

GAUTENG

MATHEMATICS, SCIENCE &

TECHNOLOGY EDUCATION

IMPROVEMENT STRATEGY

2009-2014

GAUTENG DEPARTMENT OF EDUCATION

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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 MST Teacher development Liaison with Higher Education in allied areas

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 preservice 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 inclass 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 R267 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 buyin 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, to create jobs and wealth, to compete internationally and to achieve social equity.

Mathematics, Science and Technology education in South Africa has been in an ongoing state of crisis 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. 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 not clearly understood.

Gauteng continues to strive for a major improvement in the guality 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



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100 200 300 400 500 600 African participants, Morocco and Tunisia.

- 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. In 2009, there were 98 659 Grade 12 exam candidates of which 48% wrote mathematics and 40% wrote science. The pass rate for mathematics was 55,7% which represents 27% of the total number of candidates. The pass rate for science was 42,6%, which represents 17% of the total number of candidates. An analysis of the Gauteng maths and science results is shown in table 2 below

	Maths	Physical Science
Candidates	47 567	39 688
Passed	26 499	16 910
Pass Rate	55,7%	42,6%

Table 2: Gauteng 2009 maths and science results

There were also 52 284 candidates that wrote Mathematical Literacy and these learners achieved a pass rate of 88,6%. While this represents a successful achievement, the subject is not gaining community support as it does not assist learners to enter higher education.

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

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.



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 any 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.

Table 3 below 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.

T		Math Lit	Math/ MST	Science Ed/ Physical Sc	Life Sciences
С	Registrations	876	3542	389	201
s	Programmes	9	30	10	5
а	Total Registrati	ons In ACE P	43 803		

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

The crisis is 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.

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

Summary of outcomes of the matriculation examinations: 1996 to 2006

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 mathematics 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

The need to improve MST education has been well recognised and a number of both national and provincial strategies have been implemented in the past, with varying but generally unsatisfactory results. The major initiatives are summarised below.

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 prompted 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, it has been expensive and has not been universally successful. One of the reasons for 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, Professor 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.

Comments from experienced and skilled teachers have identified a range of curriculum related issues which further undermine the success of the system as a whole and the achievement of individual learners. These include the following:

- The science curriculum is too dense and too long to be dealt with in the available time. It treats many concepts at levels of depth unnecessary for high school learners.
- The management of exams contributes to low levels of achievement. There is a general perception that many exam markers do not have the content competence to mark scripts effectively and so rely on a rigid observance of the exact wording in the memoranda. This means that learners may lose marks, even for a correct answer arrived at through an alternative but correct method. There have been assertions that the structure of exam papers is not aligned to the policy on higher order content.

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.

The MST Improvement Strategy needs to focus on all institutions that provide mathematics, science, technology and allied subjects, as listed above. This means that attention must be given not only to public ordinary primary and high schools but to other institutions, including technical and agricultural high schools. Significantly, it should also include FET Colleges, which are an important element of the MST education system. FET colleges deliver MST education to large numbers of learners whose level of achievement is as much a concern as that of their peers in ordinary high schools. FET Colleges have often been overlooked in past interventions aimed at improving learner achievement, despite them playing an important role in education. The strategy will seek to redress this.

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, values 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 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 within 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 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.

4.9 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.

4.10 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 from a wide range of stakeholders 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. This will include not only schools and FET Colleges, as the primary beneficiaries, but head office units and district offices, higher education institutions, maths and science NGO, the private and public sector. It is also intended to seek support and participation from the diplomatic community and international development agencies that support MST education.

5.3 Dynamic Monitoring, Evaluation and Adaptation

A number of hard lesson 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 improve 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

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for certification—are not closely correlated with actual ability in the classroom." The impact of teacher attitudes on the quality teaching cannot be underestimated.

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. The nature of the problem is indicated by comments made recently by a Gauteng science teacher: *"Frustration and disillusion are a Science teacher's constant companions these days. Plus an ever-growing sense of inadequacy when facing a syllabus that endlessly becomes longer and more detailed before facing a harsh exam on a very restrictive memo...." Teachers' attitudes have also been mentioned as a major reason for teachers failing the tests that they they are supposed to be preparing their learners for.*

Self-discipline is a critical element of good teaching, as is an institutional structure built on accountability. Professional attitudes and an acceptance of the rules is critical for a change strategy to work. To quote a local educational expert, "...until we institute normal *HR* processes in the civil service, like ensuring that teachers are held to the terms of their employment contracts, we cannot have good time management in schools." Another commentator has put it thus: "Discipline is top of the heap - because without it classroom experimental work becomes impossible. The overall responsibility for discipline in a school must rest with the Principal of the school, and be devolved under supervision to the MST teachers. If they have a discipline / class management problem it should be prioritised because the curriculum suffers every day the difficulty persists, it is time to make sure that the teacher knows how to cope with impossible learners" Changes in the professional attitudes and behaviours of educators remain important challenges in education and a *sine qua non* for the improvement of maths, science and technology education in South Africa and Gauteng.

The strategy therefore needs to address all three aspects, knowledge, skills and attitudes, 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, such as during school vacations or through releasing teachers from school for training courses..

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 o 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.



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, where an intensive awareness campaign will be aimed at Grade 12 learners and their parents.
- 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, teacher union repreentatives 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.
- 6.3.2.2The 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.

6.3.4 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.
- Inclusion of FET College MST teachers and lecturers in all programmes.

6.3.5 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 acrossthe-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 and FET college 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 Capacity and 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. In addition, and where it is not possible to provide a textbook for every learner, the Strategy will seek to provide workbooks for every learner. The workbooks will enable learners to undertake written work by themselves. The workbooks will need to be designed to cater to learners of different ability levels and so should allow learners to do a range of exercises, from small and basic to more advanced problem solving activities. 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.

While there is a need to address the shortage of textbooks, there is an important need to ensure that teachers know how to effectively use the textbooks they have. Properly used, textbooks will inevitably improve teachers' own content competence and will be major learning resource for learners.

7.2.6 Lesson Plans

In the same way that textbooks and worksheets need to be seen as basic universal resources that each learner should have, lesson plans are a basic requirement for each teacher. The lack of lesson planning and of written and effective lesson plans is an indication of poor professional behaviour. The Strategy will seek to ensure that a culture of lesson planning grows amongst teachers. This will include developing and distributing lesson plans for MST and allied subjects. It will also include training for teachers in how to draft, follow, adapt and share lesson plans.

7.2.7 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.

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7.2.8 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 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, through expanding and extending programmes such as the Senior Secondary Improvement Programme. These must, however, be quality assured and must make use only of teachers who have proven competence.

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 it 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.

Provision is also being made for an intensive weekend maths and science exam preparation programme in both November, before the Grade 12 final exams and in January, before the supplementary exams.

8.2.3 Maths and Science Exam Preparation Programme

The programme will provide intensive support over a short period running up to both the end of year examinations and the supplementary examinations. The purpose is to assist learners to prepare for, effectively manage and achieve optimal success in the exams. Selected teachers will provide opportunities for drill and practice at various centres throughout the districts.

8.2.4 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 be modelled on the SASOL Sci-Bono Saturday School programme. It 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.

8.2.5 Participation in MST Related Activities and 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.

8.2.6 ICT Skills

An effort will be made to improve learners' access to ICT and to the level of IT literacy of learners in general. Computer literacy in the 21st century is as necessary as basic literacy and the Strategy will seek to find ways of increasing opportunities for learners to build these skills. Bearing in mind the obstacles presented by cost and infrastructure, schools will be assisted to seek partnerships which facilitate access by learners to other ICT facilities.

8.2.7 MST Broadcast Project

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 an SMT, SGB and teacher training facility.

8.2.8 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.

8.2.9 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. It has been pointed out that the first step in improving MST management is to improve school management in general. 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 MST Peer Networks

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 for experience and best practice to flow between schools and those involved in MST education in order and to help to spread and translate effective processes, systems and culture from more successful to less successful schools. The Strategy will seek to establish practitioner networks between clusters of schools that will serve as a forum for sharing expertise and experience, for joint problem solving and for cooperative practice. There will be separate forums for school principals, Heads of Department, maths, science and technology teachers in each cluster. The intention is to establish clusters that include performing and underperforming schools. 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. (A networking approach has been proposed rather than using twinning or mentoring to spread best practice. Consultation and research into twinning and mentoring projects show much evidence of failure, mainly because they tend to be hierarchical relationships that impose too much work on the stronger partner and are seen as condescending by the weaker partners.)

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 at school level. They will be based at schools and not at district offices. They serve as peer trainers, assist in lesson planning, help to manage resources, provide in-class monitoring, assist in curriculum delivery planning, assessment management 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. The facilitators will need to be experienced and skilled and capable of providing support at Grade 12 level.

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 lead 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 Strategy has been fully costed and details are presented in Appendix 1.

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
HRD and inter-institutional	6.2.1 Standardised IPET Curriculum	All new MST teachers to have		
commission to agree a uniform	A set of Standardised IPET Curriculum	minimum level of instructional	Implementation in	
approach to MST Pre-SET training	Documents for each MST subject	and content competence	2013	
	Implementation in all HEIs			
GDE to increase bursary funds for	6.2.2 Increased number of MST Teachers	Sufficient numbers of new	300 MST teachers	
MST teacher PreSET.	Increase budget	teachers in all MST subjects	in 2010	
GDE to implement recruitment	Recruitment campaign implemented		• 1 000 new MST	
campaign for MST teachers	Improved registrations in all HEIs		teachers p.a.	R14m
GDE to plan and implement			• 100 interns p.a	
internship programme				
HRD to develop standardised	6.2.3 Induction Programme	Quicker integration of new	Test new induction	
induction for graduating teachers.	Induction programme manual for new	teachers into new jobs.	programme in 2012	
All HEIs to include induction in	MST teachers	Greater alignment between		
final year curriculum	Induction manual for HEIs	teacher training & school		

Selected schools to implement	Induction manual for schools	workplace	
school- based induction	 Initial implementation reports 		
programme for new teachers			

6.3 The Strategy for Teacher In-Service Education and Training				
Input & Process	Output Measures	Outcome	Target Indicators	Budget
GDE to convene expert panel to	6.3.1 an MST InSET Policy & Structure	 A formal InSET plan and 	 Tabled policy in 	
develop InSET policy in alignment	 Draft provincial MST InSET proposal 	management structure	2010	
with national & provincial policy	tabled for approval	 Clear expectations, 	 Implementation 	
 Panel to manage consultative 	Comprehensive MST InSET plan	opportunities, targets &	2010-2012	
process & table recommendations	approved	plans for MST teachers	 Review by end 2011 	
•				
HRD to increase budget for relief	6.3.2 Relief Teacher Programme	More MST teachers	 180 MST teachers 	
teacher recruitment	 Reports showing increased level of 	participating in regular In	trained in 2010.	
 Sci-Bono to increase pool of 	deployment of and spending on relief	SET activities.	 240 teachers trained 	
trained relief teachers	teachers.	Higher levels of MST teacher	p.a. from 2011 to	R6m
 Increased deployment to schools 	 Feedback reports from schools 	competence and morale	2014	
			 1500 days of training 	
			p.a.	
HRD & other role players to agree	6.3.3 InSET Programme	A successfully embedded		
InSET incentives	 An approved annual InSET plan & 	InSET programme and	• 6 000 in 2010.	
 Sci-Bono to table annual InSET 	programme document.	culture		R13m
plan after consultation	 Progress reports indicate successful 	 Annually increasing MST 	 9 000 teachers p.a. 	
MST InSET budget approved &	implementation and participation	teacher training participation		

	released	 Budget reports indicate implementation 	rates		
	 Annual plan to be published and 	to plan	 Higher MST teacher 		
	distributed to all MST teachers	 Service provider SLAs & contracts 	competence and morale		
	 Plan to be implemented and 	Trainer manuals and trainee resource	 More effective MST 		
	managed,	packs for all courses	teaching, assessment &		
	 Briefs distributed and tenders 	Teacher assessments indicate success	classroom management		
	awarded to service providers	of training	 Greater ICT literacy and use 		
	• Master trainers appointed, briefed,	School monitoring reports indicate	in schools by MST teachers		
	deployed & monitored	training transfer to class	 Improved learner 		
	 InSET support events planned & 	Award increased number of accredited	achievement MST rates		
	implemented	ICT certificates to MST teachers			
	 Implement ICT training for MST 	Number of educators registrations for			
	teachers	graduate & post-graduate courses			
	 Review of graduate & post- 	Evidence of improving learner			
	graduate opportunities	achievement in MST			
ľ	HRD to update comprehensive	6.3.4 MST Teacher Data		 Updated provincial 	
	MST teacher database	 Update accurate database of MST 	 Accurate database of MST 	database by mid	
	 InSET panel to commission 	teachers	teaching capacity in Gauteng	2010.	
	development of competence tests	• Databank of subject based competence	Accurate data i.r.o teacher	 Found. Phase 	D7m
	at different levels	tests at all Grade levels	competence	competence report	R/III
	InSET panel to agree competence	Set of reports on MST teacher	 Ability to react to capacity 	by end 2010	
	testing regime and plan	competence with recommendations	challenges and to plan	• GET & FET	
	 MST teachers tested to establish 	reacting to emerging information	training.	competence profile	
1					

competence database		report by 2011	

7.2 The Strategy for Improving MST Resources in Schools					
Input & Process	Output Measures	Outcome	Target Indicators	Budget	
Curriculum Dir to compile	7.2.1 MST Resource Data Base	A set of Grade related MST	Complete MST		
comprehensive checklist of MST	 Standardised MST checklists for all 	checklist	resource audit by		
resources.	Grades	An accurate MST database	2010		
GDE oversee self audit of MST	 Reports from all schools on MST 	 Information to approach 	 5 yr Provisioning 		
resources in all schools.	resources	funders and donors t support	plan by 2010		
GDE to develop provisioning	 Accurate database of resources and 	provisioning			
priority list and plan to 2014	needs in all schools.				
	 Provincial provisioning plan 				
Liaise with GoL i.r.o roll out plan	7.2.2 ICT Resources	Increased MST teacher ICT	• 500 hours of training		
Assist with laptop project plan.	Training programme calendar and plans	capacity	delivered		
Advocate ICT training	 Teacher training courses in ICT 	 Increased use of MST 	• 300 teachers trained		
programmes at Sci-Bono.	Participation rates of teachers in training	software as a resource	in 2010		
Liaise with e-learning	courses		• 500 teachers trained		
	Number of accredited certificates		annually 2011 to		
	awarded		2014		
Catalogue of small scale	7.2.3 Small Scale Equipment	 No school without MST 	50% of schools		
equipment compiled and approved	List of approved resources	resources	audited with major		
by curriculum	List of schools supplied	All schools offering applied	needs supplied in	R6m	
Selected schools provided or stock		MST activities	2010		
supplemented.			 75% of schools with 		

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	 Teachers trained in use of small 			major needs	
	scale equipment			supplied by 2011	
				 100% of schools 	
				with major needs	
				supplied by 2013.	
ľ	 MST needs audit of special 	7.2.4 Learners with Special Needs	All 115 special schools	Complete audit by	
	schools completed	Special school MST resource checklist	adequately resourced for	June 2010	
	 Priority provision plans approved 	compiled	MST and ICT	 30% provision by 	
	All special schools provided with	Complete audit report of special schools		2010	
	MST and ICT resources	needs		 60% provision by 	
		School reports on resource deliveries		2011	
				• 100% provision by	
				2012	
ŀ	Update approved textbook lists	7.2.5 Textbooks and Workbooks	Increased and appropriate	Lesson plans for	
	 Ensure that all schools have 	 Lesson plans & support materials 	use of textbooks for maths	FET maths and	
	adequate maths and science texts	produced and distributed to schools	and science	science by end 2010	
	Update and complete lesson plans	District audit of textbook availability and	More text resources used by	 Lesson plans for 	
	for FET and GET MST	use at schools	all learners.	GET by 2010	
	 Distribute and monitor use of 	 Databank of Grade differentiated 	 Set of special topic packs 	 Work books on 	R12m
	lesson plans to all schools	assessments and instruments		selected topics 2010	
	 Produce workbooks and 	 List of special topics for topic pack 		to 2012	
	worksheets for FET maths and	development.		Minimum of 1 000	
	science in selected topics	Service provider SLA and contracts for		lesson plans	
	Produce databank of assessments	special topic development			
1		1			1

Γ	and scoring instruments for MST				
	 Identify and develop special topic 				
	packs on critical MST areas				
ľ	Develop standardised checklist of	7.2.6 District Offices & Resource	Enhanced availability of MST	50% of resource	
	district office resource needs.	<u>Centres</u>	resources, particularly	centres supplied with	
	Develop standardised checklist of	 Approved comprehensive checklists of 	scarce or costly resources in	50% of checklist	
	Resource Centre equipment	district office and resource centre needs	districts	needs by end 2011	
	library	 Approved roll out plan for resource 	Greater use of resources for	 100% of resource 	
	Approve & implement roll out plan	provision	applied learning activities.	centres provided	R25m
	for providing resources to both	 Provision Roll out reports 	Greater capacity in district	with 50% of checklist	N20III
	 Advocate and facilitate use by 	Resource centre reports on resource	office to support schools	needs to by 2012	
	schools and teachers of resource	usage by schools.		All resource centres	
	centres.			provided with all	
				check.ist needs by	
				2014	
	Produce and distribute checklist of	7.2.7 Refurbishment of Labs etc.	Clarity on MST lab and	Refurbishment of 30	
	lab and special room resources	 Checklist of requirements distributed to 	special room requirements	schools in 2010	
	and requirements	schools	for schools	 Refurbishment of 	
	 Districts to conduct audit of labs 	 Audit report on state of labs and special 	Clarity about what schools	100 schools in 2011	
	and special rooms	rooms	need and what schools	 Refurbishment of 	R50m
	 Schools to request upgrade or 	Roll out plan for refurbishment approved	have.	100 schools in 2012	Room
	refurbishment	Roll out reports	 Clear roll out plan with a 	 Refurbishment of 	
	 Roll out plan for refurbishment 		focus on needy schools	100 schools in 2013	
l	announced to schools			 Refurbishment of 	
	 Implement roll out plan 			100 schools in 2014	

8.2 The Strategy for Improving Learner Achievement in MST				
Input & Process	Output Measures	Outcome	Target Indicators	Budget
 Identify and approve Foundation 	8.2.1 Foundation Phase Support	 Improved delivery and 	Achieve or exceed	
Phase support projects	Project reports	achievement of Foundations	Foundations for	
 Implement and evaluate projects 	 Evidence of achievement 	for Learning	Learning targets	R7m
in school clusters		 Increased levels of numeracy 	• 25 000 learners	
		& literacy in schools		
Identify district location and	8.2.2 MST Supplementary Tuition	 Improved learners 	• 1 000 learners per	
contract team of master trainers	 Project roll out plans for each district 	achievement in tests and end	district in 2010	
for each location	Trainer manuals and learners packs	of year exams	• 1500 learners per	
 Advocate attendance by FET 	 Project report from each district 	Improved learner participation	session per annum	
learners in districts		in MST	to 2014	D10m
Prepare supplementary materials				RIUM
 Run, manage and evaluate 				
programme in June				
 Run, manage and evaluate 				
programme in September				
Identify and confirm centres	8.2.3 Exam Preparation Programme	 Improved maths & science 	30% of learners	
 Identify, contract & prepare 	 Roll out plans for Oct/Jan 	pass rates	attending in Oct	
teachers	 Advocacy & media resources 		65% of re-writing	P4m
 Provide information via media and 	 Teaching & learning resource packs 		learners participating	N 4 111
school communications	Reports from each centre		 36 centres operating 	
Run, manage & monitor	Programme report			

programme in Oct and Jan.				
Develop project management pack	8.2.4 MST Talent Development	Improved learners	• 7 locations in 2010	
for districts	Project implementation pack	achievement in Maths and	with100 Grade 10	
Select initial locations in districts	Monthly project reports	science	learners per location	
Identify & train tutors	Learner achievement data	 Increased entry into HEIs in 	 8 more locations in 	
Select Grade 10 learners	Funder reports	science & engineering	2011	R3m
Implement, manage and evaluate			 100% pass rate of 	
project in 2010			initial Grade 10s in	
Identify pvt sector funders			2012	
Phase in new locations in 2011				
Sci-Bono to plan participation	8.2.5 MST Participation Programme	 Improved learner attitudes to 	3 000 learners in	
programme	Calendar of events, competitions and	MST in learners from poorly	2010	
Schools to be identified for	activities	achieving MST schools	• 5 000 learners p.a.	
participation	 Lists of participating schools 	 Greater participation of 	from 2011 to 2014	P5m
School teams & facilitators trained	 Project reports on achievements 	disadvantaged schools in MST		KJIII
Identify funders and sponsors	Number of learners, particularly from	improvement activities		
	disadvantaged schools and girl learners,	Greater interest in post school		
	that participate	SET careers		
Approve project and funding	8.2.6 MST Broadcast Project	Improved learner achievement	• 45 000 learners	
Contract service provider and set	 Project plan and budget 	in maths and science	participate annually	
up broadcast facilities at hub and	 Approved roll out plan and reports 	 Enhanced reach of master 	to 2014	
reception facilities at district nodes	Broadcast materials	tutors into districts		R18
Train master tutors and produce	• Attendance numbers at reception nodes			
leaner packs	Learner assessment evidence			
Implement, manage and evaluate				

programme				
Develop and approve campaign	8.2.7 MST Advocacy Campaign	Parents, learners & teachers		
plan	Programme brief and service provider	better informed about MST		R1m
 Implement manage and evaluate 	contract	policy and issues.		
programme	Campaign reports			
Increase capacity and activities of	8.2.8 Career Education	Increased number of learners		P2m
career centre at Sci-Bono		serviced		Rolli

9.2 The Strategy for Improving MST Management				
Input & Process	Output Measures	Outcome	Target Indicators	Budget
Produce guidelines for principals &	9.2.1 Learning Culture Campaign	Increase in reading and	All primary schools	
HOD on reading, writing and	Guidelines for primary and high schools	writing in both primary and	achieve minimum	
homework	for Maths and science reading & writing	high schools	reading & writing	
Present for discussion at district	with examples	Improved learners reading &	targets	
meetings	District observation reports on reading &	writing skills		D 10m
Training workshops on homework	written work at schools			RIZIII
management	School submitted evidence on reading &			
Set illustrative targets for schools	writing			
Run competition for "well read &				
well written" schools				
 Identify and set up networks of 	9.2.2 MST Network Programme	 Replication of best 	• 5 clusters of up to 25	
schools for pilot projects	 Network year plans and reports from 	management and teaching	schools in 2010	
Run preparation sessions with all	schools	practice in poor achieving	 Expansion to 40 	R3m
schools	Joint lesson and assessment schedules	schools	primary and 25 high	
 Run cooperation planning 	District observation reports	Greater cooperation,	schools by 2012	

workshops for SMT and MST	Minutes of joint planning meetings	collegiality and closer		
teachers	Lesson plans and assessment data from	relationships between		
 Arrange inter-school activities 	supported schools.	schools		
including joint participation in	 Network guideline documents for 			
competitions and Olympiads	schools			
Recruit, appoint and train 5	9.2.3 MST Cluster Facilitators	 Improved teacher 	 5 facilitators and up 	
facilitators	 Facilitator training manuals 	performance	to 25 schools in	
 Identify and prepare 5 school 	 Monthly progress reports 	 Greater collegiality and 	2010/11	
clusters & Maths or science and	 Materials produced by facilitators 	peers support at cluster		P3m
teachers in each cluster.	 Minutes of Facilitator meetings 	schools		Kolli
 Deploy cluster facilitators 		 Joint MST problem solving 		
 Monitor activities and results 		 Establishment of peer 		
Review in 2011		observation and support		
Convene planning committee to	9.2.4 MST Targets for Schools	 Improved drive for 	• 30 primary and 30	
develop project manual and set	 Project plan and manual 	improvement in MST	high schools in 2010	
achievement targets for schools	 School applications to participate 	 Improved teaching and 	• 150 schools in 2011	
 Establish incentive awards and 	 Target agreements for maths and 	learning	Minimum of 300	
support mechanisms for	science achievement set for each	 Higher level of MST 	schools annually	
participating schools	participating school.	achievement in participating	from 2012 to 2014	R5m
 Publish participation invitation, 		schools		
guidelines and advocacy		 Stronger performance 		
 Implement programme and offer 		culture across all schools.		
support to participating schools				
 Review and plan phase 2 				
Contract service providers to	9.2.5 Research and Monitoring	 Updated accurate data on 		R8m

develop & administer tests for all	Developer contracts	MST performance for a large		
grades	 Test banks for all grades 	sample of schools		
Agree participation with schools	Analysis reports	 Data to help plan training for 		
involved in other projects above	• Reaction plans and minutes of meetings	participating schools and		
Implement standardised quarterly		teachers		
tests that focus on specific topics		 Data for planning teacher 		
Score and analyse		training and topic selection		
Table reports on areas of concern		for materials development		
Give feedback and plan reaction				
Plan and implement specialist	9.2.6 District Office and SMT Training	Improved understanding in	60 hours of training	
training for district officials and	Training plans	district officials and SMT	delivered in 2010	
SMT i.r.o. MST management	Training materials	members of basic	 Participation of at 	
	Training reports	management skills as	least 90 SMT and	
		applied to MST management	district officials in	R2m
			2010.	
			 Participation to 	
			double annually to	
			2014	
Conduct investigation into current	9.2.8 Clarification of Roles	Clear role and expectations	Draft statements for	
roles, responsibilities and	 Draft statement of job responsibilities 	of all MST role players.	all MST role payers	
accountability. Consult and agree	and accountabilities of all MST role		by end of 2010.	
with MST teachers	players			
Draft revised job specification and				
description for MST teachers,				
HODs, district officials				

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.

13. PROJECT ROLL OUT PLAN

The MST Improvement Strategy will be implemented between 2010 and 2014. A detailed proposed project roll out plan is attached as Appendix 2. The Gantt charts indicate the intended roll out for each of the interventions listed in the Strategy as described above.

It must be stated, however, that the roll out of the Strategy is dependent on a number of factors that lie outside of the full control of the GDE. The availability of resources such as funding, personnel and time will determine the nature and pace of implementation. A caveat must therefore be attached to the roll out plans that the initiation of each action on each chart may need to be delayed until all the required resources are available.

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APPENDIX 1: PROJECT BUDGET

APPENDIX 2: PROJECT ROLL OUT PLAN