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Overview of the State of Maths, Science and Technology Education 1994 - 2004

1. Background

One of the key visions of apartheid government was to use gateway subjects namely mathematics, science and technology education as a tool to deny the black population access and opportunities that come with successfully passing the subjects. A major challenge of the new South African democratic government is therefore to redress the inherited inequalities through social and educational reform. There have been a number of national initiatives aimed at redressing the imbalances of the past. The Reconstruction and Development Programme (RDP) of the earlier years of transition sets the foundation for social and educational reform and provided a useful framework for policy changes and an increase the participation rate of blacks in the areas of mathematics and science and particularly girls.

This chapter provides a 10-year (1994 - 2004) review of the state of mathematics, science and technology education in respect to key policy shifts in education. The framework for this chapter is guided by two key questions.

1. *Which key policy initiatives were conceptualized, developed and disseminated since 1994?*

2. *How has the system performed in respect to the participation rate in mathematics, science and technology education since 1994?*

3. *To what extent are the students being produced in Grade 12 Science and Mathematics meeting the country's socio-economic growth in view of the global competitiveness?*

In responding to the above questions we outline key policy documents such as the Reconstruction and Development Programme (RDP) and the White Paper on education and Training (1995). We also provide an overview professional development of educators, infrastructure development and resource allocation, curriculum implementation and delivery, special funded projects that were initiated with respect to improving the state of mathematics and science education. It should be mentioned outright that any adjudication of government policies in respect to SMT education should be read within the assumption that within nine years (1994 –2003) there would have been less dramatic changes in the performance of what was one of the most divided education system in the world. According to Jansen and Taylor (2003) it is rather plausible to evaluative the performance of the government in respect to the extent which the government in the period 1994 – 2003 laid the groundwork for long-term and sustainable improvements in the education system. It is therefore critical to study government performance into two major periods, 1994 – 1999, which is seen by policy analysts (Karlsson 2001, Rensburg 2001,) as the policy formulation era marked by establishment of a unified, democratic and accountable system, flurry of policy commissions and investigation and setting frameworks or symbolic policy (Sayed, 2001). The second period 1999 – 2004 is described as policy implementation era. The above periodization may provide a useful tool for adjudicating government delivery.

2. Policy Developments 1994 – 2004

According to Jansen and Taylor (2003) there are few modern democracies that have produced more policies, laws, and regulations to govern education than post-apartheid South Africa. Lungu (2001) on the one hand indicates that the country has the most elaborate formal policy processes on the African continent. These polices – divided into White Papers and legislative process – include White Papers 1994 and 1995, National Education Policy Act (NEPA, 1996), South African Schools Act (SASA, 1996), National Norms and Standards for School (DoE, 1998), Employment of Educator Act (1998), Language Policy, Admission Policy (1999), and the now recentl Human Resource Development Strategy (HRD) (2001), etc.

The RDP laid a firm foundation for the design of all the above policies. The RDP main two goals in respect to SMTE are;

- An appropriate mathematics, science and technology education initiative that is essential to stem the waste of talent and make up the chronic national deficit, in these fields of learning, which are crucial to human understanding and to economic advancement.
- Rewriting the schooling curriculum and raising the quality of learning and teaching through a reform and redirection of in-service education of teachers (INSET) and upgrading the professional competence of teachers to the country's reconstruction and development agenda.

Following the RDP documents the most significant policy document namely; The White Paper on Education and Training (1994 and 1995) outlines the most direct way of redressing the imbalances of the past around issues of mathematics and science. It indicates that 'special criteria is needed to prepare students for subjects in short supply, particularly science, mathematics and technology. It further indicates that 'second chance' opportunities should be extended to students who would not otherwise fulfill the admission criteria, and special support should be extended to them, for as long as the need persists'.

Over an above easing the admission criteria, the White Paper provides a framework for the implementation student recovery programme in physical science and mathematics. The above decisions are arrived at on the basis of the following.

- Only one in five Black students choose physical science and mathematics in Standard 8, and the trend of performance in the senior certificate examinations has been low overall, with a particularly dismal matriculation exemption rate among students taking these subjects at higher grade.
- Fewer Black students with science and mathematics qualify for normal entry to higher education.
- Need for comprehensive programmes of special measures to encourage many more students to follow science-based careers.
- The Ministry of Education intends to give support to a new intervention starting in 1995 to 'recover' science and mathematics students and upgrade both their knowledge and attitudes to these subjects, and link successful completers to a new diploma programme in selected colleges of education.

The two major pieces of legislation namely; National Education Policy Act (1996) and South African Schools Act (1996) stand out to be major policy initiatives preceding the White Paper. They serve as useful theoretical tools for strategically steering, guiding and informing the educational transformation of South Africa. The National Education Policy Act (1996) is an outcome of the discussions of the two prior versions that were passed as the White Papers 1994 and 1995. The major thrust of the NEPA is to define the powers and duties of the national and provincial education ministries. Particular expression is given to the decentralization of the education. The SASA (1996) landmark is the introduction of compulsory school attendance for al children between the ages six and fifteen as well as the establishment of elected and representative governing bodies in public school through the country. It specifies the powers and duties of the school governing bodies, the nature and composition and the procedure they need to follow in their official duties. Briefly SASA covers the funding, organization and governance of schools. Both policies too went through a series of discussions and debates by various stakeholders before it was passed an Act. What is demonstrated by this practice is that for the first time civil society interest groups – women, religious, traditional African, conservatives and radicals, gays and lesbian and disabled, blacks and whites were involved at an unprecedented scale in public-policy making and implementation. Over and above that, the new policy recognizes that education is a fundamental human right.

A close reading and theorization of this post–apartheid policies present an interesting analysis as well as policy-practice dialogue. It would be necessary to understand that these policies were set within the parameters of neo-marxist tradition of social redress and within the pervasive impact of globalization. Under the given context and reality around of resources and capacity, to what extent were these policies implementable in last 10years? Since social policies for redress are not set *in vacuo*, the state has number of challenges – and these are not peculiar to South Africa.

3. Curriculum Innovations and Development

The heart of school reforms since 1994 was the introduction of Curriculum 2005 in

February 1997, a progressive model of education based on the principles of outcome-based education (OBE). The curriculum called for a form of learner–centered education informed by the theory of social constructivism. From a theoretical perspective this curriculum marked an epistemological break from Bantu Education and Christian National Education pedagogy of content prescription and teacher-centeredness. The new curriculum according to Manganyi (2001) is not 'old wine in new bottles'; rather it marks a totally new approach – albeit in theoretical terms.

According to Lungu (2001) C2005 is neither a policy nor a law but an executive policy announced by the Department of Education. However, it was not divorced from the White Paper on Education and Training; rather was an outcome of that document.
The design of C2005 seemed flawless and impeccable but the implementation proved to be a challenging exercise. The weakest point in the implementation was the failure to estimate the extent to which resources could act as constraints and this explicitly shows that the grand design was flawed and myopic. The second biggest shortcoming noted from the design was the impractical impossibility of directly training all teachers in the GET phase of schooling. This meant the cascading model of teacher training whereby the core teachers were identified and trained at higher level of system and then go down through various levels of the education system did not work as conceptualized. Jansen and Christie (1999) outline problems experienced.

- The new terminology, for example programme organizers, assessment standard, performance indicators, range statements, critical outcomes, specific outcomes was highly inaccessible, complex and too much for comprehending;
- The under-preparation of teachers for this complex curriculum;
- Lack of confident and competent teachers to manage the curriculum; and
- The critical lack of a solid learning material base that supports the pedagogy and philosophy of this progressive curriculum

The second Minister of Education recognized the deficiencies in C2005's design and content and called for a review of the curriculum. On the basis of the recommendations of the Curriculum Review Committee (2002) the minister introduced a streamlined curriculum in terms of learning areas and also reducing the burdensome terminology. The Learning Outcome and Assessment Standards replaced the whole complex of terminology stated above. The new National Curriculum Statements (NCS) collectively constitutes a mixed of success in overcoming some of the fundamental flaws of C2005 in terms of specifying the knowledge content, learning support material, reducing terminology in the conceptual design.

4. **Human Resource Development Strategy**

The initiatives set out by the RDP documents and White Paper on Education and Training (1995), President Thabo Mbeki emphasized the centrality of mathematics and science in 2000 and 2001 State of Nation addresses. The Ministers of Labour and Education Mr. Membathisi Mdladlana and Professor Kader Asmal, respectively, jointly launched The Human Resource Development Strategy (HRD) for South Africa in June 2001 and this was subsequently followed by creation of the **102 Dinaledi Schools**.

The HRD Strategy, which also has its origins in the Reconstruction and Development Programmes (RDP), is an attempt to operationalise the President Mbeki ideas explicit in his state of the Nation addresses. In terms of the *HRD strategyIndicator Five*: Mathematics and Science Results (2001 p25) 'the problem in mathematics and science has not to do with numbers who passed on Higher Grade or who obtained university exemptions'. The strategy notes that 'generally, mathematical and science literacy are extremely poor in the entire schooling system'.

In order to arrest the chronic situation Kader Asmal appointed AZAPO Member of Parliament Mr. Mosibudi Mangena amid some eyebrows within and outside parliament with a particularly mandate to deliver by increasing the rate of participation including female learners. The deputy minister took the bull by horns and announced outright that the Department of Education strategy to improve mathematics and science will move forward with the announcement of 100 schools to be dedicated towards the plan (Sowetan 17/08/01). Following the above announcement the Deputy Minister of Education released the names of 102 dedicated mathematics and science high schools as part of national strategy to improve mathematics, science and technology in schools (Sowetan 25/09/01).

Provincial departments were requested to draw their own strategic plans for mathematics, science and technology education for the next 6-years (2003 –2008). The provincial plans had to include their vision and mission and commitment to restructuring GET and FET education in terms of professional development, provision of resources, new curriculum implementation and delivery, and administrative and community support. All the above sub-goals had to be designed in line with the national HRD strategy for maths and science.

A discourse around the importance of maths and science continued when the deputy minister emphasized in October 2002 that the production of more high quality Grade 12 learners with mathematics and science who would be able to enter higher education have become essential. Choosing appropriate subjects provide basis for multiple options for the job and has thus become the major preoccupation for the department. Students can become technicians, engineers and business people - a fundamental goal of the National Skills Development Strategy (2001).

The recommendations of the National Strategy for Improving Science Maths and Technology Education were implemented when the 102 **Dinaledi Schools 'Creating Tomorrow Stars'** were established as an attempt to increase the participation rate. In line with the redress agenda, resources were concentrated on a set of focus schools that would become quality sites of science and maths teaching (Kahn, 2004).

Dinaledi had thus far become the flagship of the Department of Education and the project has been receiving financial boost from DoE. For example, more than R400-million was earmarked for the promotion of science and mathematics and science promotion (Star, 24/08/01). Furthermore, Schools specializing in mathematics and science received R138 –million from DoE. Each school has been allocated more than 6-million for mathematics and science projects (Sunday Tribune 28/10/01). These financial injection allowed the project to supply schools with resources such as books, DSTV and laboratory equipments, and maths and science educators are offered special training sessions.

Over and above Dinaledi Project Schools more resources were pumbed into the areas of maths and science teaching and learning. These included;

- R40-million agreement with Canada
- GDE and some of the SA major financial institutions such as Standard Bank, FNB, NEDCOR and Investec bought into the idea of offering free places at independent schools for up to 500 black pupils.
- R35-million project donated to beef up maths and accounting instruction in the EC in view of benefiting 6400 learners.
- Cuban Maths and Science teachers from Cuba were brought to Northern Cape in 2001 with the aim of providing training at schools level.
- The Carnegie Scholarship offers scholarships to girls in maths and science.

Projects above show that resources have been pumped into education and to what extent are we able to account for the resources in terms of the output. Does the output commensurate the input?

5. Participation Rate

At this juncture it is critical to take stock of how these policies were translated into practice in terms increasing participation rate and producing quality Higher Grade passes by looking at the enrollment trends since 1996.

South Africa has in the last years witnessed a drop in the number Grade 12 candidates. Table 1 provides a detail picture of the enrollment trends in South Africa since 1996.

Table 1

Year	Candidates	Percentage Increase or decrease over the previous year	Candidates passing	Percentage pass rate	Candidates passing with exemption
1996	518 032		278 958	53.8	79 768
1997	556 246	7.4	261 400	47.0	69 007
1998	552 384	-0.4	273 118	49.3	69 891
1999	511 474	-7.7	249 831	48.8	63 715
2000	489 941	-4.2	283 294	57.8	68 626
2001	449 371	-8.3	277 206	61.7	67 707
2002	443 821	-1.2	305 774	68.9	75 048
2003	440 267	-0.8	322 492	73.3	82 010

Sources: DoE 2003; Edusource DataNews 2001/2002

Between 1999 and 2002, the proportion of learners taking mathematics dropped from

18% to 14%, and in physical science from 41% to 33%. However, there were encouraging increases in 2002 and 2033 in the overall pass rate in critical subjects such as mathematics and physical science, with the maths pass rate rising from 47% in 2001 to 56% in 2002 and the physical science pass rate rising from 69% in 2001 to 76%. However, there were only slight increases in the numbers obtaining higher-grade passes in these subjects. There were 1 024 or 5% more learners who passed maths on higher grade and 608 or 3% more passed physical science on higher grade than in 2001.

It has become clear that the number of learners obtaining Higher Grade mathematics passes in Grade 12 is shrinking - dipping below 20 000 in 1999 and 2002 – and this poses a threat and challenge to the economic sector. From a total of 218 090 candidates writing mathematics in 1996, 22 416 passed on higher grade, and in 1999, 19 854 passed in higher grade, 2002 only 20 528 students passed on higher grade. The 56.1% Mathematics pass rate of 2002 increased in 2003 to 58.8%. The percentage of candidates who passed Physical Science increased from 76.4% to 80.3. And all the provinces have shown an improvement in the pass rate (DoE, 2003).

Table 2

Subjects	**Year**	**Total number of candidates writing**	**Total number of candidates passing**	**Percentage pass rate**	**Number of HG candidates**	**Number HG candidates passing**
Mathematics	1996	218 225	108 910	49.9		22 416
	1997	252 617	116 836	46.3	68 451	22 798
	1999	281 304	122 225	43.4	50 105	19 854
	2001	263 945	123 149	46.7	34 870	19 504
	2002	260 989	146 446	56.1	???	20 528
Physical Science						
	1996	122 278	74 110	60.6	70 269	25 462
	1997	141 278	91 538	64.8	76 086	26 971
	1999	160 949	102 896	63.9	66 486	24 191
	2001	153 847	105 552	68.6	48 996	24 280
	2002	153 855	117 529	76.4	50 992	24 888

The previous figures may prove to be the Achilles heel of the country in both short and medium -term. The United Nations Development Programme (2001:28) indicates that science and technology activities require skilled workforce and the human resources development is therefore important. The South African White Paper on Science and Technology (DACST, 1996) on the other hand, indicates that any national system of innovation requires an enabling framework for socio-economic development in the country. If the above policy pronouncements are not fulfilled, structural reconfigurations may be required to be implemented with the urgency is deserves.

6. Results by Race and Gender

The question 'What is the performance of African students in Senior Certificate examinations Mathematics and Physical Science?' links well with the question raised in parliamentary in 2000 - "Is it true that only 3000 African students obtain a Mathematics HG pass?" Below we provide results of both maths and science by race.

Kahn (2003) used the 'language proxy method' to extrapolate the achievement trends between 1999 and 2003. The proxy method (1999) assumes that the majority of African examination candidates take an African language and that the majority of non-African examination candidates do not. Although the method may not be 100% accurate it gives a measure of confidence and reasonable estimates of the likely total number of African candidates and their success in the examinations. The hypothesis that fewer than 5% are not Africans is upheld. In fact in seven provinces the figure is below 1%, and the exceptions are Western Cape and Gauteng where the higher-grade uptake is 4%. Table 3 provides a broad overview of the national data between 1999 and 2002.

YEAR	1999		2000		2001	
SUBJECT	**Cand**	**Pass**	**Cand**	**Pass**	**Cand**	**Pass**
Math HG Proxy	24529	2877	20242	3128	13745	[illegible]
Math HG National	50100	19900	38500	19300	34900	19500
Phys Sci HG Proxy	36005	[illegible]	33645	[illegible]	25838	[illegible]
Phys Sci HG National	66500	24200	55700	23300	49000	24300

The African Students Performance by Proxy method is similar to the figures provided by EduSource 2002.

Table 4: Higher Grade Mathematics Candidates, Number Passing and Number converting to a Standard Grade Pass by Race and Gender, 2002

		Candidates	%	HG pass	% pass rate	Converting to SG pass	% converting to SG pass
African	Female	7184	42.7%	1638	22.8%	1300	18.1%
	Male	9634	57.3%	2999	31.1%	1978	20.5%
	Total	16818	100.0%	4637	27.6%	3278	19.5%
Coloured	Female	742	49.1%	511	68.9%	141	19.0%
	Male	769	50.9%	556	72.3%	148	19.2%
	Total	1511	100.0%	1067	70.6%	289	19.1%

Indian	Female	2231	52.9%	1614	72.3%	416	18.6%
	Male	1987	47.1%	1421	71.5%	353	17.8%
	Total	4218	100.0%	3035	72.0%	769	18.2%
White	Female	6334	50.0%	5632	88.9%	604	9.5%
	Male	6329	50.0%	5394	85.2%	746	11.8%
	Total	12663	100.0%	11026	87.1%	1350	10.7%
Other/unknown	Female	31	45.6%	18	58.1%	3	9.7%
	Male	37	54.4%	15	40.5%	10	27.0%
	Total	68	100.0%	33	48.5%	13	19.1%
Total	Female	16522	46.8%	9413	57.0%	2464	14.9%
	Male	18756	53.2%	10385	55.4%	3235	17.2%
	Total	35278	100.0%	19798	56.1%	5699	16.2%

Source: Calculated from the Department of Education 2002 SCE database.

Note: The total number of candidates and passes does not reflect exactly those figures published by the DoE due to excluding those candidates who gained a condoned pass. (A condoned pass is given to a candidate who may have failed a single subject but has a sufficient aggregate mark and satisfies all other conditions to pass overall.)

Table 5: Higher Grade Physical Science Candidates, Number Passing and Number Converting to a Standard Grade Pass by Race and Gender, 2002

	Gender	Candidates	%	HG pass	Pass rate	Converting to SG pass	% Converting to SG pass
African	Female	13319	44.2%	2654	19.9%	5262	39.5%
	Male	16837	55.8%	4475	26.6%	6508	38.7%
	Total	30156	100.0%	7129	23.6%	11770	39.0%
Coloured	Female	786	45.4%	570	72.5%	187	23.8%
	Male	945	54.6%	681	72.1%	213	22.5%
	Total	1731	100.0%	1251	72.3%	400	23.1%
Indian	Female	2617	50.7%	1973	75.4%	538	20.6%
	Male	2540	49.3%	1736	68.3%	623	24.5%

	Total	5157	100.0%	3709	71.9%	1161	22.5%
White	Female	5815	43.0%	5098	87.7%	649	11.2%
	Male	7706	57.0%	6206	80.5%	1355	17.6%
	Total	13521	100.0%	11304	83.6%	2004	14.8%
Other/unknown	Female	57	43.5%	17	29.8%	20	35.1%
	Male	74	56.5%	24	32.4%	25	33.8%
	Total	131	100.0%	41	31.3%	45	34.4%
Total	Female	22594	44.6%	10312	45.6%	6656	29.5%
	Male	28102	55.4%	13122	46.7%	8724	31.0%
	Total	50696	100.0%	23434	46.2%	15380	30.3%

Source: Calculated from the Department of Education 2002 SCE database.
Note: The total number of candidates and passes does not reflect exactly those figures published by the DOE due to excluding those candidates who gained a condoned pass.

6. Performance by Province

It is important to draw attention to the distribution of the student enrollment by Province in mathematics and physical sciences following the language proxy. Notably Limpopo has the highest number of learners taking mathematics and science than richer Gauteng and Western Cape. Table 6 below provides the disaggregated data by province in 2002.

YEAR	1999		2000		2001		2(
JECT	Cand	Pass	Cand	Pass	Cand	Pass	Ca
HG Proxy	24529	2877	20242	31[illegible]	13745	275[illegible]	14:
HG National	50100	19900	38500	19300	34900	19500	35!
Sci HG Proxy	36005	[redacted]	33645	[redacted]	25838	[redacted]	27
Sci HG National	66500	24200	55700	23300	49000	24300	55

Math HG

	Proxy	Entry	Proxy	Entry	Proxy	Er
EC	599	*833*	33131	*34674*	704	
KZN	4560	*5029*	45724	*48159*	6838	
[redacted]		*999*	[redacted]	*16445*	[redacted]	
LP	5546	*5779*	27670	*28266*	10784	
GP	1568	*2451*	17876	*22972*	2339	
NW	731	*832*	16686	*17054*	2212	
Totals	14445	*16719*	170671	*183584*	27200	
% Under		*13.6*		*7.0*		

The above results responds not only to the question raised in parliament in 2000 but to the issue of policy-practice gap. On the basis of the picture mapped above the redress policies designed and implemented earlier will have to be given close consideration.

However, The National Strategy for Science, Mathematics and Technology Education and subsequent establishment of the 102 Focus Schools became necessary respond to issues of closing that gap and seriously answer to the question of supply and demand in the economic sector. Due to structural changes with formal economies changing, with less reliance on industries based on mining and agriculture to reliance in jobs in the financial sector, there has to be students produced with quality higher grade passes in mathematics and science (National Skills Development Strategy, 2001) in order for the

South African economy to grow at a faster rate. According to the National Skills Development Strategy (2001) high skilled jobs increased by 20% between 1970 and 1998. In case the decline trend of students passing maths and science is not arrested, to what extend will the economy be globally competitive?

7. Performance by Gender

Education White Paper 2 (1996) proposed 'to increase the number of girls in science streams' through the equitable-school based funding formula. The period 1996 – 2002 has seen the female performance in mathematics improving substantially, with both the number of female candidates participating growing at a faster rate than male candidates and the gender gap in pass rates decreasing. The percentage of female candidates passing higher-grade mathematics was higher in 2002 than that of male candidates.

Table 7: Number of Mathematics Candidates and Passes, Average Annual Growth and Pass Rates by Gender, 1996 and 2002

Subject	Gender	1996	2002	Average annual growth	Pass rate 1996	Pass rate 2002
Maths candidates	Male	103056	122902	2.5%		
	Female	111677	138087	3.1%		
Maths passes	Male	48701	63299	3.8%	47.3%	51.5%
	Female	42625	58518	4.6%	38.2%	42.4%
Maths HG candidates	Male	34577	18867	-8.3%		
	Female	30646	16598	-8.4%		
Maths HG passes	Male	12817	10804	-2.4%	37.1%	57.3%
	Female	9599	9724	0.2%	31.3%	58.6%
Maths HG conversion SG	Male	5497	2831	-9.0%		
	Female	3799	2156	-7.8%		
Maths SG candidates	Male	68479	104035	6.2%		
	Female	81031	121489	6.0%		
Maths SG passes	Male	30387	49664	7.3%	44.4%	47.7%

	Female	29227	46638	6.9%	36.1%	38.4%

The participation of female candidates in physical science is notably different to that of mathematics. While the number of female candidates enrolled for and passing physical science has increased faster compared with male candidates, the gap between the male and female pass rates is wider than in mathematics (see table 3).

By analysing the gender difference in the SCE pass rate – that there are more female candidates writing the SCE is clear, largely because they are staying in school when their male counterparts are dropping out. According to Perry (2002) it is not the case that there is poor female performance - it is clearly not the case. By using other indicators and disaggregating the data it is somewhat clear that female candidates throughout the system are attaining the same or better results than male candidates

8. Infrastructure Development and Resource allocation

Physical Science Laboratories

A critical reading of the data indicates that the participation rate and results of maths and science are not the only indicators for the state of maths and science. The resource allocation is now examined in other areas. The Schools Register of Needs (SRN) survey carried out 1996 and 2000 presented data of secondary schools with physical science laboratories. In between the two years there has been significant improvement in the area of physical science laboratories. Table 5 shows the percentages of schools in the provinces with laboratories.

Number of Schools with Physical Science Laboratory by province in 1996 and 2000

Table 8

Province	1996		2000	
	Number	%	Number	%
EC	223	29.7	208	23.6
FS	180	73.2	176	66.7
GP	377	71.0	431	83.2

KZN	375	30.1	359	24.8
MP	135	41.0	112	34.1
NC	50	78.1	44	66.7
LP	159	11.7	209	15.0
NW	148	48.1	168	54.4
WC	253	83.2	160	52.1
National	1900	37.0	1867	33.9

The number of schools with physical science laboratories decreased from 37.0% in 1996 to 33.9% in 2000. Gauteng, North West and Limpopo reported an increase in the number of secondary schools with physical science laboratories in 2000.

9. Unqualified and underqualified educators

Teacher development in South Africa is a critical factor, not only for the successful implementation of education policies, but also for the democratization process as a whole. The participation and performance of the majority of our learners in mathematics and physical science especially in the higher grade is far from satisfactory. The context in which mathematics, science and technology are taught in schools reveals a body of teachers who are generally minimally qualified as subject specialists. Their experience is limited to working to a given syllabus with its prescribed textbooks, following the syllabus closely and emphasizing content knowledge. Teaching at all levels is inordinately influenced by the external Grade 12 examination, an examination that emphasizes content knowledge and recall of facts. Innovation and change has not been a feature of the professional work of the majority of our teachers.

For the most part, mathematics, science and technology educators in secondary schools teach theory from a textbook and provide learners with little or no practical experience. The current syllabus places emphasis on rote learning of subject matter rather than the processes of science and the role science could play in solving local and national problems. Although the introduction of Curriculum 2005 was designed to address some of these shortcomings, it has not been implemented in Grade 12.

By 1994 the number of unqualified or underqualified teachers stood at 122 459 or 36 per cent of the teaching force. As noted by Tshoane (2001) in HRD review (2003) some of the policy implementation failures could be attributed to lack of teacher of teacher preparedness.

Table 9

Year	Unqualified/ underqualified	Percentage qualified	Qualified	Total
1994	122 459	36	219 444	341 903
2000	76 839	22	266 641	343 480

Sources HRD Review 2003, p 313

Department of Education established a Teacher Development Directorate, which was tasked amongst others with the co-ordination of in-service training offered by the government. A programme to upgrade about 10 000 under qualified teachers a year, through a National Professional Diploma, was established and in addition 900 maths and science teachers were to upgrade and a further 1800 will be upgraded in 2003 (Vally and Deltiens, 2001). In 2001/2002 annual report, the department reported that the number of unqualified/underqualified teachers was reduced significantly 22 per cent from 120 000 to 65 000 through development programmes. These developments represent a move from training teachers to perform specific tasks to professionalism and empowerment (Dielties and Motimele 2003).

An audit into 102 Dinaledi Schools maths and science teachers indicates that from a total 307 teachers, 188 (64.6%) obtained a Grade 12 qualification and 177 (56.7%) obtained a diploma as a professional qualification. A few teachers have obtained Honours (17, 5.6%) and Eastern Cape has the highest number of educators (5) with Masters degrees. It is in the light of this background that we can see the growing demand being made on teachers and learners for significant change in the teaching and learning of mathematics, science and technology.

Conclusion

The chapter has outlined key policy and legislative initiatives designed and implemented during the two ministerial terms of Prof. Sbusiso Bengu (1994 –1999) and Prof. Kader Asmal (1999 – 2004). On the basis of the design of the policies to what extent have these policies been translated to practice with respect of changing the landscape of education including increasing the participation rate in mathematics and science. The conclusion is that although the government laid the groundwork for improvements in the education system in terms of policies, the number of students passing maths and science higher grade has not increased. This may call for the reconfigurations of some notations in the policies since it will have some implications for the economy of the country.

In the period under it is plausible that several initiatives such to increasing the participation rate of females in maths and science, upgrading more than 120 000 unqualified or underqualified teachers and building more classrooms have taken off. However, this proved not to be enough and following Jansen (2001) this should studied in the context of the government having laid groundwork for long-term and sustainable improvements in the education system.

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