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INVESTIGATION INTO THE IMPLEMENTATION OF MATHS, SCIENCE AND TECHNOLOGY

TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
SECTION 1: SIMILARITIES IN AND DIFFERENCES BETWEEN PROVINCIAL IMPLEMENTATION STRATEGIES.....	5
1.1 The National Strategy for MST Education in GET and FET	5
1.2 Implementation Plan for Mathematics, Science and Technology	6
1.3 Provincial Implementation Strategies.....	6
1.4 Similarities in Provincial Strategies	7
1.5 Differences	8
SECTION 2: PROVINCIAL REPORTS	11
2.1. EASTERN CAPE PROVINCE.....	11
2.2. FREE STATE PROVINCE.....	12
2.3. GAUTENG PROVINCE	12
2.4. KZN PROVINCE	12
2.5. LIMPOPO PROVINCE	14
2.6. MPUMULANGA PROVINCE	14
2.7. NORTHERN CAPE PROVINCE.....	15
2.8. NORTH WEST PROVINCE	16
2.9. WESTERN CAPE PROVINCE.....	16
SECTION 3: STRENGTHS AND WEAKNESSES.....	18
SECTION 4: SIMILARITIES IN AND DIFFERENCES BETWEEN THE PROVINCES.....	33
SIMILARITIES.....	33
DIFFERENCES	40

SECTION 5: GENERIC AND SPECIFIC SUPPORT NEEDED	42
5.1 GENERIC SUPPORT	42
5.2 SPECIFIC SUPPORT	47
SECTION 6: RECOMMENDATIONS	50
6.1 A Dedicated MST Strategy Office	50
6.2 A Teacher Development and Support Programme	51
6.3 A Resource Management Programme.....	51
6.4 The Dinaledi Programme	51
SECTION 7: CONCLUSION.....	51
Priority 1: Identify and Rank Priorities.....	52
Priority 2: Address Teachers and Teaching Issues	53

EXECUTIVE SUMMARY

The task team appointed by the Minister of Basic Education was asked to conduct an Investigation into Implementation of Maths, Science and Technology Strategy. The team has studied the national and provincial strategies and has engaged with provincial education departments by means of visits to the provinces, where interviews were held with many teachers, heads of MST departments at schools, district officials and head office officials. The interviews were supplemented by detailed questionnaires about the implementation of MST in schools.

The evidence gathered shows that there is a dominant similarity across the provinces, both in their strategies and the limitations to their implementation. This report describes these commonalities and limitations in some detail and makes a series of recommendations to address the latter, under the general headings:

1. A dedicated MST Strategy Office.
2. A teacher development and support programme.
3. A resource management programme.
4. The Dinaledi Programme

It was evident to the task team that the objectives and the strategies are laudable but the human and financial resources provided to achieve the objectives are inadequate. In a situation of multiple objectives and scarce resources it is necessary to prioritise which are most critical to achieve. It is therefore urgent to prioritise the large number of objectives and to develop plans that can be implemented substantially and successfully. The team therefore recommends that national and provincial departments agree on priorities.

Based on the findings of the investigation, the task team believes that the first and most critical priority to address is to do with teachers and teaching related issues.

SECTION 1: SIMILARITIES IN AND DIFFERENCES BETWEEN PROVINCIAL IMPLEMENTATION STRATEGIES

It is to be expected that provincial MST implementation strategies should extend from the national strategy and that they would be developed through discussions between the DBE and the provincial departments. Furthermore, given their common source in the national strategy, it may be expected that considerable similarities should exist between the various provincial strategies. The task team investigated this by inspecting the various provincial strategy documents and other evidence. Interviews conducted in the provinces also helped to shed light on the extent to which there was a basic understanding of and follow through on the national strategy.

1.1 The National Strategy for MST Education in GET and FET

The document was published in 2001 and adopts three thrusts:

- (a) To raise participation and performance by historically disadvantaged learners in Senior Certificate mathematics and physical science;
- (b) To provide high-quality mathematics, science and technology education for all learners taking the first GETC and FETC; and
- (c) To increase and enhance the human resource capacity to deliver quality mathematics, science and technology education.

The national strategy document goes further and indicates how these goals will be realised in implementing the strategy:

1. Establishment of dedicated mathematics and science schools, strengthen the teaching of English second language, support LTSM procurement, delivery and retrieval, and increase participation and performance by girls;
2. Development of new curricula for mathematics, science and technology with learning outcomes and assessment standards;
3. Establishment of an adequate supply of qualified and competent mathematics and science educators, upgrade under-qualified and unqualified educators, and provide incentives for attracting students as educators in mathematics, science and technology.

There are, however, some curious and concerning features of the document:

- The acronym MST is generally translated as mathematics and science. The T for Technology is largely disregarded;
- Despite a commitment to improving MST in both bands, GET is largely ignored;
- Science is effectively interpreted as physical science alone, generally ignoring subjects such as life science, agricultural science in FET and Natural Sciences in GET.

1.2 Implementation Plan for Mathematics, Science and Technology

Although this document, which was published in 2012, may not fully describe national MST strategy, it provides a more recent perspective on government's strategy. In particular it identifies failures and achievements since the initial publication of the national MST strategy. The first Thrust, regarding the participation and performance by historically disadvantaged learners, receives most of the attention, with shortcomings in the dedicated schools strategy being a principal concern. It is also acknowledged that technology education was not promoted effectively.

The document also introduces new terminology: Pillars replace thrusts in defining the following implementation strategies:

- A. Improving of participation and performance of girl learners.
- B. Support for teaching and learning.
- C. Teacher development.
- D. Provision of resources.

These pillars relate to previous statements of intent with three much generalized pillars (B, C and D) and one more specific pillar (A). However, overall the document is confusing and poorly prepared and, unlike the 2001 strategy document, does not inspire confidence and is unhelpful to provinces.

1.3 Provincial Implementation Strategies

There is considerable variation in the provincial MST strategy documents. The variation is less to do with the recognition of the national MST strategy of 2001 as a base document of the implementation plan of 2012, as it is in the extent to which provincial plans interpret the operational implications and actions to achieve the main goals.

Gauteng and Limpopo produced the most comprehensive strategy documents that are strong on content and logic. Four other provinces (Eastern Cape, KwaZulu Natal, Northern Cape, and Western Cape) produced somewhat smaller strategy documents, which are also well presented, logical and clear. In a number of these cases the analyses and proposals are supported by references or bibliographies which demonstrate that the strategies are based on informed research. Documents were received from the other provinces (Free State, Mpumalanga, North West) too late to inform the visits by the provincial teams, but have been included in the comparative table nevertheless.

The key pillars and thrusts of the national documents find expression in slightly different ways in each of the provincial strategies. In many instances, national terminology is amended to a provincial terminology, so that we find objectives, key thrusts, strategic pillars, focus areas and domains, as well as simply pillars and

thrusts. Most provincial strategies have either 4 or 5 such key pillars and most include some distinctive variations.

An in depth analysis of the provincial strategy documents shows some important similarities and differences, which are discussed below.

1.4 Similarities in Provincial Strategies

1.4.1 Centrality of Educators

The most striking and significant similarity is the recognition that the improvement of educators is a fundamental target. Several documents explicitly quote the well-worn statement that “the quality of an education system cannot exceed the quality of its teachers”. Consequently all strategies and implementation plans provide for teacher training and some indication can be found of intended scope and mechanisms. Much of the training depends upon subject advisers or curriculum facilitators, although in certain cases this responsibility has been given to NGOs and HEIs. The duration and nature of the training is variable. Usually there is no indication of how the effectiveness of the training will be evaluated. It is also noteworthy that there is rarely any reference to development and training of the subject advisers, despite their key function.

1.4.2 Resources

Teaching and learning resources are also part of the all provincial strategies. Whilst there are variations in detail the primary beneficiaries of the plans are clearly the Dinaledi schools. Whilst this is in tune with the national strategy, it does burden those schools to achieve significant levels of success.

1.4.3 Learners

Learners are another element common to the provincial strategies. There is a plethora of interventions and enrichment initiatives, some to stimulate interest, some to create career awareness and others to improve subject knowledge and skills.

1.4.4 Emphasis on Science

The imbalance in the original national strategy document resulting from an overemphasis on physical science is largely retained in the provincial documents. As such, the ambiguous treatment of Technology as a subject, the weak focus on GET level planning and the almost total absence of any reference to any other branch of science other than physical science are as evident in provincial strategies as in the national strategy.

1.4.5 Absence of Monitoring and Evaluation

The impression created by these strategy documents is of a great deal of effort being made to improve MST education and that a wide variety of activities are being implemented. There is little evidence, however, of evaluation. It is to be expected that monitoring and evaluation would be

important for planning purposes. Similarly the strategies show no evidence of or reference to priorities, implying that all the pillars of the strategies are seen as equal in importance or not.

1.5 Differences

1.5.1 Poor Evidence of Educational Technology

The significance of educational technology as a teaching and learning resource is generally acknowledged in the provincial strategies. However, only in one province (KZN) does this acknowledgement go as far as identification as a “strategic pillar”. Two other provinces (GP, WC) have mounted important ICT based projects.

1.5.2 Advocacy

The significance of “partnership, presence and profile” is recognized in its appearance as a fifth “strategic pillar” (KwaZulu Natal), and overlaps in part with “monitoring, evaluation and advocacy” as the fifth thrust/pillar in two other provinces (Mpumalanga and Western Cape). Once again these aspects of strategy are not necessarily ignored by other provinces.

Comparison of Provincial Strategy Implementation Plans

Province	Thrusts, pillars, objectives, domains, focus areas	Comments
E Cape	<ol style="list-style-type: none"> 1. Strengthen MST teaching 2. Improve provision of MST resources 3. Provide programmes of learner support 4. Improve MST management 	Train subject advisers
Free State	<ol style="list-style-type: none"> 1. Teacher development 2. Learner development & support 3. Provision of resources 4. Curriculum and leadership management 	English and Accounting included GET Senior phase Prof development of subject advisers Business plan
Gauteng	<ol style="list-style-type: none"> 1. Improving MST teaching 2. Improving MST resources 3. Improving learner achievement 4. Improving MST management 	Final section gives outputs and indicators
KZN	<ol style="list-style-type: none"> 1. Educator capacity, supply, demand 2. Quality learner participation, performance, competitiveness 3. Adequate resourcing of MST classrooms and education centres 4. Active ICT integration into curriculum delivery 5. Partnership, presence and profile 	Reaching other stakeholders
Limpopo	<ol style="list-style-type: none"> 1. Learner support 2. Teaching and teacher development 3. Resources 4. School monitoring and management support 	Concludes with Plan of Action Intermediate phase maths plan SMT development
Mpumalanga	<ol style="list-style-type: none"> 1. Schools 2. Teachers (support and development) 3. Learners (participation and performance) 4. Resources 	CI orientation; technical schools MST Academy

	5. Monitoring, Evaluation and Advocacy	
N Cape	<ol style="list-style-type: none"> 1. Teacher domain 2. Learner domain 3. Content domain 4. School domain 	Protecting teaching time
N West	<ol style="list-style-type: none"> 1. Improving of participation & performance of girl learners 2. Support for teaching and learning 3. Teacher development 4. Provision of resources 5. MST management 6. Quantifiable targets 7. Interdepartmental & DBE social partners 	GLIP LITNUM PSF
W Cape	<ol style="list-style-type: none"> 1. Schools 2. Teacher support and development 3. Resourcing 4. Learners 5. Monitoring, evaluation and advocacy 	Separate docs on teacher dev strategy and on Litnum strategy Public support

SECTION 2: PROVINCIAL REPORTS

PROVINCIAL EXECUTIVE SUMMARIES

Section 2 presents the executive summaries provided in the individual team reports for each province. Variations in the extensiveness of these summaries reflect the different ways in which the provincial teams interpreted this task. The detailed findings are incorporated into the main body of this ministerial report, whilst all the reports are available in full as an annexure. Strong similarities have emerged, that are confirmed in Sections 3 and 4 of this report. The Ministerial Committee appreciates the support of the Provincial, District and school personnel that assisted the teams by providing valuable insights into the management of MST in the provinces. It should be noted however that some provinces did not provide their MST strategies before the provincial visits took place, and this may be evident when reading the following summaries.

2.1. EASTERN CAPE PROVINCE

The Eastern Cape Province is a large province with many rural districts. The province has historically been seriously impacted by discriminatory education delivery in the pre-democratic system in South Africa. In the current democratic system, the province continues to struggle to overcome the serious under performance in the vast majority of the schools. The Province was ranked 9th out of the nine provinces in both Mathematics and Physical Sciences performance in the 2012 NSC examination.

Key findings were:

- Many vacant posts throughout the system – at school, district and provincial level.
- Most of the rural schools are faced with multi-grade teaching.
- Whilst a MST sub-directorate is in place, it operates as a unique entity with limited engagement with the curriculum directorate and limited engagement with district subject advisors. However, there is one MST official per district who is responsible for implementation of MST activities in each district.
- The GET and FET directorates have provincial subject planners and subject advisors in districts who are responsible for curriculum implementation in schools. They train and support teachers.
- Schools have a serious shortage of qualified and competent educators - the resultant impact on the teaching of mathematics and science is sufficiently serious to foreground the need for a systematic programme to upgrade educators competence both in content and pedagogy to enable them to teach the curriculum efficiently. The province reports poor teacher development both in-service and pre-service.
- Teachers also raised concerns about the competency of some curriculum advisors and the inadequate ratio of curriculum advisors to teachers. This often results in teacher workshops being of below standard. They also suggested that workshops be complemented by follow-up classroom support by curriculum advisors.
- An absence of effective monitoring and evaluation is evident in the schools that were selected by the province for the investigation.
- Currently some training is done during contact teaching time which impacts on teaching and learning. The distance that teachers have to travel is a contributory obstacle in resolving this problem.
- Budgetary constraints have led to a serious shortage of physical resources such as laboratories and equipment and have impacted on the execution of practical work in Physical Sciences required by the curriculum.
- ICT in teaching and learning is non-existent in the vast majority of schools that were selected by the province for the investigation.
- Communication is a general problem throughout the system. For example even curriculum advisors do not have access to e-mail at work. Most schools were provided with a laptop and 3G facility but claim that they do not know how to use the technology.

- The Dinaledi schools have not been very successful in serving as hubs of support and mentoring in Mathematics and Science for other schools. Dinaledi schools are struggling to comply with the national requirements such as 60% of learners in FET must take Mathematics because of the disastrous shortage of competent Mathematics and Science teachers.

Teachers are the agents of change. It is clear that in the short-term a sustainable teacher development strategy is required to address the serious shortcomings in teacher content, pedagogy and classroom management.

2.2. FREE STATE PROVINCE

There is a general sense that the basics require urgent attention. This includes a more effective leadership and management that holds all role players accountable, a more effective management of the budget, make more posts at all levels available, provide improved teacher training programmes and improve on the quality of the support provided by the Department.

2.3. GAUTENG PROVINCE

A document entitled ***Gauteng Mathematics, Science and Technology Improvement Strategy: 2009-2014*** sets out the strategy and plans for the improvement of MST in Gauteng.

The establishment of Sci-Bono to drive the MST strategy in the province has already achieved a measure of success. The biggest advantage is that this unit presents a unified, focus on MST. Unfortunately many of the officials at district level have not yet bought into the concept and much advocacy work remains to be done to ensure greater synergy between Sci-Bono and district structures.

The unsatisfactory performance in Mathematics, Science and Technology in Gauteng cannot be attributed to a deficient strategy. Rather, it can be traced to systemic factors that affect, not only MST subjects, but all teaching and learning in the province. The main barrier to successful implementation of a MST strategy is the shortage of qualified and experienced teachers.

2.4. KZN PROVINCE

The KZN Department of Education manages education in a geographical large area bordered by the Indian Ocean in the east and also shares borders with Mozambique, Swaziland, Mpumalanga, Free State, Lesotho and the Eastern Cape resulting in high migration patterns. It has a large rural population. The structure of the Department consist of Head Office and 12 Education Districts, namely, Obonjeni, Vryheid, Amajuba, Empangeni, Umzinyathi, Othukela, Ilembe, Umgungundlovu, Pinetown, Umlazi, Sisonke and Ugu. KZN was ranked 8th out of the nine provinces in both Mathematics and Physical Science performance in the 2012 NSC examination.

Key findings were:

- The subject advisory service are involved in several programmes and expressed feelings of frustration, stress and helplessness as they were unable to do justice to the demands of each of the programmes expected of them. They were also unclear on what was expected of them
- Educators and principals expressed satisfaction at being involved in dealing with the challenges encountered by the department. The implementation of CAPS was well received and educators generally felt that this was in the right direction. Some concerns expressed included lack of time to complete certain sections, the inclusion of certain

sections demanded additional training and they were critical about the quality of training provided. Since the MST programmes were directed at specific schools and identified learners, not all schools were aware of its implementation. The non-specialization of Mathematics and Science educators in the GET phase was of concern to Principals.

- The Advisory service facilitated programmes with host schools to support both Educators and Learners from 20 schools per district. Their interactions were directed at exposing learners to the standards required and encouraging greater exposure to problem solving. In excess of 11000 learners attended learner support programmes in 7 education districts. In the absence of follow up activities and monitoring of performance of these learners it has been difficult to establish the effectiveness of the programme.
- Educators generally welcomed the subject advisors but would prefer more frequent visits to assist the school in understanding CAPS and its implementation. They were less sympathetic with the quality of workshops conducted by Unions. It was also evident that the qualifications and competence of mathematics and science educators in general was a serious impediment for effective learning and teaching.
- Educators appear to be happy with the content of the workshops as it dealt with areas identified by the moderators report. They were less satisfied with the workshops being conducted after school hours and weekends citing tiredness after a long school day.
- Subject advisors were happy with the resources provided to the schools and which were further supplemented by curriculum material and workbooks. Hey Maths! Software has been installed on two laptops in 80 schools. Little focus was however placed on equipment and consumables for facilitating experimental work in the sciences with the exception of the Dinaledi schools.
- Several programmes were designed to support mathematics and Science educators through workshops and content orientated programmes particularly those related to the implementation of CAPS. Attempts are being made to facilitate physical science practical work in the classroom. This however is beset by a lot of logistical problems. By and large each subject advisor organizes activities that he/she considers important with little inputs from a strategic perspective. Monitoring and evaluation of programmes is less evident.
- The small sample of identified learners did not impact on many of the schools identified and inputs were consequently minimal and/or the impact was not established. However anecdotal evidence appears to suggest that learners were benefiting from learner support programs.
- Educators cited several areas where textbooks were not available particularly in the FET phase. They demonstrated concern that books supplied were in some cases different from that which they ordered.
- The schools in the KZN area have a serious shortage of qualified and competent educators. The impact of this on the teaching of mathematics and science is sufficiently serious to focus on a systematic programme to upgrade educator qualification particularly in content orientated curriculum. Great concern was expressed by subject advisors, on the quality and competence of Mathematics and Science educators in the GET phase.
- Principals in general acknowledge that the skill level of mathematics and science educators is a serious challenge but they attempt to make the best possible use of available staff. In the absence of a concerted effort by the department to systematically improve the quality of MST educators, the situation is unlikely to improve to the desired state.
- Partnership has been established with several service providers including S A Mathematics foundation (Olympiads), PLATO software, DST, Sugar Industry, SAASTA, Eskom Expo, Technology Innovation Agency, Ethekwini Municipality, Standard Bank, SITFE and Future Wise Quiz focusing on learners, educators and the provision of resources primarily in the under developed areas.
- The members of the MST team, GET Curriculum directorate and FET Curriculum directorate continue to work in isolation. The impact of their work cannot therefore be evaluated from a strategic perspective. The shortage of qualified mathematics and

science officials particularly in the GET phase is a serious impediment for effective implementation of the MST strategy.

- The shortage of qualified Mathematics and Science educators is a serious impediment for effective learning and teaching to take place.
- Science practical work is virtually non-existent making it difficult to inspire learners to choose science as career possibility.
- Language impacts on the teaching and learning of Mathematics and Science in particular at the switch over at Grade 4 level.
- Educators reported that the workbooks provided by DBE contained many errors and that the Siyavula textbooks did not necessarily deal with the depth required by the curriculum.

2.5. LIMPOPO PROVINCE

Limpopo is a large province – both in terms of geographical spread and the number of schools – facing many challenges, including the following:

- the province has the second lowest matric results in the country
- the Limpopo Department of Education has recently been placed under national administration
- limited resources – funding, physical resources and human resources – hamper efforts to improve education in the province
- only five districts must service all the schools in the province.

A document entitled ***Provincial Mathematics, Science and Technology Improvement Strategy: 2010-2014*** sets out the strategy and plans for the improvement of MST in Limpopo. Many of the objectives stipulated in the document are yet to be achieved.

The relative successes realized through the Dinaledi schools in Limpopo indicate that it is indeed possible for even this disadvantaged province to improve education results in Mathematics, Science and Technology. However, the following problems prevent progress in most of the schools in the province:

- poor communication of the MST strategy to all relevant parties
- shortage of qualified Mathematics, Science and Technology teachers
- insufficient subject content and pedagogical support to teachers
- shortage of physical resources
- lack of emphasis on: Technology as a subject; technology related subjects; and technology as a tool to enhance teaching and learning.

These challenges are amplified when it comes to the many rural and small farm schools, in which many under-performing learners receive their education.

The poor performance in Mathematics, Science and Technology in Limpopo can be traced to systemic factors that affect, not only these subjects, but all teaching and learning in the province. MST can improve in this province through a range of dedicated and funded programmes, but it must be clear that more than artificial interventions are required: the entire support system for teachers and schools must be given attention. Improving MST would therefore call for more than mere MST interventions.

2.6. MPUMULANGA PROVINCE

The Mpumulanga Department of Education manages education in a geographically large province with a large rural population. The structure of the Department consist of Head Office and 4 Education Districts, namely, Bohlabela, Nkangala, GertSibande and Ehlanzeni.

The Mpumalanga Department of Education has developed a strategic plan for Mathematics, Science and Technology Education for the period 2003 to 2008. This has been further refined in 2009. The strategy focussed on 2 principal goals, namely:

- To increase and enhance the human resource capacity to deliver quality MST Education for all learners in the GET and FET bands; and
- To increase the participation and performance of learners in the GET and FET bands, giving special attention to Black learners, Female learners and learners with special educational needs.

While several activities had been directed at achieving the strategic goals of the department it is evident that there has been a drop of 21% in the number of learners that wrote mathematics since 2008 and an 18% drop in Physical Science. The number of learners that passed Mathematics increased marginally by 0,88% per annum over the last 5 years while that for Physical Science show an increase of 1,56% per annum. Similar trends are also reflected in the other sciences including life sciences. It is evident that the implementation of the strategy and/or the nature of activities implemented had not achieved its intended outcomes.

Key findings were:

- Insufficient capacity to manage a multitude of programmes reflected in the revised strategy;
- A large number of activities focused on activities outside of the school environment thus reducing sustainable development within the school and in particular, the classroom;
- An extremely large percentage of time, energy and resources were spent on logistics (eg. Identification of schools and learners, arranging transport, identifying venues, providing refreshments and writing reports), thus compromising real curriculum and professional development;
- Lack of a coherent strategy to develop educators particularly in Mathematics and Science;
- The lack of monitoring and evaluation of programmes made it difficult to assess the effectiveness of the activities undertaken and take action if required;
- A dire shortage of competent and skilled Mathematics and Science educators.

Two key aspects which featured strongly in the responses of all those who were interviewed includes:

- Positive sentiments have been made regarding CAPS and its implementation with a few resolvable issues.
- The competency level of educators of Mathematics and Science is the most serious challenge facing the department.

2.7. NORTHERN CAPE PROVINCE

MST teachers and officials in the Northern Cape are unaware of the national MST Strategy and delivery of Mathematics, Science and Technology education in the province is not guided by or managed according to either the national or provincial MST Strategy. Some district officials have recently seen some of the documents. No school-based educators have seen the documents. None of the head office officials, district officials or school-based staff interviewed was involved in drawing up the strategy. It seems that MST curriculum delivery and management are guided largely by curriculum documents such as CAPS and its precursors and by a general understanding of what is needed for MST curriculum delivery.

There is general consensus between head office, district and school based staff in respect of MSTE in the Northern Cape, about the key issues impacting on MSTE.

- There is a wide concern about the competence levels of MST teachers in the province. It is widely perceived that too many teachers lack both content mastery and instructional skills. There were many negative comments about the quality and products of pre-service teacher training.
- There is agreement that advisory services and in-service support are inadequate in the province. This is largely due to the vast area of the province and inadequate number of district officials for the number of schools needing support.
- There is wide agreement that there are inadequate resources for MST. This applies mainly to facilities, laboratories and equipment, rather than to textbooks. The take up of ICT in schools is also seen as slow. There has, however, been great success in using ICT resources to support Mathematics and Science through the use of DVDs.
- There is concern about the poor quality of primary level education and gaps that learners bring into high school.

2.8. NORTH WEST PROVINCE

The North West Province is a large province that continues to be plagued by underperformance in the vast majority of the schools. The following problems prevent progress in most of the schools in the province:

- poor communication and support provided by the Provincial officials
- poor communication of the MST strategy to all relevant parties
- shortage of qualified Mathematics, Science and Technology teachers
- insufficient subject content and pedagogical support to teachers
- shortage of physical resources
- lack of emphasis on: Technology as a subject; technology related subjects; technology as a tool to enhance teaching and learning.

All of the above challenges are amplified by the many rural and small farm schools, which consists of the majority of underperforming learners in the province.

The poor performance in Mathematics, Science and Technology in the province can be traced to systemic factors that affect, not only these subjects, but all teaching and learning in the province. MST can improve in this province through a range of dedicated and funded programmes, but it must be clear that more than artificial interventions are required. The entire support system for teachers and schools must be given more attention.

2.9. WESTERN CAPE PROVINCE

The Western Cape Province is the province renowned for good performance and adequate ICT penetration in schools. While this perception generally holds, the investigation revealed that there are several instances where penetration is not as wide as the public is made to believe. This report summarized the findings and sheds light on critical areas needing attention.

There seems to be a strong consensus between head office, district and school based staff in respect of MST education in the Western Cape. The following issues emerged:

- Although the department has both the Provincial MST Strategy as well as the LitNum Strategy, most participants in the investigation had not seen the documents. The delivery of Mathematics, Science and Technology education is not guided by or managed according to either the national or provincial MST Strategy. Very few participants have seen the documents. The MST curriculum delivery and management

are guided largely by curriculum documents such as CAPS and its precursors and by a general understanding of what is needed for MST curriculum delivery. Participants had a good sense of the requirements of the CAPS documents. It is fortuitous that there is a broad overlap between the MST Strategies and what is seen as needed.

- There is a wide concern about the competence levels of MST teachers in the province. It is widely perceived that too many teachers lack both content mastery and instructional skills. This starts from the poor pre-service training of teachers and the inadequate district capacity to provide in-service support.
- There is wide agreement that there are inadequate resources for MST. This applies mainly to facilities, laboratories and equipment, rather than to textbooks. The take up of ICTs in schools is also seen as slow. Although most participants indicated that there is a computer laboratory in the school, there is however, little ICT training and support resulting in very low levels of ICT integration into curriculum delivery.
- The 'abrupt termination' of the Khanya Project was not seen as helping the situation. Even those schools that benefited from the Khanya Project, now sit with a lot of technical problems with computers.

There is a general sense that what is needed, is to get the basics right. This includes a more effective leadership and management that holds all role players accountable, a more effective management of the budget, more posts at all levels, better training and quality of support.

SECTION 3: STRENGTHS AND WEAKNESSES

STRENGTHS AND WEAKNESSES

Section 3 is a summary of the common strengths and weaknesses, prevalent within the nine individual MST reports. These reports were compiled, based on inputs received during the provincial visits by the members of the Ministerial Committee. Each Provincial MST report reflects the views expressed by the department officials and school staff that formed part of the interview groups. These views have not been tested against evidence from other sources. Details of the focus groups per province are provided within each report. Comments are provided by the committee members, based on the specific feedback received from the Provincial visits and serves to provide clarity, expanding on each point listed. Comments are applicable in varying degrees to each province.

STRENGTHS	COMMENTS
Private sector's willingness to support education should be investigated within each province.	This component requires guidelines to ensure that partnerships are effective, guided and regulated by a protocol to ensure (a) alignment to provincial strategy and priorities; (b) that the provincial departments are aware of all projects conducted at school level; (c) that support is targeted where there is a need rather than only where donors have an interest; The guidelines should include not just the private sector but all external role players including NGOs, HEIs, etc.
The schools draw on each other through Cluster groups for information sharing and skills transfer, where Cluster programmes are in place.	The subject advisor to school ratios are very high in most provinces, resulting in schools relying on Cluster groups for support. However, cluster groups only succeed when enthusiastic teachers are involved to ensure that the programme is maintained. The concept of Communities of Practice might further strengthen cooperation and the spread of best practice. However, this process would require Departmental guidance.
Willingness of teachers lacking pedagogical and/or content knowledge to be trained.	Teachers are generally desperate to upskill themselves and have become frustrated with the lack of proper training offered and supplied by their District Departments.

	<p>In Gauteng and Limpopo, many teachers were reluctant to undergo professional development. Interference of the Unions with teacher training was in fact an expression of the unwillingness of the teachers to attend training on Saturdays and school holidays.</p> <p>Training may be further strengthened by exploring a variety of training methods, which includes ICT based, distance training technologies.</p> <p>There does seem to be a broad community of dedicated teachers who are committed to education and who are willing to be involved and engaged in improving MST and the effectiveness of schooling in general. Ways might be sought for more regular contact and channels of communication to and from ordinary teachers and district officials, to counter feelings of being voiceless.</p>
<p>The co-ordinators for the MST strategy in some provinces, have a clear understanding of the national strategy and have developed a provincial strategy that is aligned.</p>	<p>This is not the case in North West where, at the time of the visit to the Province, provided a 5 page document that suggests possible planned programmes. The Free State has a draft document that has not been made available to the MST co-ordinators. In May, a provincial strategy was submitted to the MST committee.</p>
<p>Principals and educators are positive about the CAPS curricula however, comments have been received that the syllabi are too long. Implementation is far from satisfactory, due to a lack of teaching and learning resources, subject specific teacher training and adequate time to author decent textbooks.</p>	<p>Applicable to all the provinces to a greater or lesser degree.</p>
<p>Technologies exist that can be leveraged to address problems especially related to collecting and disseminating information to teachers and schools.</p>	<p>Generally applicable to all the Provinces.</p>
<p>Dinaledi schools appear to be well equipped.</p>	<p>Applicable to all the Provinces. However, the equipment is underused.</p>
<p>The Khanya ICT project in the Western Cape assisted to promote the use of ICT.</p>	<p>The long term cost of stopping successful projects like Khanya because of the lack of funding includes increasing school level cynicism about how seriously to take ICT expansion in schools.</p> <p>GoL in Gauteng has much experience on how to implement ICT within the schools and what works and does not work.</p>
<p>The Technical Recap programme in the Western Cape has proved</p>	<p>This may be quite generalised throughout most provinces but the lack of</p>

to be a success.	human resources is specifically highlighted in NC.
In Gauteng, Sci-Bono is an organizational unit dedicated to the promotion of MST in the province and has shown many successes in co-ordinating the Provincial MST strategy and implementation plan through a central point.	
In Gauteng, the Primary Language and Maths Strategy is aligned to the National LitNum strategy and has made an impact within the GET Phases.	
The Gauteng Online project has provided each school in the province with good quality computer technology for learners, laying a solid foundation on which to build and promote Technology as a teaching and learning resource.	We should not overstate the achievements of GoL. There are many harsh lessons learned through the project. GoL was not an Education Department project and the GDE did not control the project or rollout. This aspect, together with poor training and other weaknesses, exacerbated the lack of achievement of intended educational targets.

WEAKNESSES	COMMENTS
Within the Provincial/District Departments	
There appears to be an authoritarian approach by the Department /Districts with regard to the relationship with the schools. There appears to be a disconnect between schools and the District officials, as well as between District and Province. Schools claim that the District officials appear to be out of touch with the schools, teachers and requirements.	There may also be a sense that many district officials are not trained or skilled to oversee and support teachers, i.e. that many district officials lack professional credibility.
There is a lack of a MST Provincial Strategy and implementation plan to provide clear guidelines and targets to the District, Schools and teachers in most of the provinces. District officials claim that they are either not aware of the MST documents or that they have not seen it. They further claim that they were not involved in the planning process so they are not in a position to implement the process. The national and provincial strategies are not impacting on delivery and are not a reference point for curriculum delivery.	The MST Strategies may be less important than the translation into practical actions with specific targets, credible deadlines and certain budgets. Officials, SMTs and teachers want to know what to do more than why to do it (which is often obvious) and that they have what is required to implement the strategy properly.
Lack of an integrated approach to Provincial MST strategies and delivery as the MST unit. If there is a dedicated unit, it generally works as an independent, unique entity with little co-ordination from the Provincial offices as a central point.	Applicable to all the provinces to a lesser or greater degree. In Gauteng the Sci-Bono initiative does a great deal to integrate and consolidate the MST strategy. This works well, except for fact that many district staff, particularly subject advisors, have not fully bought into the initiative and still has an “us-them” view of Sci-Bono.
Some subject advisors in the GET and FET sectors are not adequately competent and skilled to execute their tasks effectively in most of the provinces.	Generally applicable to all the Provinces. However, few subject advisors were competent and skilled in Technology subjects and ICT and were unable to provide the necessary support and guidance in using ICT as a teaching and learning tool in Technology subjects, Mathematics and Science.
Focus by the Departments on the FET phase, to the detriment of the GET phases. Qualifications and competence among the subject advisory services for the GET phase has compromised effective curriculum support.	Applicable to all the provinces.

<p>Lack of department officials to support teachers in Mathematics and Science subjects as the subject advisor to school / teacher ratios are very high. Technology subject advisors were very few across all the Departments and as a result, the Technology subjects are severely neglected. The same applies to FET Technical subjects.</p>	<p>Applicable to all the provinces.</p> <p>In Provinces that have large rural regions, the cost implications to visit schools regularly makes the effect of a shortage of support staff even more strongly apparent.</p>
<p>No planned monitoring and evaluation systems are in place in most provinces, to inform the attendance, impact and success of provincially co-ordinated interventions for both teachers and learners.</p>	<p>In most Provinces, data is being collected regularly, but not being used to manage delivery effectively. Data is collected for the sake of compliance, rather than to stimulate management reaction to issues and challenges, thereby addressing them.</p>
<p>Schools become frustrated when they plan activities for the year, but plans are often overturned by last minute instructions from the District, Provincial and National departments. In many cases, these instructions are perceived as “last minute” as they may have been issued timeously, but bureaucratic processes cause major delays in communication.</p>	<p>This aspect particularly, demonstrates the effect of poor communication processes within provinces and was expressed by department officials, principals and teachers alike as a major challenge.</p>
<p>Teacher appointments: The Provincial Department guidelines are not clear and consistently followed especially with regard to temporary appointments. Appointments of teachers in temporary posts are often confirmed by the start of the second term, resulting in the loss of valuable teaching time. Similarly, posts that are temporarily vacant owing to maternity leave may take months to fill, leaving learners severely impacted.</p>	<p>Many schools complained that temporary posts are generally only filled by the start of the 2nd school term leaving learners untaught for the entire 1st term of school.</p> <p>Rural and multi-grade schools with small staff complements, are particularly effected when teacher appointments are delayed, since there are fewer teachers to share the work load.</p> <p>In NW, the Head Office has released a document dated December 2012 where it states that no foreign teachers may be employed in a temporary capacity. This has caused delays in filling posts timeously.</p>
<p>Lack of resources at district offices:</p> <ul style="list-style-type: none"> • staff are not issued with personal computers or laptops; • where printers are available, toners are more often than not unavailable or unobtainable; • photo copy facilities are inadequate, owing to a lack of paper and toners; • internet connectivity is often not available and email connectivity is 	<p>Applicable to all the provinces to a greater or lesser extent. In spite of the challenges, there is a core of subject advisors that are dedicated and trying their best to provide assistance to their allocated schools.</p>

<p>erratic;</p> <ul style="list-style-type: none"> • insufficient vehicles for use by curriculum/subject advisors makes it impossible for them to reach all schools within their schedule of visits; and • some curriculum/subject advisors do not have office space from which to operate. 	
<p>A number of Provincial / District learning programmes target small groups of learners, resulting in minimal impact on the overall performance of the learners. When these programmes are funded externally, no monitoring and evaluation on the part of the Province appears to take place.</p>	<p>Districts appear to work in silos and were unable to provide a list of the individual learning programmes other than the SSIP programme that targets schools that have achieved a Matric pass rate of less than 40% in the Free State. Similar silo processes were apparent in KZN and Mpumalanga. Other provinces like Gauteng, target schools with pass rates less than 80%.</p> <p>Dinaledi schools are an example of where extra resources have been provided to a small number of schools, with minimal overall impact.</p>
<p>A large number of activities occur outside of the school environment, resulting in professionals spending greater time in organising events and dealing with logistics.</p>	<p>Applicable to all the provinces to a lesser or greater degree.</p>
<p>Lack of accountability in the Provincial system, means that no one is ever held responsible for poor results, poor staff performance or inadequate service delivery.</p>	<p>Generally applicable to all provinces to a lesser or greater degree.</p>
<p>Communication</p>	
<p>Communication is made difficult owing to the following factors:</p> <ul style="list-style-type: none"> • head office staff are often unclear about the nature and purpose of national strategies; • staff shortages and frozen posts at head office, as well as in the districts; • vast distances between many rural schools and district offices with a lack of connectivity and proper transport of the curriculum / subject advisors to travel to the schools; • access to vital information is a serious barrier to effective implementation 	<p>In many Provinces the MST team, GET Curriculum directorate and FET Curriculum directorate worked in isolation with little or no co-ordination of MST activities. The same silo thinking often prevailed between personnel in the District office and Provincial Head Office.</p>

<p>of the MST strategy;</p> <ul style="list-style-type: none"> • a frequent change in curriculum, education policies and the constant introduction of new interventions that are frequently not communicated to the schools timeously. Teachers and curriculum/subject advisors complain about conflicting instructions, pacesetters and new timetables that are released by the National department, the Provincial department and District offices; no sooner have plans been formulated to execute one set of instructions, when another set of instructions is given and often received late or at all; • a lack of electronic equipment (district officials and curriculum/subject advisors are not issued with computer equipment, and photo copiers including related consumables, are seldom available); • documents (hard copies and/or digital copies) are sent to schools but often principals neglect to study the documents and advise the teaching staff. 	
<p>Teaching and Learning Resources</p>	
<p>Education Resource Centres are not accessed and utilized by most teachers and officials. Many teachers did not know where the resource centres are located or what they are equipped with.</p> <p>In some instances, the District officials indicated that the Resource Centre buildings are in place but they are not resourced or equipped and do not have allocated staff to manage the facility as there is no budget, so they have become 'white elephants'.</p>	<p>Generally applicable to most of the Provinces to a greater or lesser degree.</p>
<p>Lack of resources e.g. books, laboratories (including equipment and consumables), technology support material and computer equipment are in short supply and no budget is available for these resources.</p> <p>Textbooks and workbooks are often not delivered on time.</p>	<p>Comments received indicate that the workbooks supplied by the DBE have many errors and lack content detail. Practicals and activities are lacking in the workbooks.</p> <p>Free books from donors seem to receive rather luke-warm support. Officials and teachers alike, complained about the quality of Siyavula books.</p> <p>In Limpopo, some textbooks have still not been received.</p>

<p>In general, teachers and curriculum advisors are not skilled in the use of technology as a teaching and learning aid. The equipment, when provided, is under-utilized because staff generally do not know how to use these tools. Teachers are not equipped with Technological Pedagogical Content Knowledge (TPCK) for effective use of the technology in the classroom. There are also issues with maintenance and updating of ICT, where these skills are severely lacking in the schools.</p>	<p>Applicable to all the provinces to a greater or lesser degree.</p>
<p>Teachers and curriculum/subject advisors have suggested that data projectors are used into classrooms, so that teachers can use PowerPoint presentations and other available resources. They further suggested that DVDs containing relevant subject material could strengthen MST education. Access to free Open Source programmes like GeoGebra is an example of an excellent classroom-teaching tool for Mathematics. There are many other resources that can be accessed or developed specifically for subject specific assistance.</p>	<p>Provinces need to be cautious about commercial ICT products, which work well for as long as external support is available and which are very expensive in the long term.</p>
<p>Where schools are fortunate enough to have computer centres, these resources are often only used to teach computer literacy and are not used for curriculum purposes. Very little support is provided by the Department to schools to acquire, secure against theft and maintain computer facilities.</p>	<p>Some of the interviewed schools stated that computer hardware is simply delivered to the schools with no security processes in place, no dedicated computer lab infrastructure, no ICT training and no installation of the hardware, thus rendering the equipment useless.</p>
<p>Lack of Provincial budget to supply schools with the required Technology equipment (computers, laptops, data projectors) as well as education programmes to be used by the teachers in the classroom. Programmes and software often require annual licence fees that are very expensive, so they are provided for a limited period only.</p>	<p>The success of ICT programmes makes a case for the development of DBE owned resources that are designed as subject specific CAPS support resources. This would remove expensive licensing processes, provide a sustainable set of resources and ensure that the educational content was relevant and impactful.</p>
<p>The conclusion of the Khanya project in the Western Cape left schools with little or no resources, support or capacity to maintain ICT in schools.</p>	<p>Sustainability plans were not executed post project. The education department decided to follow a different route with regards to e-Learning, but left the Khanya installations without provisions for sustainability.</p>
<p>Teachers have expressed the view that while learners are interested in technology and in some cases are using it already, the teachers are being</p>	

<p>left behind. Many teachers are digitally illiterate and unable to use technology as a teaching and learning tool. Teachers are unable to perform a simple task like type a Mathematics or Science test paper and are in dire need of ICT training.</p>	
<p>Lack of creativity when teaching: even in cases where teachers could do experiments using inexpensive, locally found resources, teachers wait for the Department to provide.</p> <p>Where there are no Science laboratories, schools should buy or be supplied with proper Science kits and relevant consumable.</p> <p>In the Foundation phase, teachers generally show more creativity than in the higher grades, finding inexpensive tools, equipment and everyday objects to teach Numeracy.</p>	
<p>Dinaledi schools are often reluctant to share their resources and appear to work in seclusion.</p>	<p>Many schools are critical of the Dinaledi school selection process and have expressed that Dinaledi schools are favoured, receiving special treatment when they do not produce the same Matric results as those schools that are not within the Dinaledi programme.</p> <p>It was suggested that the Dinaledi Schools are reviewed and evaluated on a two-year basis so that non-performing schools are removed from the programme and replaced with schools that are more deserving.</p>
<p>The Gauteng Online project has provided each school in the province with good quality computer technology for learners, laying a solid foundation on which to build and promote Technology as a resource.</p>	<p>Many harsh lessons have been learned through the project, which is often referred to as Gauteng 'Offline'. GoL was not an Education Department project and the GDE did not control it. This aspect, together with poor training and other weaknesses exacerbated the lack of achievement of educational targets.</p>
<p>Human Resources</p>	
<p>Teacher competence is regarded as weak throughout the system by the schools and Department official and poses the greatest threat to</p>	<p>Applicable and critical to all the Provinces to a lesser or greater degree.</p>

MSTprogress.	
<p>There is a serious shortage of competent, qualified Mathematics, Science and especially Technology subject teachers. The following may be reasons for this:</p> <ul style="list-style-type: none"> • inadequate pedagogical training at HEIs; • parts of the curriculum are new to the teacher due to frequent curriculum changes resulting in the teacher being unable to master all the subject components properly; • insufficient supervision and support is provided by curriculum/subject advisors at school level; • inadequate support by curriculum/subject advisors who are dealing with subjects that are not part of their specialization fields; • curriculum/subject advisors can only do “book checks” and are barred from doing class visits and lesson observations to support weak teachers; • inadequate in-service-training/training and development is provided to the teachers. 	<p>Applicable and critical to all the Provinces to a lesser or greater degree.</p> <p>The removal of Geometry from the Mathematics NCS to the optional Mathematics Paper 3 has resulted in many teachers having no exposure to this topic since 2008. The Mathematics teachers will now have to teach Geometry within the CAPS syllabi as CAPS has included this content of Mathematics Paper 3 to the curriculum. This poses many challenges to the teachers.</p> <p>Furthermore, the content knowledge in Mathematics that requires attention is much of the content that learners and teachers struggled with in the old Higher Grade curriculum, which has now been included into CAPS.</p> <p>Many teachers were previously only exposed to teaching the old Standard Grade Mathematics syllabi and lack the expertise to deal with the necessary depth required by many of the CAPS topics.</p>
<p>Qualified and competent teachers from neighbouring countries are appointed on a temporary basis, but often these contracts are renewed late, not renewed or sometimes cancelled, causing instability within the schools.</p>	<p>Especially applicable in NW, but was also highlighted in Northern Cape, Gauteng and Limpopo.</p>
<p>HOD selection was noted as a serious point of concern. HODs are appointed that are not qualified in the specific MST subjects and were therefore not able to assist the subject teachers or provide guidance and mentorship. Similarly district official recruitment requires attention as they should be aware of school processes and requirements, as well as skilled in project management, monitoring and evaluation processes.</p>	<p>Relevant to all of the provinces to a lesser or greater degree.</p>
<p>In the GET phases especially, the shortage of qualified Mathematics, Science and Technology teachers results in teachers that are skilled and trained in other subject areas, being forced to teach these subjects with no adequate skill or experience. This resulted in a weak foundation in MST</p>	<p>Applicable to all the Provinces to a lesser or greater degree.</p>

subjects. In some cases, multi-grade teaching in MST subjects is implemented to compensate for the lack of qualified MST teachers.	
In small, rural schools, teachers are forced to offer a number of subjects to multi-grade classes. The PPM regulations restrict the number of teachers in these schools. It is also more difficult to attract qualified teachers to schools in remote areas, thereby seriously impacting on learner progress and subject specific fundamentals.	The implementation of larger schools with subsidised boarding facilities will address the challenges around small rural and farm schools and the restrictions of PPN.
Often the most qualified and experienced teachers are used to teach in the FET phases and especially Grade 12. Less or under qualified and often inexperience teachers are allocated to the lower grades, especially the Senior phase, resulting in a weak foundation.	Applicable to all the Provinces to a lesser or greater degree.
Career Guidance	
Lack of proper Career Guidance in Grades 8 and 9 to direct subject choices according to competence, and fields of interest.	The dearth of skilled career educators needs to be addressed, possibly through the centralised development of more resources and upskilling of Life Orientation teachers.
Learners are moved to Mathematical Literacy instead of remediating the problem areas in Mathematics. Forcing the change to Mathematical Literacy, ensures adequate school pass rates. Ratio of Mathematical Literacy to Mathematics in the FET Phase Nationally is around 60% to 40% with Mathematical Literacy dominating in Technical High Schools.	Generally applicable to all of the provinces. Learners are forced to select Mathematical Literacy but are allowed to continue with Physical Science in spite of the learner not being skilled to perform the calculations required in Physics. This in turn, impacts severely on Science pass rates. Too many learners are allowed to select combinations such as Physical Science and Mathematical Literacy, believing that this will allow entry to HEIs.
Teacher Development and Training	
Lack of training and development in subject knowledge by the Provincial Departments. Training sessions are arranged and conducted by the curriculum/subject	Applicable to all the Provinces to a lesser or greater degree.

<p>advisors who may not have the required expertise. Attendance is poor as a result of the training sessions being viewed as simply going through a document or aligning subject files with no proper attention given to subject specific knowledge training programmes. There is no evidence that Ad hoc programmes to support the teachers, has a positive impact on the performance of learners and exam results.</p>	<p>There is consensus in all of the Provinces regarding the great need for InSET but the impression is that training is inadequate and has little/no impact.</p>
<p>Training sessions are often scheduled by the Departments to take place during term time with the teacher being expected to be out of class for a week at a time. This means that learners are left untaught during this period. On return to class, the teacher must then catch up on the missed work.</p>	<p>Saturday training sessions generally result in poor attendance due to Labour Union interference and by teacher choice. Training and development programs should be scheduled to take place during school holiday periods and should be addressed at policy level. Training sessions scheduled to take place during school holiday periods would not interfere with the school teaching program, ensure high attendance and bypass Labour Union regulations.</p>
<p>Curriculum</p>	
<p>Teachers indicated that there is insufficient time allocated for Mathematics and Science subjects to complete the CAPS syllabi. They have expressed a need for double periods for completing Laboratory work/tests.</p>	<p>The Provincial Departments should advise the schools on appropriate time tabling processes.</p>
<p>Learners that progress from the GET phases lack the proper foundation in Mathematics, Technology and Science subjects by the time they reach FET. The schools and Department officials stated that by removing the standardized National Gr. 9 exams, the teaching and performance in the FET phase was greatly impacted as learners lack foundational competencies when entering FET.</p>	<p>Applicable to all the Provinces to a lesser or greater degree.</p>
<p>Technology as a subject</p>	
<p>The “T” in MST is not taken seriously and is given very little attention in all of the Provinces. There is further no clarity or distinction provided between Technology as a subject/series of subjects and the use of technology as a teaching tool.</p>	<p>Applicable to all the Provinces to a lesser or greater degree.</p>

<p>There are very few qualified Technology teachers and technological resources are not available in many schools. This results in the neglect of the subject.</p>	<p>Applicable to all the provinces except Gauteng and Western Cape and is a major barrier to the teaching of Technology subjects.</p>
<p>Technology in the GET phase is a much neglected and under-valued subject. The CAPs combination of Technology with Natural Science in the GET Intermediate phase has caused many further challenges:</p> <ul style="list-style-type: none"> • teachers and curriculum/subject advisors stated that the combined subject does not lay a proper foundation for Technology as a subject in the Senior phase and does not prepare learners to make the correct subject choices in the FET phase; • many teachers that have Natural Science training, have no prior experience in teaching Technology and thus they tend to neglect this part of the subject, in favour of Biology and Science; • generally, curriculum/subject advisors are Science trained and therefore new to Technology as a subject. As such, they lack the expertise and experience to provide proper support to teachers; • adequate training is not provided to upskill the Natural Science & Technology teachers. 	<p>Applicable to all the Provinces to a lesser or greater degree.</p>
<p>Engineering subjects are offered by only a very small number of schools Nationally. Generally, schools are not equipped with the hard and soft ware to offer Engineering subjects due to budget constraints. Qualified Engineering teachers are few and people who do have the correct qualifications, are not attracted into the teaching profession, rather opting for the private sector.</p>	<p>Applicable to all the Provinces to a lesser or greater degree.</p>
<p>CAT and IT, as well as Agricultural Sciences, Life Sciences and Engineering subjects are viewed as subjects separate from and therefore not part of the MST strategy.</p>	<p>Applicable to all the provinces to a greater or lesser degree.</p>
<p>Generally, public schools are encouraged by their Departments not to offer CAT, IT and Engineering subjects in the FET phase for the following reasons:</p> <ul style="list-style-type: none"> • these subjects are resource intensive (computer laboratories are required for learners to have 1:1 access to computing devices) and the 	<p>Applicable to all the provinces to a greater or lesser degree.</p>

<p>Department generally does not provide any additional funding to schools that wish to offer these subjects, so all technology must be acquired, upgraded and maintained by the schools themselves;</p> <ul style="list-style-type: none"> • CAT is not regarded as a designated subject by tertiary institutions and therefore little encouragement exists for schools to offer the subject or for learners to select the subject; • very few specialized curriculum/subject advisors are available to support teachers/schools that offer these subjects with the technical expertise required; • very few qualified teachers are available to offer these subjects; • specialized technicians are not available to ensure that the required technology is in good working order during the year and particularly during examination time; • soft ware programmes are very expensive and budget is not available; • a 1:1 relationship between learners and computing devices is required for CAT and IT. In some schools, this ratio has decreased to one device for three learners, making it increasingly difficult to continue offering this subject. <p>The result of the lack of DBE support to teach IT, CAT and Engineering subjects effectively, has resulted in these subjects currently being offered mainly by the more affluent fee paying schools and private schools.</p>	
<p>MST for Girl Learners</p>	
<p>Constraints like teenage pregnancy and household chores impacts negatively on girl performance in MST.</p>	
<p>Very little effort is made within the Provinces to encourage Girl Learners to select MST subjects. In some cases, the sum total of encouragement is to bus Girl Learners to a Science Expo once a year.</p>	<p>There is a gender imbalance in technical subjects at FET level, especially in the more rural regions.</p>
<p>Language Challenges</p>	

<p>The conversion from Mother Tongue/Home Language instruction to English as the medium of instruction at Gr 4 level is a major challenge for teachers. The teachers have indicated that terminologies in especially Mathematics and Science must be retaught from the beginning with learners now having to master not only the subject content but also a new language. These impacts dramatically on understanding and results.</p>	<p>Generally applicable to all the provinces. There were suggestions that English as the medium of instruction is either introduced slowly from Grade 1 or that English as the medium of instruction is delayed until Grade 6.</p>
<p>In some Provinces, the Home language of the learners and teachers are often not the same. This results in the teaching and learning process taking place in a third language, for example: a Zulu speaking teacher teaches a Sotho speaking learner, using the medium of English. During the Foundation Phase, when learners are taught in the Home language, teachers have expressed the lack of an adequate vocabulary for some concepts and objects. The same applies to GET and FET learners who must master subject specific terminology, in a First Additional Language.</p>	
<p>Rural and small farm schools</p>	
<p>There is a lack of adequate, fully funded schools with boarding facilities and other amenities for both learners and teachers. Boarding schools will address the needs of disadvantaged learners and the lack of qualified MST teachers in rural and small farm schools. Combining several rural/small farm schools into one large school, will address the challenges around PPM as well as provide proper learning and boarding facilities to severely disadvantaged communities.</p>	<p>Applicable to all provinces with large rural areas and many small farm schools</p>
<p>Teaching Qualifications at HEI Institutions</p>	
<p>Teaching qualifications and pedagogical training offered by HEIs are viewed as inadequate. Higher Education Institutions do not align training and qualifications to the requirements within the school subject specific curricula, which results in a shortfall in content specific knowledge, when the teachers reach the classroom.</p>	<p>There are issues with the quality and consistency of new teachers. There may be a strong case for a national curriculum framework for preSET training. HEI's should be guided by the DBE to align teaching qualification with the needs of the Education System.</p>

SECTION 4: SIMILARITIES IN AND DIFFERENCES BETWEEN THE PROVINCES

SIMILARITIES AND DIFFERENCES IN THE NINE PROVINCES

Section 4 represents the significant similarities and difference between the nine provinces, as extracted from the detailed individual MST reports. The components listed are aligned to the directive received by the Ministerial Committee. The similarities and differences between the individual provinces provide insight into common challenges that are experienced, as well as reflecting successes.

SIMILARITIES

COMPONENT	SIMILARITIES	PROVINCES
<p>Provincial MST Strategy and detailed Implementation Plan</p>	<p>The DBE 2001 MST strategy is reportedly used by the Provincial Departments. Provincial Departments are required to draft an individual detailed Implementation plan, which provides definite targets for each of the phases and includes details of funded projects. The Implementation plans are not in place or are inadequate, so the Districts are uninformed and unguided, as are the schools.</p> <p>Please note: A new provincial strategy document was received from North West and Free State after the provincial reports were completed.</p>	<p>Gauteng, Western Cape and KZN have a comprehensive Implementation plan in place.</p> <p>However, in KZN the provincial officials were not clear of the status of the MST strategy document. This resulted in little utilisation of the key elements of the document driving implementation.</p> <p>Limpopo has a published document, but most of the officials claim not to have seen it.</p> <p>Free State have had a draft document since 2011, but officials claim to have not seen the document.</p> <p>North West has a 5-page document that states planned interventions.</p> <p>Northern Cape has a plan but a few officials claim to have seen it for the first time just before the interviews. School staff indicated that they have not seen the document.</p> <p>Eastern Cape: most officials saw the National MST Strategy for the first time during the interviews. Though some provincial officials claim to have drafted their own strategy based on the National document, they could not</p>

		show the document. Schools indicated very little knowledge and understanding of the Provincial MST strategy.
Provincial MST Strategy and detailed Implementation Plan	Lack of an integrated approach to Provincial MST strategies and delivery as the MST unit, if there is a dedicated unit, works as an independent, unique entity with little co-ordination from the Provincial offices as a central point.	<p>Applicable to North West, Free State, Northern Cape and Western Cape.</p> <p>Gauteng has resolved this problem by the establishment of Sci-Bono.</p> <p>Limpopo does not have a separate MST unit, but has a dedicated person managing the Dinaledi schools, which accounts for the relative success of Dinaledi only, in this province.</p> <p>Eastern Cape: the MST directorate is intended to be supportive to curriculum, however the directorate acts as an independent entity.</p> <p>In KZN the MST team, GET Curriculum directorate and FET Curriculum directorate worked in isolation with little or no coordination of activities pertaining to MST.</p>
Human Resource Challenges	<p>The recruitment of unemployed graduates as MST teachers does not include thorough mentorship and training programs, before the individuals are placed into the classroom.</p> <p>The PPM process is severely impacting farm and small rural schools resulting in multi-grade and multi-subject teaching.</p> <p>Lack of competent, experienced, skilled and qualified MST teachers.</p> <p>Lack of specialized training for MST subjects for each</p>	Applicable to all the provinces to a greater or lesser degree.

	<p>phase that includes specialized training of the MSTHODs.</p> <p>Subject advisors and HODs are not in some cases appointed on merit and experience in the subjects that they supervise resulting in a lack of support provided to the subject teachers.</p> <p>Mentorship programmes are lacking in schools and the Provinces to mentor teachers and encourage best practice.</p>	
Teacher and HOD appointments in MST subjects	Unclear Provincial department guidelines and lack of consistency with regard to temporary appointments. Appointments of teachers in temporary posts are often confirmed by the start of the second term, resulting in the loss of valuable teaching time. Similarly, posts that are temporarily vacant owing to maternity leave take months to fill leaving learners severely impacted. HODs are appointed that are not familiar with MST subjects resulting in lack of support to subject teachers.	Applicable to all the provinces to a greater or lesser degree.
Communication	Communication channels between National, Provincial, Districts and Schools are poor, resulting in miscommunication and inaccurate communication.	Applicable to all the provinces to a greater or lesser degree.
CAPS syllabus	The CAPS syllabi contain too much content impacting on timeous completion of the curriculum. Revision of the CAPS syllabi is required, to ensure that all content requirements could be met within the allocated time frames, providing adequate time to consolidate knowledge.	<p>Applicable to North West, Free State, Northern Cape, KZN, Mpumalanga and Western Cape</p> <p>Feedback from Gauteng and Limpopo does not indicate issues with the CAPS syllabus.</p> <p>Eastern Cape: expressed that the transition into Gr 4 with regards to Language is not easy for both the teachers and learners; the time available (while following CAPS) is not enough to introduce the content and/or terminology effectively. The inclusion of Mathematics Paper 3 into the</p>

		CAPS curriculum appears to be a daunting task for many of the teachers.
CAPS alignment to Tertiary education requirements	There is a shortfall between what is required to successfully complete a teaching qualification at a tertiary institution and the CAPS syllabi. Collaboration is required between the CAPS FET components for Mathematics, Science and Technology to align with the basic knowledge required and the Tertiary institution qualifications.	There appears to be less of a gap between CAPS and tertiary training, but rather a gap between what is required for MST teaching in general. A general feeling exists that pre-service training does not adequately qualify teachers for classroom teaching.
Technology as a subject	<p>At the GET phase, Technology is no longer a stand-alone subject but combined with Natural Science. Teachers stated that this combination has rendered the subject of Technology as irrelevant. Technology should be separated from Natural Science and afforded its own space in the curriculum.</p> <p>At FET Phase: where Technology subjects are offered at the schools, learners generally do not have access to computers at their homes so all their work must be completed at school in the afternoons, which poses a challenge since staff is not always available to staff the computer lab. Provision should be made to ensure that computer labs are available to learners in the afternoons. The supply of computers/laptops/tablets to learners when they select a technology subject.</p>	<p>Applicable to all the provinces to a greater or lesser degree.</p> <p>The “T” in MST is not taken seriously. Technology as a subject has very few qualified teachers and the technological resources, for the most part, are not available in many schools.</p>
Mathematics	The lack of experienced and qualified Mathematics teachers, the demands of the subject and the high failure rate is a challenge. A third component of Mathematics that is not as demanding as pure Mathematics but more robust and acceptable at tertiary level than Mathematical Literacy, for subjects that require some Mathematics, other than Engineering and Actuary may be a solution.	Applicable to all the provinces to a greater or lesser degree.
Criteria to pass the year successfully	Learners, especially in the FET phase may meet the minimum requirements to pass the year, but may have	Applicable to all the provinces to a greater or lesser degree.

	<p>achieved poorly or failed Mathematics and/or Physical Science. This results in major challenges going forward as the learner will lack the basic knowledge to progress with the subject content during next year of study, impacting severely on pass rates in Grade 12.</p>	
Technology as a Teaching and Learning resources	<p>Computer technology and connectivity is required by schools to increase efficiency of communications between schools, subject and curriculum advisors, Circuit, District and Provincial officials.</p> <p>All schools are not provided with the approved Science kits that align to the new CAPS syllabi.</p> <p>Textbooks and workbooks are not generally delivered on time. Workbooks are inadequate and do not contain the required subject detail or the relevant practicals and consolidation exercises.</p> <p>Provision of ICT training is required to enhance ICT integration into curriculum delivery.</p> <p>Lack of intensive advocacy for resourcing and optimal utilisation of Education Resource Centres.</p>	<p>Applicable to all the provinces to a greater or lesser degree.</p> <p>Gauteng: provisioning of textbooks does not seem to be a problem. ICT has been provided by the Gauteng Online project, but in general, teachers have not received adequate training to use these resources for teaching and learning.</p> <p>KZN: Teachers indicated that textbooks were not available in some areas, particularly in the FET phase. In some cases, books received were different from that which was ordered. Software has been installed on two laptops in 80 schools.</p> <p>Limpopo is still experiencing textbook challenges.</p>
Class sizes	<p>High teacher to Learner ratios that are generally 1:45 and up to 1:60 in both FET and GET phases. At GET phase, these ratios do not allow for special attention to weaker learners and severely impacts on teaching and knowledge transfer. These ratios further impact on teacher productivity, especially with regard to administration and marking.</p>	<p>Applicable to all the provinces to a greater or lesser degree.</p>
Language barriers	<p>The language of instruction is generally different from Home Language posing a challenge in MST especially, as the terms often cannot be translated and impacts greatly</p>	<p>Applicable to all the provinces to a greater or lesser degree.</p>

	on knowledge content, interpretation and application. The language barrier further impacts on the ANA results.	
Reading skills	Reading skills of learners in Senior and FET phases are severely lacking. Proper grounding is not provided to learners in the lower grades. Poor reading skills impacts directly on comprehension, learning and understanding in all subjects.	Applicable to all the provinces to a greater or lesser degree.
eLearning	Lack of user-friendly Provincial Department websites to enable teachers to download information, prepare worksheets and access workshop information. Lack of access by learners causes an inability to conduct research and reference up to date information. Schools lack software and hardware to assist teachers in the teaching of Mathematics, Science and Technology subjects. Schools are not supplied with the appropriate eLearning resources, which include laptops, projectors and approved ICT training. There is no access to free Open Source learning programmes.	Applicable to all the provinces to a greater or lesser degree.
Skilled MST teachers	There is a serious lack of qualified, skilled and experienced Mathematics, Science and Technology subject teachers.	Applicable to all the provinces to a greater or lesser degree.
Support of CAT and IT	These subjects are poorly supported and little encouragement exists for schools to offer them. They are resource intensive and no provision is made by the provincial departments to provide these resources. Since CAT is not a “designated” subject, schools are discouraged from offering the subject and learners are discouraged from selecting the subject. In general, only the more affluent schools offer CAT and IT subjects.	Applicable to all the provinces to a greater or lesser degree.

Engineering and Agricultural sciences	<p>These subjects are, in general, not viewed as “sciences” and hence receive little support.</p> <p>Only a few schools in each province, offer these subjects.</p>	Applicable to all the provinces to a greater or lesser degree.
Teacher Training and Development	<p>Lack of sufficient training and upskilling to teachers in all phases.</p> <p>Training programmes are not well attended.</p> <p>GET Teachers must select one subject only per annual intervention, which is insufficient as the teachers generally teach two or more subjects to several grades. Training received often does not correspond with the following year’s teaching programme.</p>	Applicable to all the provinces to a greater or lesser degree.
Teaching qualifications offered by HEIs	<p>Lack of alignment at the HEIs of teaching qualifications with the requirements of the subject syllabi and the skills required to teach effectively, like classroom management and selected ICT courses.</p> <p>Inconsistency in levels of quality in HEI teacher training. All are poor with some worse than others.</p>	Applicable to all the provinces to a greater or lesser degree.
Provincial and District Teacher support	<p>Insufficient support provided by the Provincial and District offices. Curriculum/subject advisors to school/teacher ratios are unacceptably high, resulting in a lack of adequate support to the teachers.</p>	<p>Applicable to all the provinces to a greater or lesser degree.</p> <p>Gauteng has attempted to resolve teacher support through Sci-Bono, but the ratio of advisors to teachers is still inadequate for the required support.</p>
Monitoring and Evaluation	<p>Lack of adequate monitoring and evaluation conducted by the National Department that includes annual site visits to selected schools in each province. No confirmation by the National Department on the accuracy of the Provincial reports or the effectiveness of the District offices and officials.</p>	Applicable to all the provinces to a greater or lesser degree.

	Lack of monitoring and evaluation by the Provincial departments to confirm reports by the Districts and schools.	
Siyavula textbooks	These books have not been received enthusiastically; advisors and teachers feel there are shortcomings, a lack of depth required within the curriculum and too many printing and editing errors.	Applicable to all the provinces to a greater or lesser degree.

DIFFERENCES

COMPONENT	DIFFERENCES
MST Implementation plans	<p>The existence and implementation of MST plans:</p> <p>North West Province: MST plan is a vague 4 page statement of planned events that has not been communicated to Districts and schools.</p> <p>Free State: an MST plan is in draft format since 2011. Department officials at District level appear to not have been part of the process and claim to not have access to the document.</p> <p>Gauteng: MST plans are implemented successfully by Sci-Bono based on available budget.</p> <p>KZN: MST plans are available but results indicate that plans are not being implemented successfully.</p> <p>Western Cape: MST plans are generally implemented successfully.</p> <p>Limpopo has a strategy document, with plans that consist mainly of power point presentations, but it appears only a few officials have seen this strategy/plan.</p> <p>Northern Cape: have a plan, but few officials are aware of it. Schools are unaware that a plan exists.</p> <p>Eastern Cape: it was claimed that the Province have drafted their own strategy based on the National MST strategy document, but the document was not provided to the MST committee researchers. Schools indicated that they have very little knowledge and understanding of the Provincial MST strategy and that this document has not been made available to them.</p>
Girl Learner uptake of MST subjects	<p>Lack of a Nationally guided approach to encourage Girl Learners to select MST subjects. Generally programmes to increase interest in MST subjects are targeted at Girl Learners who have already selected the MST subjects and are achieving.</p> <p>Gauteng and Limpopo: a few programmes are in place to expose girls to MST subjects, but do not reach all learners, particularly in rural Limpopo. There is a general feeling among teachers and officials that girls still view MST as difficult subjects that they feel intimidated in boy dominated classes and that domestic responsibilities hamper them. However,</p>

	no barriers exist to prevent girls from taking MST subjects.
ICT training for teachers	<p>Western Cape KhanyaICT project ensured training for their teachers.</p> <p>Sci-Bono (Gauteng) has ensured some ICT training for teachers.</p> <p>Gauteng Online provided technology to schools and some training to teachers, but not enough to ensure optimal usage of resources. Gauteng Online is generally not seen as useful.</p> <p>In Limpopo, ICT training for teachers has been negligible to date.</p> <p>In Eastern Cape, both the teachers and subject advisors are in need of Technological Pedagogical Content Knowledge (TPCK)</p> <p>In KZN, Hey Maths! software has been installed on two laptops in each of 80 schools.</p>
Selection, approach to and support of the Dinaledi Schools	<p>North West: all Dinaledi schools have not all received the required support. Dinaledi Schools are not sharing skills, knowledge and equipment with neighbouring schools. Non-Dinaledi schools are dissatisfied with the selection criteria and are generally achieving better results than Dinaledi schools without the extra support.</p> <p>Limpopo: dedicated project leaders, as well as other units within the province have provided much support.</p> <p>Gauteng: in general, the feeling is that the Dinaledi schools have not achieved their purpose.</p> <p>Eastern Cape, the Dinaledi schools have not been very successful in serving as hubs of support and mentoring in Mathematics and Science to the neighbouring schools. Dinaledi schools are struggling to comply with the national requirements, like for example, that 60% of the learners in FET are required to select Mathematics. A severe shortage of competent Mathematics and Science teachers is a reason provided, resulting in temporary teachers and a lack of continuity.</p>

SECTION 5: GENERIC AND SPECIFIC SUPPORT NEEDED

After a systematic investigation into the way MST programmes are implemented across provinces, it is clear that intervention is needed in the short and medium term to improve the way that MST strategy is conceptualized, continuously supported, managed and monitored. Special attention will need to be paid to improving MST education if we are to achieve a South Africa that is able to improve the lives of its citizens and which will be economically and technologically competitive. To this end, the task team presents both generic recommendations that apply across the school system and specific recommendations that apply to particular areas of the system.

5.1 GENERIC SUPPORT

5.1.1 National Strategy

Investigations reveal that the national strategy guiding MST is out of date. The initial 2001 strategy is twelve years old and has been overtaken by many other developments in MST, as has its revision in 2005. It is also clear that few provinces have clear, comprehensive and aligned MST strategies. Most provincial strategies have recently been drafted and have not permeated the provincial education systems in districts and schools. While all strategies have clear goals, many lack sufficient detail in respect of intended actions, scale, timelines and budgets to facilitate action, management and monitoring.

It is recommended that the Department of Basic Education should establish an office at senior management level to review and overhaul the original strategy into a comprehensive national MST strategy which includes plans to implement, monitor, evaluate, manage and report on the systematic roll out of the strategy. The existing provincial MST strategies provide a good starting point and should play a role in the consolidation of a comprehensive national strategy.

5.1.2 Teacher Education

All provinces highlighted the inadequate quality of MST teachers as one of the main causes for concern. Two main areas emerge from the investigation:

5.1.2.1 Continuous Professional Development and Support

The investigation revealed that teacher development and support is largely inadequate and uneven across the country. It is characterised by short workshops of one or two days which are ineffective and have minimal impact on teaching quality. It is evident that most teachers go for long periods of time with no training or development support. This issue requires urgent and resolute attention. The following are being proposed:

- (i) A comprehensive rethink of the approach to professional development and In-Service teacher training is needed in order to strengthen efficiency and impact. Training should be delivered through a variety of modalities, but should preferably be delivered through full time, multi-day courses of a week or more. A suggested approach is to agree specific days during school holidays for teacher training. Models for this in other countries should be investigated.
- (ii) Intensive training, of extended periods (of, for example, between 15 and 20 weekdays) should be considered for identified teachers. A system of deployment of

specially trained substitute teachers should be explored to facilitate such intensive training. (The availability of a large number of competent foreign teachers, unemployed graduates and retired academics in South Africa is noted in this regard.)

- (iii) The restructuring of teacher training should be considered. This may include exploring the viability of provincial teacher training institutes, strengthening provincial departments' capacity to coordinate training provided by HEIs and NGOs and managing training and support provided by provincial head offices and districts.
- (iv) A greater training and development focus should be placed at primary school level so as to build a solid foundation in mathematics and science. MST subject specialisation for teachers at lower levels, especially in Intermediate and Senior phases, should be explored. This might involve developing competence in two or three MST subjects in teachers in these phases.

5.1.2.2 Initial Teacher Education and Training

The investigation found serious challenges in respect of initial teacher education (i.e. Pre-Service Education and Training). The overall perception from provincial education department officials and schools is that HEIs are failing the system by delivering new MST teachers who are not adequately trained. The ACE programmes are a case in point: Schools, districts offices and provincial head offices agree that the ACE programmes have made no constructive contribution to the quality of MST teaching in schools. While HEIs decry the quality of educational preparedness of learners they receive from the school system, schools complain that new teachers are incompetent or insufficiently prepared to enter the school system productively. The following recommendations are proposed:

- (i) There needs to be continuous communication and interaction between DHET and DBE to ensure effective management of the school/post-school interface. The separation into two departments, while recognised as important, has contributed to the growth of an unintended silo effect that undermines success and which contributes to the persistence of an unhealthy cycle of poor teaching leading to poor teacher competence. Joint action by the two departments is needed to address the issue.
- (ii) The DBE should be actively involved in the development and approval of all teacher training programmes offered by HEIs and involved in the setting and monitoring of quality benchmarks for teacher training. It is suggested that a national course framework for new teacher training be adopted which all HEIs will be required to adhere to.
- (iii) It is also suggested that HEIs should periodically review training to ensure that they produce teachers who have the appropriate set of skills at an appropriate level of competence to fit into the modern educational workplace and that this should include basic ICT competence. While technology has permeated the economy it has yet to become the norm in teacher programmes at universities or, as a consequence, in schools. As a result, HEIs continue to produce teachers with gaps in the basic skill set required by a modern professional educator. An overhaul of

teacher training methodology, to incorporate modern training approaches and technologies, is therefore recommended.

5.1.3 Management and Support of MST

The investigation has identified the need to improve the capacity of district offices to monitor, manage and support MST curriculum delivery in schools and to ensure that teachers are able to achieve their goals. The main issues raised by interviewees are the following:

- Current capacity is limited by a shortage of staff and resources needed to service schools. The ratio of district officials to the teachers is often too low to allow an adequate level of support.
- Many subject advisors are not qualified for the subjects that they supervise. There is also a need for more specialised management and support training for district officials.
- The administrative workload of subject advisors and curriculum support officials is too high and leaves little time for support, mentoring and monitoring.
- Much of subject advisors work happens outside the classroom and has minimal impact on the quality of classroom curriculum delivery.

To address these issues, the following interventions are proposed:

- (i) An audit of MST curriculum support officials and subject advisors should be undertaken in order to establish each province's MST subject advisory capacity, deployment profile and expertise. This will assist in identifying gaps and planning appropriate responses.
- (ii) Provinces need to be instructed, capacitated and monitored to ensure that the recruitment and appointment of subject advisors is on merit and that all advisors have the appropriate levels of expertise. Levels of performance in MST are unlikely to improve without the credible specialist leadership and management.
- (iii) Subject advisors should be assisted to focus on the quality of curriculum delivery and the support and mentoring of teachers as their main goal. Most of their work should be done in the classroom.
- (iv) Achieving this will require the support and cooperation of all role players including school management and particularly teacher unions. It is suggested that DBE leads an initiative to improve the quality of MST advisory services.

5.1.4 Multigrade Schools

Multigrade and farm schools remain a feature of most provincial school systems. These schools need specialised attention and differentiated programmes. One teacher cannot productively teach four grades simultaneously. The following recommendations are proposed:

- (i) Consolidate multigrade schools wherever possible and operate regional facilities or boarding schools and which will provide accommodation for both learners and teachers, instead of multiple smaller schools with multigrade classrooms.
- (ii) Review the Post Provisioning Norms (PPN) for multigrade schools.
- (iii) Design and implement special teacher development and support programmes for teachers in multigrade schools.

5.1.5 Language

In a number of provinces, language was raised as a critical issue in the teaching and learning of Mathematics and Science. Two main concerns were raised:

- Meaningful learning and understanding are more likely to result from teaching and learning in the home language. Language is not merely a vehicle for communication; it is a critical tool for thinking. Poor language development has extremely negative consequences for learners at all levels and in all grades.
- The current policy for introducing English as a medium of instruction needs to be reviewed. There is wide agreement that the current policy and practice is problematic for non-English speaking learners, but there is no agreement about a more constructive approach. Some interviewees suggested delaying the switch to English to higher grades, while others propose introducing English even earlier.

The report makes the following proposals:

- (i) Research should be undertaken to inform a review of language policy in order to ensure an optimal policy approach.
- (ii) DBE should consider the provision of mechanisms, resources and guidelines for all grades to support the teaching and learning of MST in English. (An example may be a glossary of standard MST terminology that can be distributed throughout the school system and used in training programmes for teachers.)

5.1.6 Coordination with Other State Departments

The Department of Science and Technology and Statistics South Africa have each signed cooperation agreements with the Department of Education. This offers much potential for improving education, but it appears that this potential is not being exploited as productively as it could be. For instance, DST supports science centres and maintains a database of unemployed science graduates. DBE has not taken optimal advantage of either of these resources. The graduates are mostly highly competent in the area of content mastery and might be as productively deployed in schools as they have been to science centres. A similar internship scheme could be explored to deploy graduates to schools to assist in areas such as homework management, ICT support and administrative support and other areas where pressure is evident.

The following is proposed:

- (i) The revised national MST strategy, once established, should include guidelines for how departments can optimise cooperation and value.
- (ii) The DBE should consider setting up an internship programme of unemployed science graduates, linked to other existing databases of unemployed graduates, with a view to advocating teaching as a career choice and facilitating deployment to schools. This would include training and deployment of trained unemployed graduates as substitute teachers.
- (iii) The MST strategy should aim to optimally utilise science centres to support teaching and learning. Many science centres currently focus on providing single contact exposure to science and technology for learners and aim to excite learners about SET. Science centres can, however, be transformed to provide stronger and more sustained educational benefits for learners and teachers. The science centres should be mandated to help advance the curriculum rather than to merely promote interest in SET.

5.1.7 Enhancement and Coordination of External Support

The investigation has revealed that most provinces have no systematic plan for external support from or partnerships with the private sector or other offices of the public sector. Projects are loosely overseen by special projects units or partnerships units. There is no roadmap, strategy, coordination, database management or the active promotion of a meaningful and measured contribution to MST. While many companies have constructive and credible reasons and strategies for supporting education, others appear to engage in corporate social investment (CSI) in order to fulfil their CSI obligations. Many companies avoid working with and through provincial education departments and communicate directly with schools, without the knowledge of the provincial offices or relevant directorates. As a result there is little evidence of sustained and useful impact.

The following recommendations are proposed:

- (i) External support partnerships for MST should be actively encouraged, facilitated, coordinated and enhanced.
- (ii) Such support should be guided by and aim to support the national MST strategy
- (iii) DBE and provincial education departments should play an active role in identifying, negotiating, planning, monitoring and managing CSI involvement in the provinces. Private and public sector role players should be encouraged to cooperate and to engage in consortiums in order to work at scale so as to achieve optimal impact on identified MST priorities
- (iv) SETAs have an important role to play in supporting the development of school leavers that can eventually enter the technical economy. It is recommended that

DBE engage SETAs to look for ways for them to support MST. The ETDP SETA, in particular, should be approached to fund teacher development programmes

5.2 SPECIFIC SUPPORT

This section seeks to focus on specific areas where particular intervention has been identified as necessary.

5.2.1. Dinaledi Project Initiative

The Dinaledi Project initiative has achieved several important gains, but has not achieved the level of positive impact that was intended. The gains include:

- A major improvement in MST infrastructure in Dinaledi schools;
- A consistent higher pass rate in Dinaledi schools than in other schools. Dinaledi schools have been responsible for a significant percentage of the annual national passes in maths and science.
- While some Dinaledi schools have not risen to the challenge, most Dinaledi schools have made and continue to make a major contribution to MST achievement.

It would appear that the Dinaledi programme continues to hold valuable potential to contribute to MST improvement but a review is necessary if the potential is to be exploited to optimal effect. In this regard, the following is proposed:

- (i) The list of schools designated as Dinaledi schools should be reviewed and strengthened by:
 - Removing non-performing schools from the project;
 - Restructuring the programme to provide for differentiated levels of support for different categories of schools in Dinaledi. This will include providing more support for non-fee paying Dinaledi schools than for fee paying schools;
 - Increasing the number of non-fee paying Dinaledi schools with high levels of potential
- (ii) A stronger system of curriculum support, planning, management and monitoring should be put in place alongside infrastructural and resource provision. Provincial education departments should convene transversal Dinaledi committees that include representation from curriculum, HRD and teacher training, institutional development and other relevant directorates.
- (iii) MST content, instructional management, assessment and other training should be strengthened for classroom teachers and management training provided for SMTs in Dinaledi schools.
- (iv) Local private and public sector partnerships should be sought to support MST curriculum activity at schools and to strengthen links to the world of work.
- (v) A strategic investment to expand the role of selected Dinaledi Schools to include Boarding Facilities for Learners and Teachers should be considered in the short-term

5.2.2. Talent Search and Development

More often than not, provincial education departments seem to focus on under-performing schools to the neglect of gifted learners and learners with MST potential who attend other schools. The following recommendations are made in this regard:

- (i) MST talent development programmes should be incorporated into the revised national MST strategy.
- (ii) At least one dedicated Maths and Science Academy or a special Mathematics, Science and Technology School should be established in each province. The school should preferably be a boarding facility to accommodate learners and teachers from across the province. The schools should be managed nationally.

5.2.3. Resource Provisioning and Effective Utilisation

The provision of an adequate supply of high quality resources remains a critical part of effective MST curriculum delivery. There are still inequalities across the system in this regard and there remains a strong need to redress these. Science laboratories are generally not well equipped and there are few computer facilities in the provinces. Where they do exist, they are often not fully functional, staffed, maintained or effectively used.

The investigation also found that although the provision of resources is still a crucial component of quality education, an even greater issue is the optimal utilisation of the available resources. Several provinces have had substantial resource distribution, but training in the use and management of these resources has been weak and therefore the subsequent usage and value of the resources and facilities distributed is perceived to have been poor.

While there is still an overall shortage of science laboratories in schools, there are many such facilities that have been established and equipped across the provinces. However the level of practical work happening in these laboratories is far less than it should be. The same low usage applies to science kits. Many interviewees point to the lack of time in the timetable to be able to serve the needs of large numbers of learners.

The following recommendations are made:

- (i) A meaningful budget allocation should be made at national and provincial levels for MST resource provision. The success of the current national Technical Schools Recapitalisation programme may well be replicated through a similar programme that focuses on science and ICT resource provisioning.
- (ii) A strategy should be developed that facilitates, guides, supports and further incentivises private sector contribution to the improvement of MST.
- (iii) The provision of resources should be accompanied by a compulsory training, and a proper post-training management and monitoring plan.

- (iv) It is suggested that provinces make use of regional support centres such as the education centres in KZN, the education resource centres in the Free State, the teacher resource centres in the Western Cape and their equivalents in other provinces. Without exception, the investigation found that these facilities are not being optimally accessed or used by teachers.
- (v) Programmes and guidelines for science investigations and practical activities should be put in place, implemented and monitored.
- (vi) Schools should be encouraged to offer extramural science activities such as science clubs and afternoon practical science activities.

5.2.4. Exploiting the ICT Platform

The use of ICT to support MST education is an area where South Africa lags behind international trends. It appears that there is some, but insufficient recognition by policy makers of the potential that ICT offers for curriculum delivery, assessment, administration and other school functions. The investigation revealed that one of the most glaring differences between provinces is in the provision of ICT infrastructure and connectivity and in the levels of ICT integration in schools. There are also startling differences in ICT integration between schools in the same province. The use of ICT to support curriculum delivery is extremely rare in all provinces.

Broadband access for schools is problematic as costs are too high to make it a viable resource for teaching and learning. The situation is worst for schools in rural areas. The investigation shows that there is a real risk of the digital divide widening at an increasing rate.

There is evidence of educational value in the use of maths and science software that has been tested and experimented with by a few provinces. These projects have had some positive albeit short term results but they have, however, proven to be too expensive and unsustainable to continue. In most cases, this is exacerbated by dependence on commercial service providers.

The following recommendations are proposed:

- (i) The planning, roll out, management and monitoring of ICT in schools should be made a medium term priority and an appropriate budget allocation should be made to facilitate resource distribution, training, maintenance and updating.
- (ii) The Department should explore the development of open source education resources for provision to schools.
- (iii) That DBE should engage the Department of Communications with a view to special arrangements to provide broadband services to schools.

5.2.5. Technology Subjects

Most provinces are satisfied with and appreciative of the Technical Schools Recapitalisation programme.

Technology as a subject in the GET has been incorporated with the Natural Sciences subject. There is a wide perception that justice is not being done to this subject and that is considered by policy makers as a second class subject. This perception is strengthened by an apparent lack of resourcing and training.

Schools offering CAT and IT at FET level generally have outdated equipment. It appears that almost no budget has been allocated for the upgrading or updating of IT resources. The imminent introduction of the new technical curricula as part of CAPS has added to the level of concern expressed by schools. Interviewees referred to the commitment of the DHET to produce many more artisans over the next few years as being unrealistic if basic education does not invest in resources to improve technical education.

In this regard, the following proposals are put forward:

- (i) The implications of combining Natural Science with Technology need to be investigated. The training of technology teachers must be improved and ongoing support for teachers provided for.
- (ii) A centralised and intensive programme should be put in place to prepare for the introduction of new technical subjects at FET level.

SECTION 6: RECOMMENDATIONS

Section 5 has sought to capture the broad scope of issues needing attention and corrective action in order to achieve systemic improvement in MST delivery and achievement. This section seeks to make some key recommendations that the Department of Basic Education should consider in the short term. Adoption of these recommendations into a new strategy would help to signal a renewed purpose and focus to all stakeholders achieve some quick wins and build momentum for a sustained and significant improvement of MST in future.

6.1 A Dedicated MST Strategy Office

The current state of MST across the country and the lack of a working national framework for improving MST warrant the establishment of national MST office to develop, implement, coordinate and manage the roll out of a revised MST Strategy. It is recommended that such an office be set up at DBE, with the appropriate level of authority and adequate human and other resources, to coordinate and assist provinces to implement the Strategy at provincial level. The proposed office should implement mechanisms for schools and district offices to elevate concerns and issue to the DBE to allow a system wide communication structure that accommodates all voices.

6.2 A Teacher Development and Support Programme

MST educator capacity has been found to be wanting at all levels. In this regard, it is recommended that DBE:

- 6.1.1 Plans and implements a rigorous national MST teacher development programme. The programmes should focus on improving mastery of MST curriculum content and instructional management. The programme should make use of appropriate and effective training interventions and techniques.
- 6.1.2 Moves to improve subject advisory services by strengthening district capacity, resources and training. Coaching and mentoring should be made effective by:
 - Focussing more on subject support than on administration;
 - Prioritising classroom based support, coaching and mentoring.

6.3 A Resource Management Programme

The effective provision, utilisation, management and maintenance of resources have emerged as a critical component for the success of MST education. Three areas need attention:

- 6.1.3 General MST LTSM, equipment and consumables
- 6.1.4 Technology Education resources
- 6.1.5 ICT Infrastructure, digital content and broadband services

6.4 The Dinaledi Programme

The Dinaledi Programme needs review and a refocus to reach its full potential. This will involve reviewing the selection and participation criteria and the nature of the interventions that Dinaledi offers to schools.

SECTION 7: CONCLUSION

The investigation has revealed systemic problems in MST education at all levels. It is noteworthy that there is general agreement throughout all provinces about the key issues that need attention. The interviews held in provinces reveal some uncomfortable attitudes and issues that undermine progress.

It is natural that all learners, educators and administrators would like to succeed and to enjoy recognition of their success by their communities. If they do not have this desire, then something is seriously wrong. Learners who act as if they do not care do so for various reasons:

- Many have no respect for their teachers;
- Many are learning with inadequate resources;
- Too many face unemployment after leaving school.

Similarly, teachers who lack motivation, minimise their time on task and are abusive to learners. They too do so for various reasons:

- They feel that provincial officials do not respect them;
- They get no professional support from subject advisers and heads of department;

- They lack teaching and learning resources;
- They do not understand the curriculum they have to teach.

The important work that teachers do in shaping society is often not recognised or respected. Efforts to further acknowledge excellence and dedication in the South Africa's MST teaching community will go a long way to improving motivation and participation by teachers.

District officials too fail to inspire and support schools in their care for different reasons:

- They lack administrative skills and subject competence,
- They lack the resources they need and have too many tasks to cope with,
- They are harassed by provincial officials demanding (usually at short notice) attention to new initiatives, more paper work and similar pressures.

Most of the interviewees complain about the frequency of curriculum change, the non-arrival of required resources and other perceived failures of the system. The media makes much of these perceived failings and focuses attention on often shallow analyses of the matric pass. Trade union actions exacerbate the situation and contribute to destabilising schooling, promoting rather than helping to manage discontent. It is increasingly clear that we cannot continue to do what we have done previously and yet expect a better result. Decisive and innovative action on some key priorities is clearly needed.

It should be recognised that the national and provincial MST strategies all have good plans for addressing the correctly identified needs. The problem is these plans require a level of human, financial and other resources that has not been available to facilitate effective and successful implementation. The result has been that none of the strategies was implemented as planned and almost all have been largely perceived as failures, even when some achievement is evident. This has led to increasing frustration and demotivation which undermines any fresh attempts to address the situation through new initiatives. A perceived lack of success by government to improve MST education has also led to the private sector mounting independent, uncoordinated, unaligned and mostly low impact interventions. This represents a serious waste of potentially very useful resources.

While there are clear requirements for the improvement of MST education, progress in some priority areas is dependent on prior achievement in other priority areas. Many of the critical priorities depend on fundamental conditions which are not clearly evident in the national and provincial strategy documents. While most of the strategies identify main pillars or thrusts, there is little identification of the issues that must be addressed and resolved before further progress can be achieved. It appears that the same level of attention has been to each pillar at the same time and this may well have contributed to the low level of achievement of the whole strategy.

This task team therefore makes the following recommendations in respect of both the critical priorities and the sequence of interventions to address them.

Priority 1: Identify and Rank Priorities

It is recommended that DBE and provincial education departments agree a revised national MST strategy that identifies a list of priorities, with a ranking and sequencing of these priorities. The strategy should include a plan that identifies critical conditions and dependencies. Having suggested this initial step towards a revised MST strategy, the task team recommends the following operational priorities:

Priority 2: Address Teachers and Teaching Issues

The task team believes that teachers remain the pivotal factor in MST education and that the productivity of teachers impacts on every other element of schooling, including learner success. Addressing the issues linked to teachers and teaching is the single most important strategic intervention. Urgent and detailed plans to improve teaching are needed before any other plans will have a chance to succeed.

The task team makes the following points in this regard:

1. There is a national pool of dedicated and competent MST teachers. They must be recognised and nurtured. Their knowledge and experience must be used to best advantage.
2. The approach to teacher training must be reviewed and strengthened. Training activities, methods and processes implemented by provinces need strengthening. Issues of accreditation, training incentives and recognition need review. The design and management of a teacher training system that has effective benchmarks, effective engagement with training providers such as HEIs and NGOs, the effective identification of which teachers need what training and support, proper monitoring and evaluation, post-training support in schools, and many other important elements of the system need to be planned.
3. The capacity and competence of MST advisory services and management at school and district level needs attention. There is a list of issues that must be reviewed so that there is an effective and credible system of support for teachers from subject advisors, who can provide effective curriculum and instructional support and whose work is not seen as administrative.
4. There is a critical need to intervene in pre-service teacher production in order to ensure that HEIs produce competent and credible new teachers of sufficient quality and in sufficient quantities to service the MST needs of the school system.