance of the Master trainers. Teachers will be invited to attend the sessions. It is planned to secure additional support for this project from the private sector.

8.2.3 MST Talent Development Programme

The programme will identify and select Grade 10 learners who have shown high levels of interest and achievement in maths and science for participation in a three year enrichment programme. The purpose of the programme is to increase the number of Grade 12 learners

from disadvantaged communities that enter and succeed in higher education studies in science, engineering and technology. The programme will eventually be run in each district but will be phased in over a three year period. It is planned to secure additional support for this project from the private sector.

The programme will also seek to implement a preparatory phase of the programme in Grades 8 and 9. High potential learners will be identified in each district to participate in a programme of activities and events which aim to raise interest in and to prepare learners for participation in the FET Talent Development Programme.

8.2.4 Participation in MST Related Events

There is evidence of improved learner attitudes and achievement as a result of participation in MST related activities such as competitions. The Strategy will seek to increase participation by teams of learners in established MST events such as the maths, science and technology Olympiads, the ESKOM Expo for Young Scientists, the national Primary Schools Astronomy Quiz and other similar events. The GDE will, through the Sci-Bono Discovery Centre, liaise with the Federation of Engineering, Science and Technology Olympiads and Competitions (FESTOC) and with a range of private sector funders to facilitate participation of schools. This initiative will also involve arranging for school visits to various MST related sites, presentations and activities. An emphasis will be placed on the participation of schools serving disadvantaged communities and on the participation of girl learners.

8.2.5 MST Broadcast Programme

This intervention involves the setting up of a central broadcast facility and a set of district based reception centres which will use digital broadcast technology to deliver lessons by Master teachers to large groups of learners. A weekly programme of presentations will be delivered, focussing on selected topics in Grade 12 maths and science. It is intended to implement the project in 2011. The target is to deliver the programme to at least 300 learners per district. The facility will also be available for use as a teacher training facility.

8.2.6 A Public Advocacy Campaign for MST

The GDE will work with private and public sector partners to raise parental and learner awareness of the need to consider maths, science and technology studies at FET level. The campaign will be conducted in public and in schools and targeted at Senior phase and FET level learners and their parents. The objective is to ensure that all learners are aware of what level of maths is needed for post school studies, to counter misunderstanding about issues

such as maths Paper 3 and to increase the number of learners who select maths rather than maths literacy.

8.2.7 SET Career Education

The role of career education has often been ignored as a strong motivational factor in MST learning. The GDE's Strategic Goal 3 seeks to enable "*young people to make the transition from school to further education*" and this is an almost impossible task without adequate career counselling and guidance. The Strategy will therefore include an improvement in the access of learners to a wide range of career education activities and events. This will be managed largely by the BHP Billiton Career Centre at Sci-Bono but will also include local HEIs and other agencies.

9. OBJECTIVE 4: IMPROVING MST MANAGEMENT

Gauteng Strategic Goal 1 is to ensure that Gauteng has effective schools and learning institutions. Strategic objective 1 of that goal is defined as *“Strengthening school management and institutional capacity to ensure that all teachers are in school, in class, on time, teaching with the required textbooks.”* It is impossible to improve one element of schooling in a sustainable and productive way without addressing the other related elements. MST education in schools is inextricably linked to the rest of the school, to the district and to management at the GDE head office. For the Strategy to achieve any useful purchase in the classroom, it must identify and address a number of important issues.

9.1 Managing the MST Educational Environment

One of the challenges in any education system is the management of curriculum delivery so that there is a uniformly high level of delivery, in a managed, structured and sequenced process throughout the school system. In Gauteng, this has been a major challenge. The MST Improvement Strategy will aim at achieving a situation where each school plans and implements a 35 week MST programme for every grade, where teachers are competent instructional managers, supported by their HODs, where assessment is regular and rigorous and where the levels of learner achievement meet the desired benchmarks.

9.2 The Strategy to Improve MST Management

The Strategy will include the following interventions.

9.2.1 Learning Culture Campaign

A campaign will be launched in all schools to encourage teachers to adopt a strong MST leaning culture. The campaign will strive to get teachers to increase the amount of writing and reading that is done as part of daily teaching and learning. It will also encourage and support teachers in giving regular homework that is checked and reviewed.

9.2.2 Twinning of Schools and Mentoring

A feature of the Gauteng school system is the extreme difference in levels of achievement between high achieving and low achieving schools. The schools that are achieving good results in MST have processes and systems in place and show a constructive school

structure that facilitates achievement. The Strategy will create opportunities to translate and spread these processes, systems and culture from one school to others. It is intended to develop a school twinning project that will cluster strong MST schools with schools which are functional but not achieving good MST results. The intention is to start the project with a manageable level of challenge where the gap between the stronger and weaker twinned schools is not too wide. Once some positive experience has been built, the project will expand to more schools and to greater level so challenge. The project will seek to get school managers and individual MST teachers to cooperate with each other in areas such as planning, sequencing, homework and assessment. The project will also look at other non-MST related opportunities for cooperation.

9.2.3 MST Cluster Facilitators

A successful model for improving the quality of curriculum delivery has been the appointment of academic facilitators in schools. These are teachers who mandate is to provide on-site support in methodology, instructional leadership and assessment to their colleagues. They serve as peer trainers, assist in lesson planning, help to manage resources, provide in-class monitoring and provide confidential and constructive feedback. The Strategy will aim to appoint a team of MST Facilitators who will work with a cluster of between 3 and 5 schools to provide support to MST teachers in the cluster. The Facilitators will not have authority over their peers and the teachers in the cluster will need to participate voluntarily. In order to encourage this, the participating principals, HODs and teachers will be offered incentives such as being invited to attend conferences, to go on study trips or to receive preferential treatment in respect of the Laptop project or other initiatives.

9.2.4 School MST Targets

The Strategy will aim to encourage schools to set and achieve MST targets for each phase and FET grade. A range of incentives will be offered to schools that achieve their targets or which can show evidence of efforts to achieve them. The targets will initially be based on a feasible improvement on each school's current level of achievement. The second phase will be based on the school achieving a minimum percentage pass rate. The incentives will be non-financial and will include official recognition in an annual award scheme. Schools will be invited to participate and will apply for this. Applying schools will receive initial benefits. Schools that do not apply will not be penalised but their SGB and parent bodies will be informed that the school has chosen not to participate. A programme of support will be developed to assist schools in participating in the programme.

The Strategy will also set standards of excellence that schools can aim to achieve in order to be recognised as Schools of MST Excellence. Similar levels will be set to be recognised as a School of High Achievement in MST.

9.2.5 Research and Monitoring

The gathering of and reaction to MST education data will facilitate the proper planning of training. The Strategy will develop and implement standardised assessment and tests for schools that will be written regularly at various grades. An analysis of school-by-school results will assist in identifying gaps throughout the district and at each school. This will assist teachers to plan their personal take-up of training opportunities. This activity will align with both the national and provincial plans for external testing at Grade 3, 6, 9 and 12 levels.

9.2.6 District Office and SMT Training in MST Management

Gauteng's Strategic Goal 2 is to "*ensure that GDE head office and districts provide relevant, effective and coordinated support for quality education.*" The MST Improvement Strategy will align its activities with this goal in seeking to improve MST management. District officials often lack formal training and experience in middle management skills. The Strategy will attempt to improve the management of MST at district level by providing customised training in a range of skills including teacher training, content mastery, assessment, basic human resource management, instructional leadership and other areas. This element of the strategy will require cooperation between the GDE's HRD, Sci-Bono and the Matthew Goniwe School of Leadership and Governance.

9.2.7 Clarification of Roles

There has been feedback from teachers and HOD about a lack of clarity in what is expected from them. This has led to poor communications and performance in some cases. An MST performance evaluation process will be provided to all schools. This will assist in clarifying the roles of teachers and HODs and will provide schools with a set of professional activities that MST teachers are expected to be responsible for.

10. FINANCIAL IMPLICATIONS

The MST Improvement Strategy will require a significant budget to implement. The figures shown in the table below are estimated and not based on detailed data. They should be considered as illustrative. The actual costs of the Strategy will need to be more fully researched. Some of the components of the Strategy, however, are already be included in other departmental allocations and so are excluded from the following illustrative budget. This includes funding Teacher PreSET, InSET and bursaries. A budget has, however, been included for certain capital works, such as the upgrading of MST facilities in special schools and the refurbishment of school laboratories.

The budget table applies to the 2010/11 financial year only. Many of the interventions included in the Strategy will be reviewed after the first year of the Strategy.

The reference numbers in the table below are drawn from Sections 6 to 9 above.

Ref	Intervention	Estimated Budget
6.2.2.2	Recruitment campaign for new MST teachers	R3m
6.2.2.4	Incentive scheme for MST recruits	R5m
6.2.2.5	MST internship programme	R6m
6.3.2.1	Relief Teacher programme	R6m
6.3.3.3	Block release training	R3m
6.3.3.4	Vacation training programme	R3m
6.3.3.8	Best Practice workshops	R1m
6.3.3.9	Support Programme	R3m
6.3.3.10	ICT Training	R3m
6.3.4.2	Teacher Competence Database	R7m
Objective 1: To strengthen MST teaching		R40m

Ref	Intervention	Estimated Budget
7.2.3	Small Scale Equipment	R6m
7.2.4	Upgrading MST in special schools	R50m
7.2.5	Text Resources	R12m
7.2.6	District offices and Resource Centres	R25m
7.2.7	Refurbishment of Labs	R50m
Objective 2: To Improve MST Resources		R143m

Ref	Intervention	Estimated Budget
8.2.1	Foundation phase support	R7m
8.2.2	Supplementary Tuition	R10m
8.2.3	Talent Development	R3m
8.2.4	MST Participation	R5m
8.2.5	MST Broadcast project	R18m
8.2.6	MST Advocacy	R1m
8.2.7	Career Education	R3m
Objective 3: To Improve Learner Achievement in MST		R47m

Ref	Intervention	Estimated Budget
9.2.1	Learning Culture campaign	R12m
9.2.2	Twinning & Mentoring	R3m
9.2.3	MST Cluster Facilitators	R3m
9.2.4	MST School Target project	R5m
9.2.5	Research & Monitoring	R8m
9.2.6	District & SMT training	R2m
Objective 4: To Improve MST Management		R33m

Objective 1: To strengthen MST teaching	R40m
Objective 2: To Improve MST Resources	R143m
Objective 3: To Improve Learner Achievement in MST	R47m
Objective 4: To Improve MST Management	R33m
TOTAL: MST IMPROVEMENT STRATEGY	R263m

11. OUTPUTS AND INDICATORS

The following is a summary of the MST Improvement Strategy's proposed interventions between 2010 and 2014. The following points clarify the set out of the outcomes and indicators listed below.

- The table adopts a standard logic model that lists Inputs and actions to be taken. These lead to short term measurable Outputs which aim to achieve longer term Outcomes.
- The numbering of the main Strategy elements refers to the more detailed explanations in Sections 6 to 9 above.

6.2 The Strategy for MST Teacher Pre-Service Education and Training				
Input & Actions	Output Measures	Outcome	Target Indicators	Budget
<ul style="list-style-type: none"> · HRD and inter-institutional commission to agree a uniform approach to MST Pre-SET training 	<p>6.2.1 <u>Standardised IPET Curriculum</u></p> <ul style="list-style-type: none"> · A set of Standardised IPET Curriculum Documents for each MST subject · Implementation in all HEIs 	All new MST teachers to have minimum level of instructional and content competence	Implementation in 2013	
<ul style="list-style-type: none"> · GDE to increase bursary funds for MST teacher PreSET. · GDE to implement recruitment campaign for MST teachers · GDE to plan and implement internship programme 	<p>6.2.2 <u>Increased number of MST Teachers</u></p> <ul style="list-style-type: none"> · Increase budget · Recruitment campaign implemented · Improved registrations in all HEIs 	Sufficient numbers of new teachers in all MST subjects	<ul style="list-style-type: none"> · 1 000 new MST teachers p.a. · 100 interns p.a 	R14m
<ul style="list-style-type: none"> · HRD to develop standardised induction for graduating teachers. · All HEIs to include induction in final year curriculum · Selected schools to implement 	<p>6.2.3 <u>Induction Programme</u></p> <ul style="list-style-type: none"> · Induction programme manual for new MST teachers · Induction manual for HEIs · Induction manual for schools 	<ul style="list-style-type: none"> · Quicker integration of new teachers into new jobs. · Greater alignment between teacher training & school workplace 	Test new induction programme in 2012	

school- based induction programme for new teachers	· Initial implementation reports			
--	----------------------------------	--	--	--

6.3 The Strategy for Teacher In-Service Education and Training

Input & Process	Output Measures	Outcome	Target Indicators	Budget
<ul style="list-style-type: none"> · GDE to convene expert panel to develop InSET policy in alignment with national & provincial policy · Panel to manage consultative process & table recommendations · 	<u>6.3.1 an MST InSET Policy & Structure</u> <ul style="list-style-type: none"> · Draft provincial MST InSET proposal tabled for approval · Comprehensive MST InSET plan approved 	<ul style="list-style-type: none"> · A formal InSET plan and management structure · Clear expectations, opportunities, targets & plans for MST teachers 	<ul style="list-style-type: none"> · Tabled policy in 2010 · Implementation 2010-2012 · Review by end 2011 	
<ul style="list-style-type: none"> · HRD to increase budget for relief teacher recruitment · Sci-Bono to increase pool of trained relief teachers · Increased deployment to schools 	<u>6.3.2 Relief Teacher Programme</u> <ul style="list-style-type: none"> · Reports showing increased level of deployment of and spending on relief teachers. · Feedback reports from schools 	<ul style="list-style-type: none"> · More MST teachers participating in regular In SET activities. · Higher levels of MST teacher competence and morale 	<ul style="list-style-type: none"> · 120 MST teachers trained in 2010. · 240 teachers trained p.a. from 2011 to 2014 · 1500 days of training p.a. 	R6m
<ul style="list-style-type: none"> · HRD & other role players to agree InSET incentives · Sci-Bono to table annual InSET plan after consultation · MST InSET budget approved & released 	<u>6.3.3 InSET Programme</u> <ul style="list-style-type: none"> · An approved annual InSET plan & programme document. · Progress reports indicate successful implementation and participation · Budget reports indicate implementation 	<ul style="list-style-type: none"> · A successfully embedded InSET programme and culture · Annually increasing MST teacher training participation rates 	<ul style="list-style-type: none"> · 35% participation rate in 2010. · 60%/40% participation of GET/FET in 2010 · Participation rate of 	R13m

<ul style="list-style-type: none"> · Annual plan to be published and distributed to all MST teachers · Plan to be implemented and managed, · Briefs distributed and tenders awarded to service providers · Master trainers appointed, briefed, deployed & monitored · InSET support events planned & implemented · Implement ICT training for MST teachers · Review of graduate & post-graduate opportunities 	<ul style="list-style-type: none"> to plan · Service provider SLAs & contracts · Trainer manuals and trainee resource packs for all courses · Teacher assessments indicate success of training · School monitoring reports indicate training transfer to class · Award increased number of accredited ICT certificates to MST teachers · Number of educators registrations for graduate & post-graduate courses · Evidence of improving learner achievement in MST 	<ul style="list-style-type: none"> · Higher MST teacher competence and morale · More effective MST teaching, assessment & classroom management · Greater ICT literacy and use in schools by MST teachers · Improved learner achievement MST rates 	<ul style="list-style-type: none"> 45% in 2011 · Participation rate of 55% in 2012 · Participation rate of 55% in 2013 · Participation rate of 60% in 2012 	
<ul style="list-style-type: none"> · HRD to update comprehensive MST teacher database · InSET panel to commission development of competence tests at different levels · InSET panel to agree competence testing regime and plan · MST teachers tested to establish competence database 	<p><u>6.3.4 MST Teacher Data</u></p> <ul style="list-style-type: none"> · Update accurate database of MST teachers · Databank of subject based competence tests at all Grade levels · Set of reports on MST teacher competence with recommendations reacting to emerging information 	<ul style="list-style-type: none"> · Accurate database of MST teaching capacity in Gauteng · Accurate data i.r.o teacher competence · Ability to react to capacity challenges and to plan training. 	<ul style="list-style-type: none"> · Updated provincial database by mid 2010. · Found. Phase competence report by end 2010 · GET & FET competence profile report by 2011 	R7m

7.2 The Strategy for Improving MST Resources in Schools

Input & Process	Output Measures	Outcome	Target Indicators	Budget
<ul style="list-style-type: none"> Curriculum Dir to compile comprehensive checklist of MST resources. GDE oversee self audit of MST resources in all schools. GDE to develop provisioning priority list and plan to 2014 	<u>7.2.1 MST Resource Data Base</u> <ul style="list-style-type: none"> Standardised MST checklists for all Grades Reports from all schools on MST resources Accurate database of resources and needs in all schools. Provincial provisioning plan 	<ul style="list-style-type: none"> A set of Grade related MST checklist An accurate MST database Information to approach funders and donors to support provisioning 	<ul style="list-style-type: none"> Complete MST resource audit by 2010 5 yr Provisioning plan by 2010 	
<ul style="list-style-type: none"> Liaise with GoL i.r.o roll out plan Assist with laptop project plan. Advocate ICT training programmes at Sci-Bono. Liaise with e-learning 	<u>7.2.2 ICT Resources</u> <ul style="list-style-type: none"> Training programme calendar and plans Teacher training courses in ICT Participation rates of teachers in training courses Number of accredited certificates awarded 	<ul style="list-style-type: none"> Increased MST teacher ICT capacity Increased use of MST software as a resource 	<ul style="list-style-type: none"> 500 hours of training delivered 300 teachers trained in 2010 500 teachers trained annually 2011 to 2014 	
<ul style="list-style-type: none"> Catalogue of small scale equipment compiled and approved by curriculum Selected schools provided or stock supplemented. Teachers trained in use of small 	<u>7.2.3 Small Scale Equipment</u> <ul style="list-style-type: none"> List of approved resources List of schools supplied 	<ul style="list-style-type: none"> No school without MST resources All schools offering applied MST activities 	<ul style="list-style-type: none"> 50% of schools audited with major needs supplied in 2010 75% of schools with major needs 	R6m

scale equipment			<ul style="list-style-type: none"> supplied by 2011 100% of schools with major needs supplied by 2013. 	
<ul style="list-style-type: none"> MST needs audit of special schools completed Priority provision plans approved All special schools provided with MST and ICT resources 	<u>7.2.4 Learners with Special Needs</u> <ul style="list-style-type: none"> Special school MST resource checklist compiled Complete audit report of special schools needs School reports on resource deliveries 	<ul style="list-style-type: none"> All special schools adequately resourced for MST and ICT 	<ul style="list-style-type: none"> Complete audit by June 2010 30% provision by 2010 60% provision by 2011 100% provision by 2012 	
<ul style="list-style-type: none"> Update approved textbook lists Ensure that all schools have adequate maths and science texts Update and complete lesson plans for FET and GET MST Distribute and monitor use of lesson plans to all schools Produce workbooks and worksheets for FET maths and science in selected topics Produce databank of assessments and scoring instruments for MST 	<u>7.2.5 Textbooks and Workbooks</u> <ul style="list-style-type: none"> Lesson plans & support materials produced and distributed to schools District audit of textbook availability and use at schools Databank of Grade differentiated assessments and instruments List of special topics for topic pack development. Service provider SLA and contracts for special topic development 	<ul style="list-style-type: none"> Increased and appropriate use of textbooks for maths and science More text resources used by all learners. Set of special topic packs 	<ul style="list-style-type: none"> Lesson plans for FET maths and science by end 2010 Lesson plans for GET by 2010 Work books on selected topics 2010 to 2012 	R12m

<ul style="list-style-type: none"> Identify and develop special topic packs on critical MST areas 				
<ul style="list-style-type: none"> Develop standardised checklist of district office resource needs. Develop standardised checklist of Resource Centre equipment library Approve & implement roll out plan for providing resources to both Advocate and facilitate use by schools and teachers of resource centres. 	<u>7.2.6 District Offices & Resource Centres</u> <ul style="list-style-type: none"> Approved comprehensive checklists of district office and resource centre needs Approved roll out plan for resource provision Provision Roll out reports Resource centre reports on resource usage by schools. 	<ul style="list-style-type: none"> Enhanced availability of MST resources, particularly scarce or costly resources in districts Greater use of resources for applied learning activities. Greater capacity in district office to support schools 	<ul style="list-style-type: none"> 50% of resource centres supplied with 50% of checklist needs by end 2011 100% of resource centres provided with 50% of checklist needs to by 2012 All resource centres provided with all checklist needs by 2014 	R25m
<ul style="list-style-type: none"> Produce and distribute checklist of lab and special room resources and requirements Districts to conduct audit of labs and special rooms Schools to request upgrade or refurbishment Roll out plan for refurbishment announced to schools Implement roll out plan 	<u>7.2.7 Refurbishment of Labs etc.</u> <ul style="list-style-type: none"> Checklist of requirements distributed to schools Audit report on state of labs and special rooms Roll out plan for refurbishment approved Roll out reports 	<ul style="list-style-type: none"> Clarity on MST lab and special room requirements for schools Clarity about what schools need and what schools have. Clear roll out plan with a focus on needy schools 	<ul style="list-style-type: none"> Refurbishment of 150 schools in 2010 Refurbishment of 300 schools in 2011 Refurbishment of 300 schools in 2012 Refurbishment of 300 schools in 2013 Refurbishment of 350 schools in 2014 	R50m

8.2 The Strategy for Improving Learner Achievement in MST

Input & Process	Output Measures	Outcome	Target Indicators	Budget
<ul style="list-style-type: none"> Identify and approve Foundation Phase support projects Implement and evaluate projects in school clusters 	<u>8.2.1 Foundation Phase Support</u> <ul style="list-style-type: none"> Project reports Evidence of achievement 	<ul style="list-style-type: none"> Improved delivery and achievement of Foundations for Learning Increased levels of numeracy & literacy in schools 	<ul style="list-style-type: none"> Achieve or exceed Foundations for Learning targets 	R7m
<ul style="list-style-type: none"> Identify district location and contract team of master trainers for each location Advocate attendance by FET learners in districts Prepare supplementary materials Run, manage and evaluate programme in June Run, manage and evaluate programme in September 	<u>8.2.2 MST Supplementary Tuition</u> <ul style="list-style-type: none"> Project roll out plans for each district Trainer manuals and learners packs Project report from each district 	<ul style="list-style-type: none"> Improved learners achievement in tests and end of year exams Improved learner participation in MST 	<ul style="list-style-type: none"> 300 learners per district per session in 2010 500 learners per session per annum to 2014 	R10m
<ul style="list-style-type: none"> Develop project management pack for districts Select initial locations in districts Identify & train tutors Select Grade 10 learners Implement, manage and evaluate 	<u>8.2.3 MST Talent Development</u> <ul style="list-style-type: none"> Project implementation pack Monthly project reports Learner achievement data Funder reports 	<ul style="list-style-type: none"> Improved learners achievement in Maths and science Increased entry into HEIs in science & engineering 	<ul style="list-style-type: none"> 7 locations in 2010 with 100 Grade 10 learners per location 8 more locations in 2011 100% pass rate of 	R3m

<ul style="list-style-type: none"> project in 2010 Identify pvt sector funders Phase in new locations in 2011 			initial Grade 10s in 2012	
<ul style="list-style-type: none"> Sci-Bono to plan participation programme Schools to be identified for participation School teams & facilitators trained Identify funders and sponsors 	<u>8.2.4 MST Participation Programme</u> <ul style="list-style-type: none"> Calendar of events, competitions and activities Lists of participating schools Project reports on achievements Number of learners, particularly from disadvantaged schools and girl learners, that participate 	<ul style="list-style-type: none"> Improved learner attitudes to MST in learners from poorly achieving MST schools Greater participation of disadvantaged schools in MST improvement activities Greater interest in post school SET careers 	<ul style="list-style-type: none"> 3 000 learners in 2010 5 000 learners p.a. from 2011 to 2014 	R5m
<ul style="list-style-type: none"> Approve project and funding Contract service provider and set up broadcast facilities at hub and reception facilities at district nodes Train master tutors and produce learner packs Implement, manage and evaluate programme 	<u>8.2.5 MST Broadcast Project</u> <ul style="list-style-type: none"> Project plan and budget Approved roll out plan and reports Broadcast materials Attendance numbers at reception nodes Learner assessment evidence 	<ul style="list-style-type: none"> Improved learner achievement in maths and science Enhanced reach of master tutors into districts 	<ul style="list-style-type: none"> 4500 Grade learners participate annually to 2014 	R18
<ul style="list-style-type: none"> Develop and approve campaign plan Implement manage and evaluate programme 	<u>8.2.6 MST Advocacy Campaign</u> <ul style="list-style-type: none"> Programme brief and service provider contract Campaign reports 	<ul style="list-style-type: none"> Parents, learners & teachers better informed about MST policy and issues. 		R1m
<ul style="list-style-type: none"> Increase capacity and activities of career centre at Sci-Bono 	<u>8.2.7 Career Education</u>	<ul style="list-style-type: none"> Increased number of learners serviced 		R3m

9.2 The Strategy for Improving MST Management

Input & Process	Output Measures	Outcome	Target Indicators	Budget
<ul style="list-style-type: none"> · Produce guidelines for principals & HOD on reading, writing and homework · Present for discussion at district meetings · Training workshops on homework management · Set illustrative targets for schools · Run competition for “well read & well written” schools 	<u>9.2.1 Learning Culture Campaign</u> <ul style="list-style-type: none"> · Guidelines for primary and high schools for Maths and science reading & writing with examples · District observation reports on reading & written work at schools · School submitted evidence on reading & writing 	<ul style="list-style-type: none"> · Increase in reading and writing in both primary and high schools · Improved learners reading & writing skills 	<ul style="list-style-type: none"> · All primary schools achieve minimum reading & writing targets 	R12m
<ul style="list-style-type: none"> · Negotiate and equip selected ‘mentor’ schools and agree 1 year support for weaker performing schools · Run preparation sessions with all mentor schools · Set up school networks of 1 strong school with 3 or 4 other schools · Run cooperation planning workshops for SMT and MST teachers · Arrange inter-school activities 	<u>9.2.2 Twinning & Mentoring</u> <ul style="list-style-type: none"> · Cooperation plans and reports from mentor schools · Joint lesson and assessment schedules · District observation reports · Minutes of joint planning meetings · Lesson plans and assessment data from supported schools. · Mentoring manual from mentor schools 	<ul style="list-style-type: none"> · Replication of best management and teaching practice in poor achieving schools · Greater cooperation, collegiality and closer relationships between schools 	<ul style="list-style-type: none"> · 5 clusters of up to 25 schools in 2010 · Expansion to 40 primary and 25 high schools by 2012 	R3m

including joint participation in competitions and Olympiads				
<ul style="list-style-type: none"> Recruit, appoint and train 5 facilitators Identify and prepare 5 school clusters & Maths or science and teachers in each cluster. Deploy cluster facilitators Monitor activities and results Review in 2011 	<u>9.2.3 MST Cluster Facilitators</u> <ul style="list-style-type: none"> Facilitator training manuals Monthly progress reports Materials produced by facilitators Minutes of Facilitator meetings 	<ul style="list-style-type: none"> Improved teacher performance Greater collegiality and peers support at cluster schools Joint MST problem solving Establishment of peer observation and support 	<ul style="list-style-type: none"> 5 facilitators and up to 25 schools in 2010/11 	R3m
<ul style="list-style-type: none"> Convene planning committee to develop project manual and set achievement targets for schools Establish incentive awards and support mechanisms for participating schools Publish participation invitation, guidelines and advocacy Implement programme and offer support to participating schools Review and plan phase 2 	<u>9.2.4 MST Targets for Schools</u> <ul style="list-style-type: none"> Project plan and manual School applications to participate Target agreements for maths and science achievement set for each participating school. 	<ul style="list-style-type: none"> Improved drive for improvement in MST Improved teaching and learning Higher level of MST achievement in participating schools Stronger performance culture across all schools. 	<ul style="list-style-type: none"> 30 primary and 30 high schools in 2010 150 schools in 2011 Minimum of 300 schools annually from 2012 to 2014 	R5m
<ul style="list-style-type: none"> Contract service providers to develop & administer tests for all grades Agree participation with schools 	<u>9.2.5 Research and Monitoring</u> <ul style="list-style-type: none"> Developer contracts Test banks for all grades Analysis reports 	<ul style="list-style-type: none"> Updated accurate data on MST performance for a large sample of schools Data to help plan training for 		R8m

<ul style="list-style-type: none"> involved in other projects above · Implement standardised quarterly tests that focus on specific topics · Score and analyse · Table reports on areas of concern · Give feedback and plan reaction 	<ul style="list-style-type: none"> · Reaction plans and minutes of meetings 	<ul style="list-style-type: none"> participating schools and teachers · Data for planning teacher training and topic selection for materials development 		
<ul style="list-style-type: none"> · Plan and implement specialist training for district officials and SMT i.r.o. MST management 	<u>9.2.6 District Office and SMT Training</u> <ul style="list-style-type: none"> · Training plans · Training materials · Training reports 	<ul style="list-style-type: none"> · Improved understanding in district officials and SMT members of basic management skills as applied to MST management 	<ul style="list-style-type: none"> · 60 hours of training delivered in 2010 · Participation of at least 90 SMT and district officials in 2010. · Participation to double annually to 2014 	R2m
<ul style="list-style-type: none"> · Conduct investigation into current roles, responsibilities and accountability. Consult and agree with MST teachers · Draft revised job specification and description for MST teachers, HODs, district officials 	<u>9.2.8 Clarification of Roles</u> <ul style="list-style-type: none"> · Draft statement of job responsibilities and accountabilities of all MST role players 	<ul style="list-style-type: none"> · Clear role and expectations of all MST role players. 	<ul style="list-style-type: none"> · Draft statements for all MST role payers by end of 2010. 	

12. IMPLEMENTATION AND MANAGEMENT OF THE STRATEGY

Experience gained in previous initiatives to improve MST education has shown the need for careful planning and management. It has also shown that such initiatives have significant potential risks and pitfalls that cannot be negotiated without strong political will and courage. To this end the following issues need to be considered.

12.1 Management and Co-ordination

The MST Improvement Strategy cannot be viewed in isolation from the GDE's five year plan or from other plans within the GDE. There is an inevitable overlapping of the actions planned in this strategy and those that are planned in the different GDE directorates responsible for curriculum implementation and support, human resource development and infrastructure development. It is also likely that certain elements of the Strategy will overlap with plans and activities other GDE agencies, including the Sci-Bono Discovery Centre, the Gauteng City Region Academy and the Matthew Goniwe School of Leadership and Governance. To this end the MST Improvement Strategy will need to be managed and coordinated in a way that optimises alignment and cooperation and which avoids duplication or confusion within the GDE head office or district offices.

12.1.1 Line Management and Accountability

The Strategy's management and implementation will remain the responsibility of the appropriate line function in the GDE. The Sci-Bono Discovery Centre will play a central and coordinative role and will manage and support the implementation of the Strategy. Sci-Bono will work closely with both GDE's Curriculum and HRD directorates in respect of detailed planning, implementation, communication, management and reporting of the Strategy. It is planned that there will be regular monthly meetings to manage the implementation of the Strategy but that a strategy of fast reactions to emerging issues will be adopted by the senior managers involved.

12.1.2 Other Role Players

The improvement of MST in Gauteng schools is of interest to a number of stakeholders and there are currently a range of role players involved. Besides the GDE head office, district offices and schools, there are a number of higher education institutions, NGOs, development agencies, private sector companies and public sector offices that provide funding, services and products in support of MST in Gauteng. While this support is necessary and useful, the impact achieved can be improved through effective coordination. A complete database of service providers,

HEIs, corporates and other agencies has been set up and will need to be constantly updated so as to have a profile of all MST activities in the province. The intention is less to have a gate-keeping function and more to identify gaps that need to be addressed and to ensure that all activities are aligned to the Strategy and constructive in their implementation.

12.1.3 **An MST Advisory Committee**

There is a strong inventory of expertise and experience within and outside of the public school system that can be productively tapped. This may well assist in unlocking innovation and assist in addressing some of the more intransigent challenges to improving MST achievement. It is planned to convene a provincial MST advisory committee to assist in the following ways:

- The committee will consist of a small number of key GDE senior officials from the relevant directorates, school management and teacher representatives, invited MST experts, representatives from universities and the private sector. The committee will have no authority or official status. It will be convened by the CEO of the Sci-Bono Discovery Centre, which will serve as its secretariat.
- The committee will meet to consider and oversee the implementation of the Strategy. It will also assist in liaising within the GDE and to aligning the actions taken as part of the MST Strategy with other actions taken elsewhere in the GDE.
- The committee will assist in coordinating and communicating widely in respect of activities implemented by other MST role players in respect of teacher training and support, resource provision or MST supplementary activities. It will assist the Sci-Bono Discovery Centre to maintain an accurate and up to date data base of MST interventions in Gauteng.

12.2 **Risks and Mitigation**

The successful implementation of the MST Improvement Strategy depends on a number of variables. These pose various challenges and risks.

12.2.1 **Funding**

The implementation of a wide ranging provincial strategy that will be expected to have an impact throughout the school system is a potentially costly exercise. In an environment of economic recession, severe budgetary limitations and the competition for funding for multiple priorities, the implementation of the Strategy is likely to be

underfunded. On the positive side, however, is the fact that maths, science and technology education improvement is the single most popular corporate social investment activity in the South African private sector. The Centre for Development and Enterprise states that, *“the private sector has a profound interest in an improved maths and science schooling system. The absence of high-level skills is significantly constraining its ability to expand the economy and meet its black empowerment targets.”* Corporate funding for education in South Africa in 2007/8 was R4,1 billion, of which a third was spent supporting education. Of this total, 22% went to support maths, science and technical education directly, not counting the amount that was allocated for teacher training and resources in these areas. The Strategy has every chance of being supported by the private sector.

12.2.2 Time Availability

Teacher training and support is the mainstay of the MST Improvement Strategy and so access to teachers is critical for the success of the Strategy. The biggest challenge to InSET initiatives in the past has been the lack of time available to work with teachers. Short weekend courses have been a common feature of teacher development activities. These have generally been poorly attended and have achieved little sustained change in classroom effectiveness. In order to address this challenge, the Strategy will seek to make use of school vacation time for training and to offer weekend activities that are voluntary, incentivised, of a short duration and as appealing as possible. Another mitigation strategy is to increase the use of relief teachers so as to free more teachers for intensive training during the week.

12.2.3 Support and Participation

The Strategy will require the commitment, support and participation of a number of key role players. The support of teacher unions and of school management is vital. Union support will require formal discussions in order to (1) ensure that the development of the Strategy is contributed to by teacher unions and that its implementation is seen as constructive and important to assist with. Similarly, there are risks that school principals may not see the Strategy as a priority. The GDE head office and district offices will need to assist in communicating, advocating and encouraging support for the Strategy. The support of teachers is also important and effort will need to be made to advocate and encourage teachers to participate. The strategy will be to offer as appealing and convenient a set of opportunities as possible and to build a growing core of teachers who seek to participate and benefit. It is hoped that this will lead to a swelling of numbers as momentum builds.

The Strategy will need to give attention to issues of process and accountability. The advisory committee and GDE senior management will assist in this.

12.2.4 **Competing Priorities, Integration and Alignment**

Gauteng has adopted an ambitious five year plan that will see a range of interventions in almost every aspect of schooling and education as a whole. It is inevitable that there are risks of too much being attempted in a short time period that involves the same group of teachers, school managers and learners. The risk of 'intervention burn-out' must be managed.

Schools and schooling cannot easily be separated into independent areas of operation. Schools are entities made up of integrated and interdependent elements. The success of any MST strategy implemented in a school depends on many other factors including support from the entire SMT, other departments and the SGB, on the quality of school management, on local priorities and other factors.

The provincial strategy will also need to integrate and align with the strategies and initiatives of other directorates in the GDE. The MST improvement Strategy will require coordinated planning, implementation and management between a number of directorates, including Curriculum, Human Resources Development and others.

The mitigation of the risks associated with these issues is to locate the Strategy as a project of the most senior level of management at the GDE and to ensure an effective, detailed and accurate flow of information between all role players.

12.2.5 **Innovation and Adaptation**

The MST Improvement Strategy will implement a wide range of different approaches and activities in seeking to achieve its goals. As with all forms of innovation, success is not guaranteed and there are risks of both falling short of the intended goals and of unintended consequences. The Strategy will attempt to mitigate these risks through process of early identification and reaction to any unforeseen or negative results of implementation. The Strategy will also attempt to identify the reasons for such occurrences as part of contributing to our understanding of MST educational management.

12.2.6 **Integration, Alignment and Interdependence**

REFERENCES

Bernstein A (ed) (2007) *'Doubling for Growth'*

Centre for Development & Enterprise,

Johannesburg

Fontannaz S (Ed) (2009)

Education Handbook

Argo

Stellenbosch

Department of Education (2001)

National Strategy for Mathematics, Science and Technology Education.

Department of Education.

Pretoria

Department of Education (2001)

National Strategy for Improving Learner Attainment in Mathematics, Science and Information Communication Technology in General and Further Education and Training Bands.

Department of Education.

Pretoria

Department of Education (2005)
A National Framework for Teacher Education in South Africa
Department of Education. Pretoria

Eastern Adelaide Region (2009)
Maths & Science Strategy 2010-2012

European Commission Directorate for Education and Culture (2007)
Education and Training 2010: Cluster Mathematics, Science & Technology
National Centre for Mathematics Education Gothenburg

Gauteng Department of Education (2009)
Five Year Plan 2009 -2014
GDE Johannesburg

HSRC (2005)
National Education Quality Initiative & Education, Science and Skills Development, Grade 6 Systemic Evaluation
HSRC, Pretoria

McKinsey & Co (2007)
The World's Best Performing School Systems Come Out on Top
McKinsey & Co. London

Moloi M. & Strauss, J. (2005).
The SACMEQ II Project in South Africa
SACMEQ Harare

Nagoa M, Rogan J, Magno M (eds) (2007)
Mathematics and Science Education in Developing Countries
University of the Philippines Press Quezon City

Office of Educational Standards (2008)
Mathematics: Understanding the Score
Crown Publishers London

Presidency of the Republic of South Africa (2009)
Together Doing More and Better: Medium Term Strategic Framework

Minister in the Presidency: Planning

Pretoria

Proceedings of the Teacher Education and Research Project Conference (2009)

Centre for Education Policy Development

Johannesburg

Roberts J & Schollar E (2006)

Meta-Evaluation of Intervention Projects in Maths, Science & Language,

Zenex Foundation

Johannesburg

Schollar E. (2008)

Final Report: The Primary Mathematics Research Project 2004 - 2007

Shuttleworth & Zenex Foundations

Johannesburg,

World Bank (2007)

Education Quality and Economic Growth

World Bank

Washington