Understanding trends in high-level achievement in Grade 12 mathematics and physical science

25 January 2016[1]

Reporting on Grade 12 subject results has tended to focus on a rather low level (in particular the 30% and 40% mark levels) and a very high level (in particular the 80% distinction level). The Medium Term Strategic Framework (MTSF) of government requires the basic education sector to pay more attention to the 'missing middle', with specific reference to the 50% mark level and the key subjects mathematics and physical science.

The current report concentrates on the 50% mark level, but also the crucial 60% and 70% levels. The latter two are particularly important as they are often thresholds used by universities to allow entry into specific programmes of study.

The report finds, amongst other thing, that improvements in mathematics and physical science have been large, in particular for black African and coloured learners. This is good news for the sector, and confirms positive trends seen in South Africa's Grade 9 TIMSS results.

The report provides trends using the original marks given to learners. But it also recalculates those trends using an adjustment process which recognises that a mark of, say, 60% actually represents slightly different competency levels in different years. This finding is arrived at by examining performance distributions within limited samples of schools, of less than 50, where schools are selected on the basis of characteristics pointing to high levels of stability. Moreover, the selected schools were required to be relatively well-performing schools. The approach thus involves using schools whose performance is unlikely to have changed much as a benchmark for gauging levels of performance in the system as a whole. In mathematics, one thing that seems to confirm the utility of this approach is that before adjustments rather strange and counter-intuitive race-specific trends emerge, in particular a sharp decline in the proportion of white and Indian learners achieving specific marks. After the adjustments, more expected and intuitive race-specific trends emerge.

To illustrate the approach, trends in a sample of 32 stable schools showed that a mathematics score of 60% in 2012 equalled a score of 60% in 2013, but a score of 59% in 2014 and 2015, and a score of 63% in 2009. In mathematics, the figures suggest that there has been a general shift towards more demanding examinations, meaning it has become increasingly difficult for learners to obtain specific marks. In mathematics then, the trend in, say, the number of learners reaching a mark of 50% over the years is likely to be under-stated if original marks given to learners are taken at face value.

The report does not deal directly with the Umalusi marks standardisation process occurring each year. But it does explain that this process is not designed to produce exactly equivalent marks across the whole performance spectrum for every subject. Above all it is designed to bring about fairness. The kinds of methods proposed in the current report allow one to improve the comparability of marks at specific levels of the performance continuum in specific subjects.

The adjustments explained in the report are particularly important for mathematics as they make a large difference to the trends in indicators such as those emphasised by the

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MTSF. To illustrate, if one takes marks at face value, there has been a decline, of around 2.0% a year, in the number of learners achieving a level of 60% in mathematics, over the years 2008 to 2015. After the adjustments, the trend becomes an *increase* of 4.5% a year. In physical science, on the other hand, original values yield an increase of 6.9%, against an increase of 2.4% if the adjustments are used. In the case of this subject then, using the original marks leads to an *over*-statement of the positive trend.

The race-specific trends are particularly encouraging in mathematics. It is found that the number of black African learners obtaining a 60% level of performance increased by 66% between 2008-09 to 2014-15, from an annual average of 11,344 to 18,801. This is good for the addressing of skills shortfalls in the labour market, greater efficiency in the higher education sector, and for greater racial diversity in mathematically-oriented professions. The corresponding annual increase for coloured high-level mathematics achievers was 47%, also a relatively good figure.

The report confirms that growth in the number of better performing black students has occurred mainly where one would want this to occur, namely in historically disadvantaged schools. Certain provinces and districts stand out as being particularly strong contributors to the growth: the provinces of Limpopo and Gauteng, and the districts Cofimvaba, Gauteng West, John Taolo Gaetsewe, Sekhukhune and Thabo Mofutsanyana. The percentage of public schools producing high-level mathematics achievers (at the 60% level, after adjustments) has moreover increased. Where in 2008 60% of Grade 12 learners were in schools with at least one '60 plus whizzkid', by 2015 this figure had reached 77%.

The adjustment method used for mathematics and physical science is also applied to a further seven non-language subjects, for the 60% mark level. One important finding that emerges for eight of the nine subjects is that despite exceptional changes in the composition of the Grade 12 group between 2014 and 2015, there were no major changes in the difficulty of achieving a 60% mark. The exception was history, where the sample of stable schools suggests it became a bit easier to achieve a mark of 60% between 2014 and 2015.

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1 The need to understand trends in top performance in Grade 12 subjects

An apparent mistake in the planning of education in the United Kingdom serves as a valuable reminder of how important it is to have a reliable picture of trends in the outcomes of schools. A journal article by Jerrim (2013), from which Figure 1 below is taken, describes how confusion around whether the quality of education in schools was improving or deteriorating led to unnecessary panic and changes to policies which in some cases were probably not needed. Specifically, declining PISA mathematics results were understood to reflect a real deterioration in schools. Too little attention was paid to understanding why at the same time TIMSS mathematics results were *improving*. There seem to be good reasons to believe that the PISA trend was wrong. This appears to have come about because a new service provider took responsibility for PISA in the United Kingdom, changed the sample (in violation of PISA rules) and changed the point in the year when tests were written. The fact that even in a developed country, with supposedly high levels of planning capacity, basic measurement mistakes can lead to a misguided public discourse and set of policy reforms seems to offer important lessons for education planners around the world. Measurement errors come about very easily, and can lead to bad decisions.

Figure 1: Lessons from a serious England problem

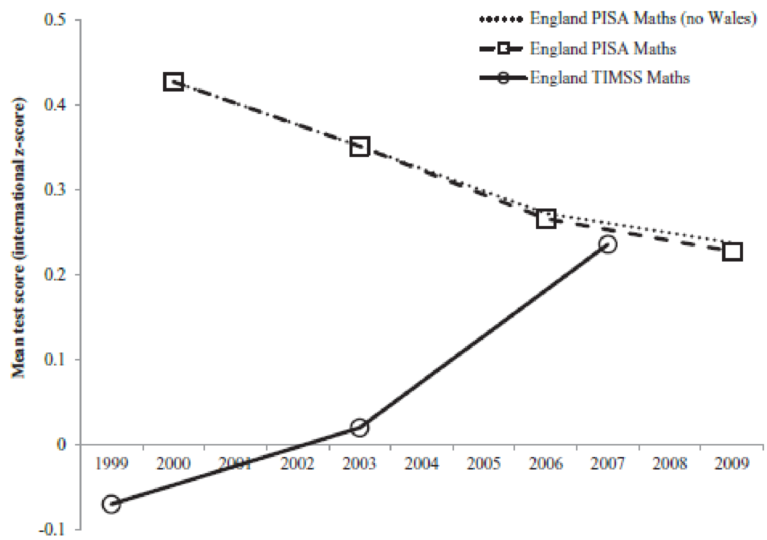


Figure 3. Change in PISA and TIMSS (8th grade) maths test scores over time

Source: Jerrim, 2013: 267.

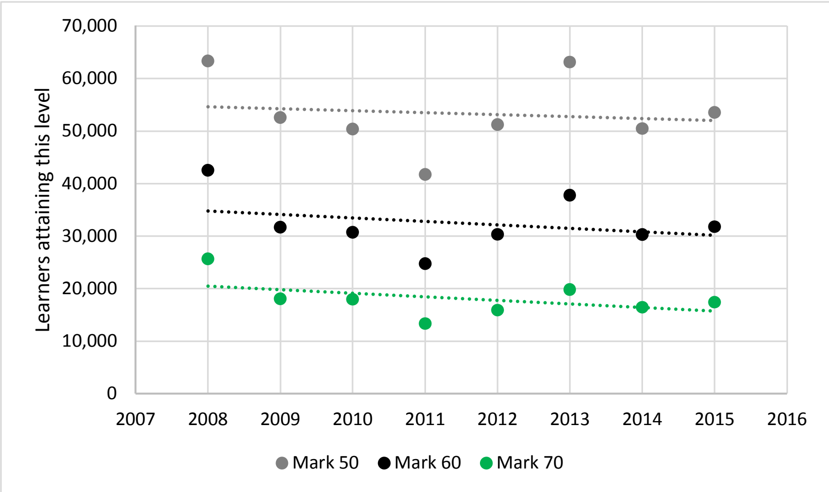
In South Africa, Presidency's Medium Term Strategic Framework (MTSF) requires the education sector to pay more attention to achievement at higher levels of performance. Specifically, Presidency is interested in the number and percentage of Grade 12 learners who achieve a mark of 50% or more in mathematics and physical science. The official examinations reports of the Department of Basic Education (DBE) have tended to focus exclusively on achievement at the 30% and 40% levels, and in more recent years at the 80% level (a 'distinction').

Figure 2 below illustrates the trend for full-time mathematics learners, at the 50%, 60% and 70% mark levels. At face value, the trends appear worrying. For instance, the trend for the 70% mark level is an annual decline of 3.8%. Given that the age 18 cohort has been declining by just 0.2% a year[2], an annual decline in the number of high-level achievers of 3.8% should

[2] Obtained from an analysis of Excel files released by Stats SA in conjunction with official mid-year population estimates.

be very worrying, and suggests strategies need to be revisited. Fortunately, the actual trend is much healthier than what is suggested by the graph. Clarifying the actual trends for mathematics and physical science (and a few other subjects), is the main aim of the current report.

Figure 2: The 'at face value' picture for mathematics



The analysis that follows focusses just on full-time examination candidates during the years 2008 to 2015, before the finalisation of results from supplementary examinations. The exclusion of the supplementary results is due to what data were easily available for the current work. Moreover, part-time learners and learners writing the Independent Examinations Board (IEB) are not the focus of this report. However, some indication is provided below of the magnitudes of these other categories.

The current report should not be seen as criticising Umalusi's annual marks standardisation process. That process is beyond the scope of the report. It should be remembered that the existing standardisation process is not designed to bring about perfect equivalence across years at specific mark levels, for instance the 60% mark level. In fact, given that there are not 'anchor items' (common questions across years) in the Grade 12 examinations, it is virtually impossible to bring about anything resembling perfect equivalences across years. This is a problem shared by most examination systems around the year. Traditional examinations, unlike standardised testing systems, are by their nature unlikely to provide aggregate results which are highly comparable over years[3]. However, retrospective analysis focussing on specific subjects and levels of performance, of the kind explored in this report, can bring one closer to comparable figures across years, and can provide margins of error.

2 Arriving at across-year equivalent scores

2.1 The basic logic

The basic assumption explored in the report is that a small sample of stable schools can offer benchmarks which can be used to gauge trends in the entire system. Specifically, a small purposive sample of schools is selected, on the basis of the apparent stability of these schools, and the assumption is made that these schools are experiencing neither noteworthy improvements nor declines. This would then provide a basis for identifying equivalent marks per year, which can be used to determine trends for the schooling system as a whole.

[3] See for instance Greaney and Kellaghan, 2008: 14.

2.2 Identifying a purposive sample of stable schools

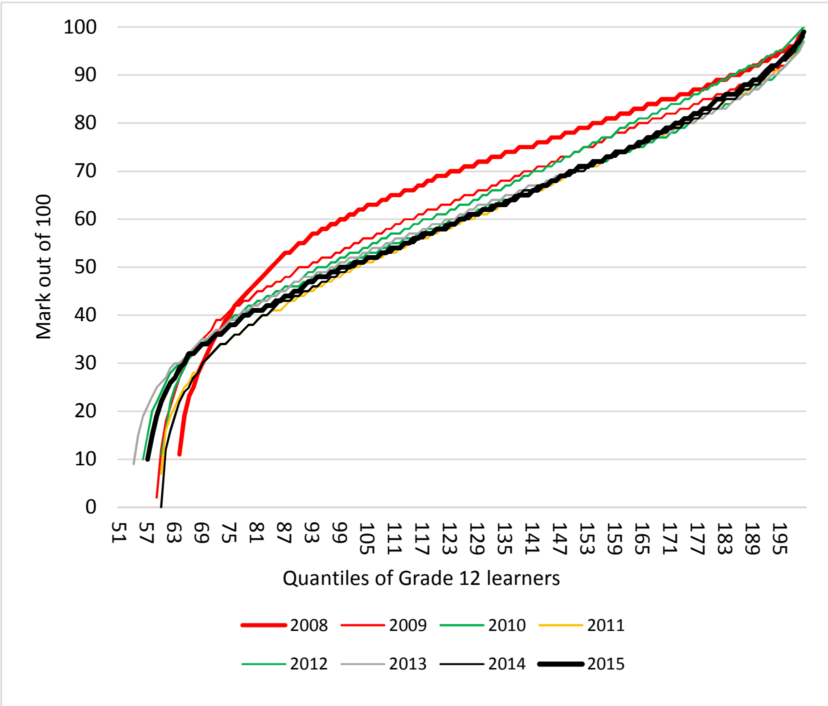
The table below explains five criteria which were used to identify schools which were assumed to display relatively stable mathematics results across the years 2008 to 2015. Thirty-two schools passed all the criteria in the table. On average, these schools contained around 5,600 Grade 12 learners per year, and 4,000 Grade 12 mathematics learners. The schools were relatively socio-economically advantaged: 66% of learners were white.

CRITERIA FOR IDENTIFYING STABLE SCHOOLS				
	Criterion	**Why**	**Exact parameters used for mathematics**	**% of schools surpassing the thresholds**
1	School must be relatively well-performing.	In theory at least, better performing schools improve less because they are close to a performance 'ceiling'. (Moreover, the aim was mainly to establish equivalent marks towards the top of the performance spectrum.)	In terms of performance at the 90^{th} percentile, counting even learners not taking mathematics, the school's rank had to be amongst the top 300. The mark used here was the mark plus a tiny random element.	3.9
2	School should not display large changes in terms of racial composition.	Ideally, one would want to identify schools where the socio-economic composition of learners does not change much. However, we do not have the data on this. To some extent, a fairly constant composition in terms of race serves as a reliable alternative indicator.	The percentage of learners in each population group in each year in Grade 12 was calculated. 'Other' was used as fifth group (this group accounts for less than 1% of learners). For each group, the difference between the maximum and minimum percentages (across the eight years) could not exceed 15%.	80.5
3	School's total Grade 12 enrolment should be stable.	An unstable enrolment figure could point to changes in the way learners were promoted into Grade 12, or to across-school migrations, both of which could impact on the performance distributions amongst Grade 12 learners.	The slope for total Grade 12 enrolment across years was calculated. This slope was divided by the mean enrolment across years to arrive at the average annual growth in enrolments. This growth had to lie within a range which did not deviate from growth in the age 18 cohort in the population by more than 2.5 percentage points. Given the growth in the age cohort was -0.2% (calculated from Stats SA figures), the school's enrolment growth had to lie in the range of -2.7% to 2.3%.	30.0
4	School's percentage of Grade 12 learners taking the subject had to be stable.	Changes in the participation within the subject could point to, for instance, more less capable learners. It could also be indicative of changes in the management of the school, or in the teaching staff, factors which could impact on the stability of the performance distribution.	Both the percentage and number of learners taking mathematics in each year was used. For each of these figures, the maximum and minimum across all years was found. The difference between the maximum and minimum was then calculated. The differences could not exceed 15 percentage points or 10 learners.	12.1
5	School's percentage of Grade 12 learners taking the subject had to be at least 50%.	This was not a stability criterion, but a way of ensuring that there were enough marks per school. This was particularly important given the approach of looking at quantiles of *all* learners, not just, for instance, mathematics learners.	All learners taking the subject during the years 2008 to 2015 was divided by all Grade 12 learners over the period. The school had to display at least 50%.	33.6

2.3 Results

The data on the 32 schools were pooled, separately for each year. Learners were sorted according to their mathematics mark. Learners who did not take mathematics were given a mark of zero. The learners, around 5,600 per year, were divided into 200 quantiles, according to their marks. The result for learners taking mathematics is illustrated in the next graph. It is clear that the 2008 mathematics examination produced a rather different performance distribution. Learners obtained higher marks in 2008 than similar learners would obtain in other years, suggesting the 2008 mathematics examination was less demanding.

Figure 3: Mathematics mark distributions in 32-school sample



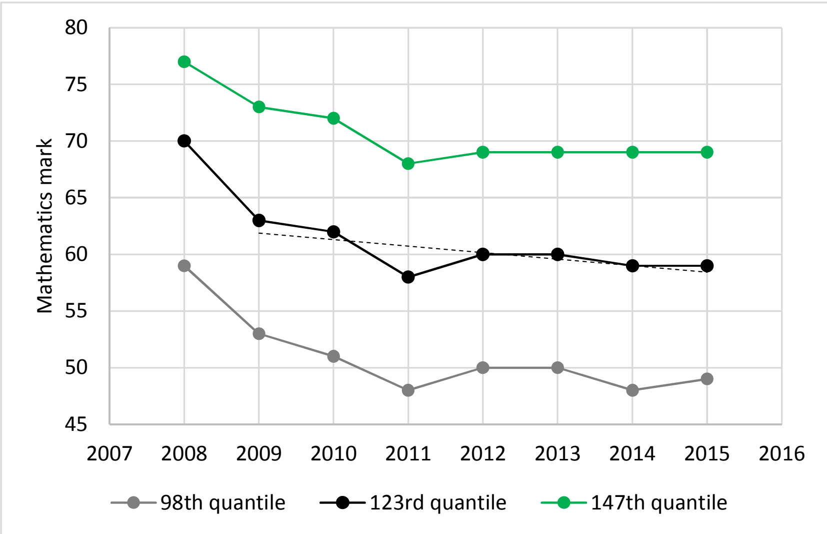
If one is to place learners within 200 performance quantiles, one will often have to decide how to allocate two learners with the same mark, say 50, into different performance quantiles, in order to ensure that the quantiles remain, as far as possible, of the same size. The solution used was to add a tiny random element to each mark. Thus one learner with 50 could be given a mark of 50.00013, whilst another could obtain 50.00048. The median mark within each quantile was considered the mark for that quantile.

Why was the marks distribution of all learners and not just mathematics learner used? It turns out that the first approach produces school rankings which are more consistent. Two statistics were compared to prove this. Firstly, the 90th percentile of all Grade 12 learners per school (where non-mathematics learners were assigned a mathematics mark of zero) was calculated. Secondly, the 86th percentile of just mathematics learners per school was calculated. (On average, 71% of learners took mathematics, so the 90th percentile of all learners is the equivalent of the 86th percentile of just mathematics learners[4].) The 32 schools were ranked by the two statistics. Ranks were then compared across years. Year-on-year rank changes were twice as large when non-mathematics learners were ignored, compared to when they were included.

[4] ((90 – (100 – 71)) / 71) × 100 = 86.

To obtain an equivalent mark per year which could represent the 60% level, the average mark across the years, within each quantile, was calculated. The quantile which produced an average mark which was closest to 60% was consider the quantile representing the ability of learners at this level. This quantile turned out to be the 123rd quantile of all Grade 12 learners in the 32 schools. Due to the clearly different marks emerging in 2008, the average mark was obtained, per quantile, using just the years 2009 to 2015, which displayed more similar patterns. The process was repeated for the 50% and 70% mark levels. The next graph illustrates the equivalent marks found.

Figure 4: Mathematics mark distributions in 32-school sample



The black dotted line in Figure 4 illustrates the trend for the equivalent marks at the 60% level for the years 2009 to 2015. The fact that the trendline slopes downward indicates that the examinations were in general becoming more demanding over these years. For instance, a mark of 59 in 2015 was as hard to obtain as a mark of 60 in 2013. The equivalent marks for the 60% level appear in the first row of the next table. Table 1 also explores how sensitive the results are to the way the sample of stable schools is selected. Three alternative approaches were followed, and the results for these are also shown. The alternative approaches sometimes produce different equivalent marks, but the difference is never more than one. The last column of the table indicates the annual growth in the number of learners obtaining a 60% level, across all schools, using the new equivalent scores. Thus, for instance, using the original 32-school sample as one's benchmark, any learner in the system with a mark of at least 59 in 2015 was considered to have reached the 60% level. And any learner with a mark of at least 62 in 2010 was considered to have reached the 60% level. And so on. The annual growth in the number of '60 plus' learners, after adjustments based on the 32-school sample, was 4.5%. In contrast, the annual growth of learners obtaining 60%, using marks at face value, was a *negative* 2.0% - this slope is illustrated by the middle trendline in Figure 2 above. The key thing to note is that how the sample of stable schools is determined has some influence on the recalculated growth, but roughly the magnitude of the growth remains similar. Specifically, in the four approaches illustrated in Table 1, the annual growth lies within the range 4.0% to 4.7%. Clearly, the picture emerging from this is very different from what was seen in Figure 2 above.

Table 1: Results from alternative mathematics runs

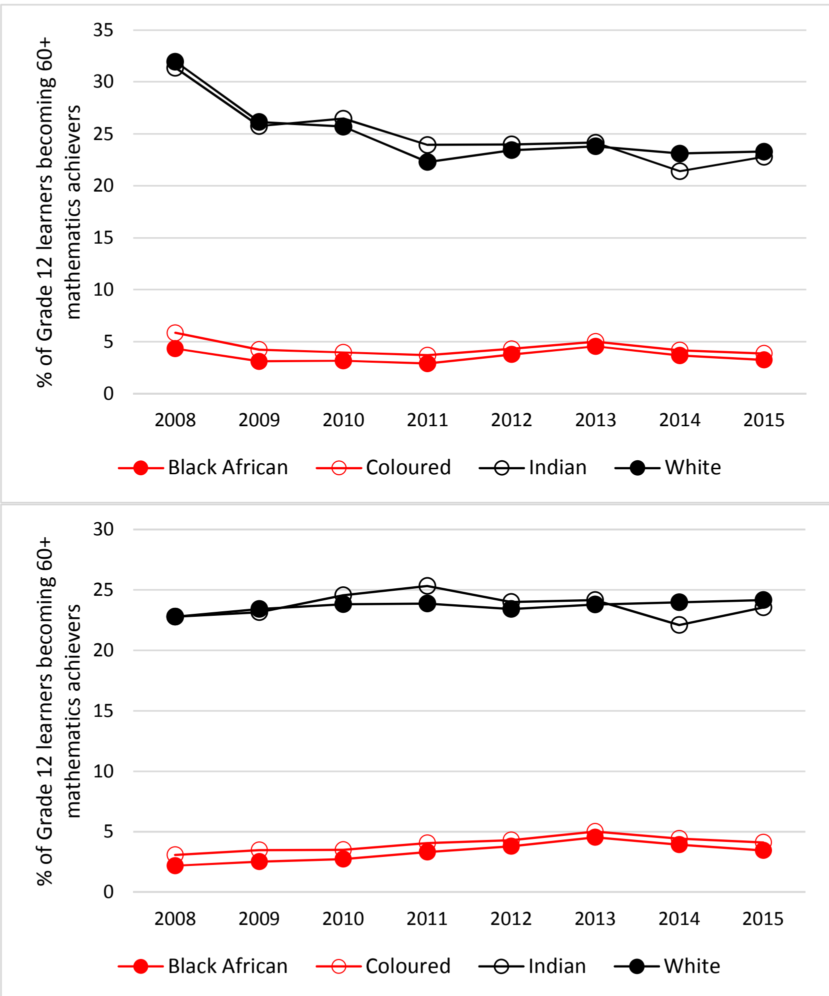
Run	Schools (and those in common with original 32)	Difference from original (values in brackets refer to rows in earlier table describing the parameters)	2008	2009	2010	2011	2012	2013	2014	2015	Average deviation from original	Annual % growth in 60+ learners in whole system
Original	32		70	63	62	58	60	60	59	59	0.0	4.5
Run 2	34 (16)	(3) Grade 12 stability parameter changed from 2.5 percentage points to more stringent 1.0. (4) Mathematics stability parameters changed from 15 percentage points to less stringent 20 percentage points, and from 10 learners to less stringent 15 learners.	70	63	62	57	59	61	58	59	0.5	4.6
Run 3	30 (23)	(3) Grade 12 stability parameter changed from 2.5 percentage points to more stringent 1.5. (5) Minimum percentage of learners taking mathematics changed from 50% to less stringent 40%.	69	63	62	57	59	60	59	59	0.4	4.0
Run 4	25 (20)	(4) Mathematics stability parameters changed from 15 percentage points to more stringent 13 percentage points, and from 10 learners to more stringent 8 learners. (5) Minimum percentage of learners taking mathematics changed from 50% to less stringent 40%.	70	63	62	57	60	60	58	59	0.3	4.7

3 Meaning of the sample-based results for the system

3.1 Fewer strange race-specific trends

One reason for not believing trends based on unadjusted marks is that the race-specific trends which emerge appear strange. The first graph in Figure 5 below reflects trends for the percentage of Grade 12 learners becoming '60 plus' mathematics learners, without any adjustments. What is very noteworthy is how similar the trends for white and Indian learners are, and how similar those for black African and coloured learners are. What is also noteworthy is the apparent decline in the ratios for white and Indian learners, for instance from 32% to 23% for white learners between 2008 and 2015. It is true that the number of white and Indian examination candidates has declined by 17% between 2008 and 2015, a trend which would mostly be explained by movement into other systems, in particular the Independent Examinations Board (IEB). It is possible that on average better performing white and Indian learners have exited the public system, which could result in lower success ratios in this system. However, the decline in the number of '60 plus' white and Indian learners, using marks at face value, has been around 30% over the whole period, and learners exiting the public system would not have constituted the 'cream' in any neat and absolute sense. The trends seen in the second graph of Figure 5, which is derived after the adjustments described above have been implemented, seem far more intuitively right. Here the ratios for white and Indian learners remain roughly constant.

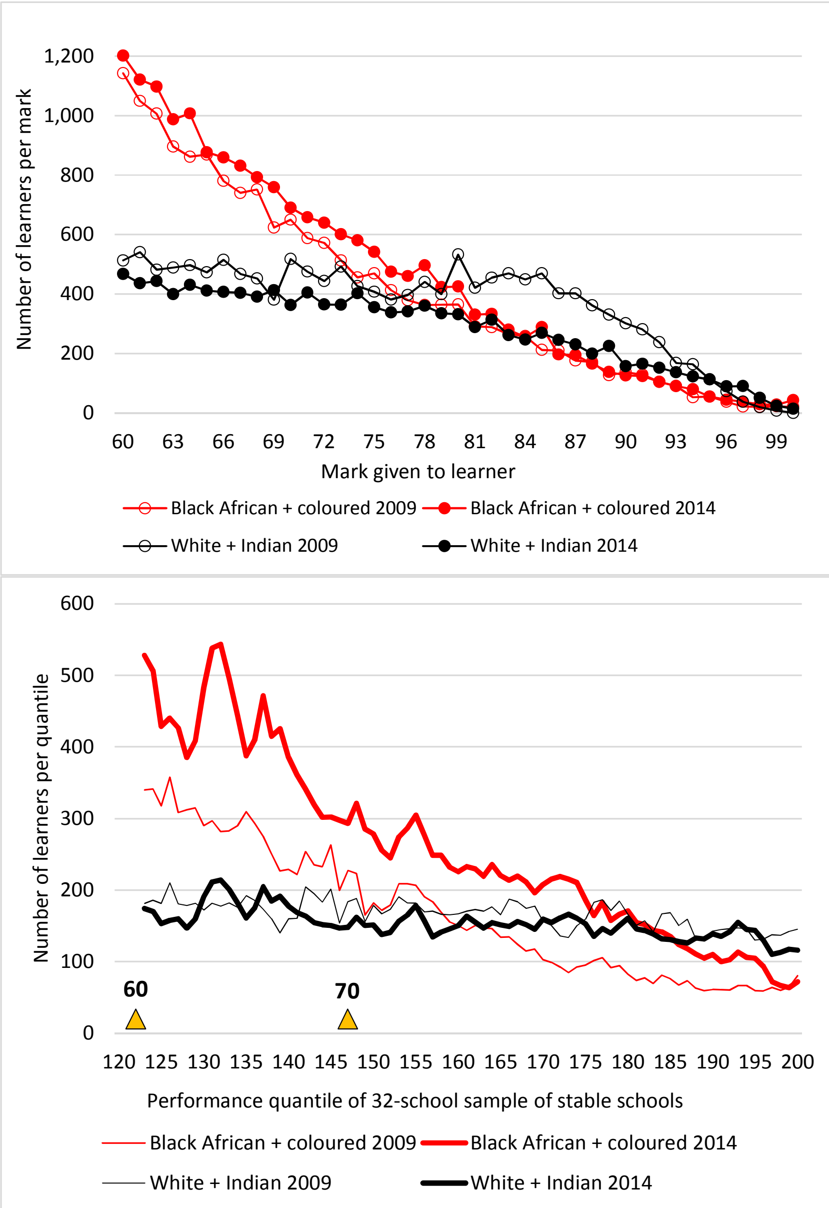
Figure 5: Race-specific probabilities before and after adjustments



3.2 Noteworthy improvements amongst black learners

The first graph of Figure 6 below suggests that much of the apparent decline in white and Indian performance between 2009 and 2014 lay in the mark range of 80% and above (the years 2009 and 2014 were selected here as both 2008 and 2015 are rather exceptional years in terms of the difficulty of the examination and the number of examination candidates respectively). The adjustment process described above produces a trend for white and Indian learners which is less differentiated across performance levels (see the second graph below). What this suggests is that white and Indian learners who would have obtained, say, 85% in 2009, would have found it harder to obtain this 85% in 2014. This problem seemed larger in the mark range 80% to 95% than, say in the mark range 60% to 80%. Importantly, the second graph below still does reflect a decline in high-performing white and Indian learners, something one would expect given the overall decline in examination candidates from these groups. Specifically, the figures used for the second graph give a decline of 10% in the number of white and Indian learners performing at least as well as the 147^{th} quantile in the 32-school sample (this quantile has been identified as best representing the 70% mark level). This 10% decline compares to an 11% decline in the number of white plus Indian examination candidates between 2009 and 2014. The figures thus suggest that the ratio of white and Indian learners becoming '70 plus' mathematics performers has remained virtually unchanged over the 2009 to 2014 period, despite the departure from the public system.

Figure 6: Race-specific mark distributions before and after adjustments

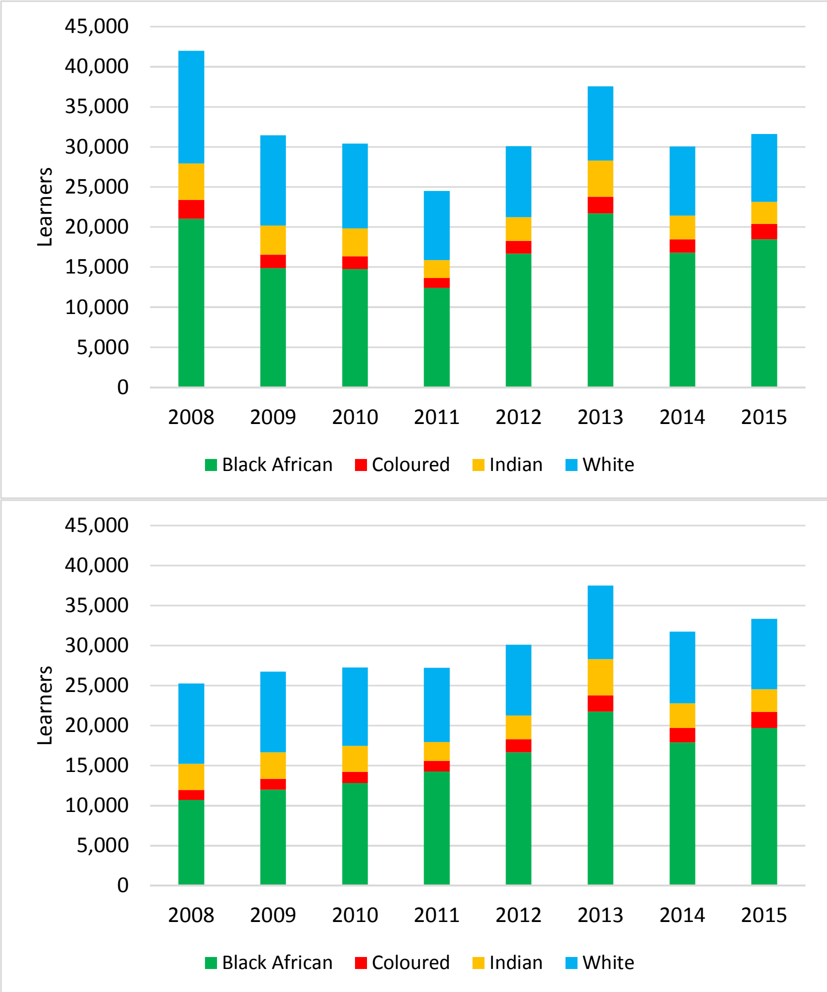


Note: In the second graph the 123rd and 147th quantiles are marked as these are the quantiles which were represented most closely the 60% and 70% mark levels.

A key trend seen in the second graph above is a large increase in the number of black African and coloured learners achieving higher mathematics marks. A small trend in this direction is even seen in the first graph (particularly in the mark range 60% to 80%), but it becomes larger after the 32-school sample has been used as a benchmark.

Numbers per population group, before and after the adjustments, are reflected in Figure 7 below. The graphs represent the number of learners achieving a mark of 60% or more or, for the second graph, reaching what was considered an equivalent mark at the 60% level. The fact that the second graph should provide a smoother trend than the first one seems to offer further support for using the adjustments. It is unlikely that the output for high-level mathematics achievers would fluctuate as much as what one sees in the first graph.

Figure 7: Trend across all years for mark 60 level before and after adjustments



The figures used for the second graph translate into an increase of 66% in the number of black African '60 plus' mathematics achievers if one compares the 2014-15 average to the 2008-09 average. The corresponding increase for coloured learners would be 46%.

There is in fact reliable evidence from outside the examinations data that improvements in mathematics have been occurring at the secondary school level. Above all, South Africa's Grade 9 TIMSS data point to a substantial improvement over the 2002 to 2011 period[5].

4 Where in the system the growth is occurring

4.1 Province, quintile and ex-department

There are two key questions we need to ask regarding recent trends. Firstly, which parts of the system are currently best at producing high-level mathematics passes in the case of black African and coloured learners? Secondly, what parts of the system account for the positive trend seen in recent years as far as black African and coloured learners are concerned?

The next table answers both these questions with respect to black African learners, using marks with adjustments based on the 32-school sample of stable schools. The first column indicates the annual output of 'high-level' black African mathematics achievers, for the years

[5] See Reddy *et al* (2010).

2013 to 2015, by province, school quintile and ex-department. In this table the 60% mark level has been considered the threshold for being considered ‘high-level’. This is a threshold frequently appearing in university entrance requirements. For instance, a mark of 60% or more in mathematics is a requirement for medicine and natural sciences at the University of Pretoria, and for accounting at the University of Fort Hare. There are many exceptions, however. Engineering at Pretoria requires a 70% score in mathematics, whilst entering economics at Fort Hare requires 50%.

Gauteng, Limpopo and KwaZulu-Natal stand out as the largest ‘producers’ of black African ‘60 plus’ mathematics learners. In terms of ex-department, just under two-thirds of the best mathematics learners come from historically black African schools (‘homeland’ or DET). The second column displays probability statistics, calculated as for Figure 5, meaning high-level mathematics achievers divided by all (black African) Grade 12 learners participating in the examinations. Gauteng and Limpopo stand out as provinces which have been particularly effective in getting learners to become mathematics achievers. The quintile figures reveal a systematic pattern whereby the poorer a school community, the lower the probability that a learner will surpass the 60% mark level. Partly this confirms the role of home background advantage in enabling learners to succeed in school. Turning to ex-department, black African learners in formerly white schools display a relatively high probability of becoming high-level achievers. Of course it should be kept in mind that these learners tend to be, on average, relatively advantaged socio-economically. It is also noteworthy that the probability statistic for these learners, of 9.9%, is still considerably lower than the statistic of around 25% for white (or Indian) learners (see Figure 5). The probability statistic for black African learners in independent schools participating in the public examinations is lower than that for these learners in historically white schools, but higher than for these learners in ex-homeland and ex-DET schools.

Table 2: Factors associated with black African 'high-level' mathematics outputs

Category	2013-2015 output	Probability 2013-2015	Probability relative to population 2013-2015	Annual change in probability 2008-2015	2015 output minus 2008 output	Annual change in 2008-2015 probability using multivariate analysis
Provinces						
EC	2,043	2.9	1.7	0.2	1,143	0.2
FS	1,132	4.3	2.6	0.4	705	0.3
GP	4,328	5.3	3.5	0.3	2,245	0.3
KN	4,264	3.0	2.4	0.1	1,850	0.1
LP	4,294	5.0	4.0	0.4	2,325	0.4
MP	2,044	4.2	3.0	0.4	1,298	0.4
NC	155	2.9	1.5	0.3	106	0.3
NW	995	3.7	1.9	0.1	200	
WC	524	3.2	1.9	0.0	264	*
SA total	19,780	4.0	2.7	0.3	10,136	
Quintiles						
Q1	2,339	2.6		0.2	1,701	*
Q2	2,582	2.9		0.2	1,626	
Q3	5,028	4.0		0.2	2,535	
Q4	3,445	5.1		0.3	1,809	0.1
Q5	3,303	7.9		0.1	1,004	
Total[6]	16,696					
Ex-department						
Homeland	7,849	3.7		0.2	4,071	
DET[7]	3,904	3.6		0.3	2,380	
White	2,589	9.9		0.1	867	
Coloured	273	3.2		0.1	101	
Indian	353	3.4		0.1	148	*
Independent	1,253	6.8		0.4	511	0.2
Other	2,549	3.5		0.2	2,060	0.1
Total	18,769					

For the third column, high-level achievers were divided by the age 18 population in the province[8]. This takes into account the fact that different provinces achieve different levels of success in getting black learners to enter Grade 12 in the first place. As one would expect, these probabilities are lower than those in the second column, but the provincial rankings are roughly the same. Not only does Limpopo do a relatively good job at ensuring that Grade 12 learners become high-level achievers (second column), the fact that its statistic in the third column (4.0%) is higher than one might expect is evidence that this province is also good at ensuring that learners do not drop out before they reach Grade 12. In North West, on the other hand, a relatively good value in the second column hides the fact that a rather low percentage of learners reach Grade 12. The three 'Capes' display low values in both columns.

[6] The reason why this total (and the one for ex-department) is lower than the total under the provinces is that some schools lacked the classification in question (this is partly logical insofar as independent schools do not carry quintile values).

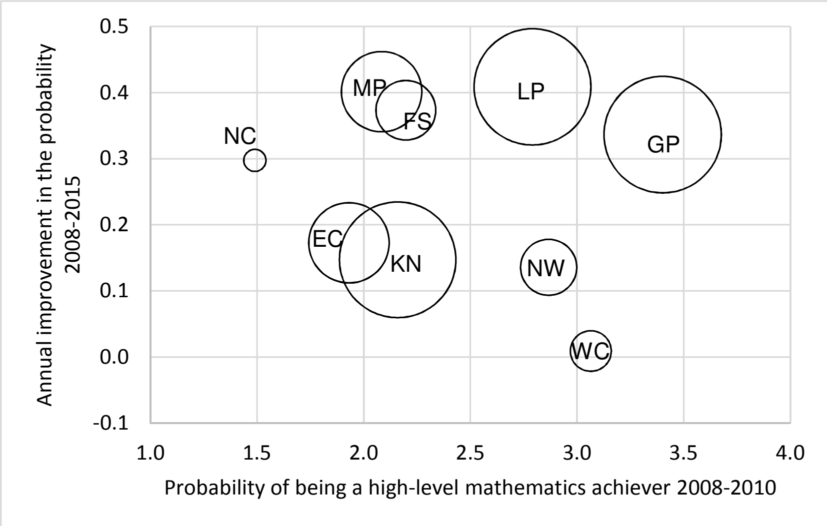
[7] Under apartheid, most urban township schools fell under the DET, or Department of Education and Training.

[8] The population figures per province were found through an approach involving the ratio, per province, between learners aged 13 to 15 (where enrolment ratios are known to be around 99%) and Grade 12 enrolment, using the 2013 Annual Survey of Schools data. These age-specific data do not have a race breakdown, meaning ratios applicable to learners of all races were used. This approach, whilst clearly not ideal, seems to yield sufficiently accurate estimates of the number of 18 year olds per province, and better estimates than other approaches using different data sources. Yet the absence of more reliable population estimates means that the ratios in the third column should be interpreted with caution.

The fourth column displays the average annual change in the probability statistic (of the second column) for the 2008 to 2015 period. Again Limpopo emerges in a positive light, as do Free State and Mpumalanga. The probability of being a high-level achiever has improved fastest in these provinces. At the other end of the spectrum, Western Cape is clearly experiencing problems in tackling the legacy of under-performance amongst black African learners at the Grade 12 level. In this province the data point to no substantial improvement in one's probability of being a high-level mathematics achiever.

The following graph displays, for each province, the initial level of success in terms of the probability of being a high-level mathematics achiever (during the years 2008 to 2010), the annual improvement in this statistic (so the fourth column of Table 2), and the average annual output of high-level passes in 2013-2015 (the first column, shown in the sizes of the circles). Limpopo and Gauteng not only had a relatively good initial level, these two provinces improved considerably. These two provinces are also large overall 'producers' of high-level mathematics results amongst black African learners.

Figure 8: Provincial progress with respect to black African learners



Note: Figures along the horizontal axis are percentages of all black African Grade 12 learners. Figures along the vertical axis are percentage point improvements. The area of each circle is proportional to the average annual output of high-level black African mathematics achievers in the 2013-2015 period.

The last column of Table 2 presents versions of the change in probability statistics (so the third column statistics) produced by a multivariate regression analysis[9]. Improvements in the probability of becoming a high-level achiever are likely to be associated with various factors simultaneously. A multivariate analysis permits a clearer picture, relative to the third column, of what factors are most closely associated with improvements. The statistics shown in the

[9] The empirical model can be described as follows:

$$p_{sy} = a + b_1 P_y + b_2 r_{1s} P_y + ... + b_9 r_{8s} P_y + b_{10} q_{1s} P_y + ... + b_{13} q_{4s} P_y + b_{14} c_{1s} P_y + ... + b_{19} c_{6s} P_y +$$
$$b_{20} r_{1s} + ... + b_{27} r_{8s} + b_{28} q_{1s} + ... + b_{32} q_{4s} + b_{33} c_{1s} + ... + b_{38} c_{6s} + u_{sy}$$

The dependent variable *p* is the probability that a learner in school *s* in year *y* will be a high-level mathematics achiever, meaning the number of high-level achievers divided by all Grade 12 learners (but only black African learners counted). Independent variables include the period *P*, carrying values 1 to 8 for 2008 to 2015, dummy variables for eight provinces (*r*), four quintiles (*q*) and six ex-departments (*c*), and then interactions between the dummy variables and *P*. Observations were weighted by black African Grade 12 enrolment. The coefficients used for the table are b_2 to b_{19}.

fifth column are coefficients, all statistically significant at least at the 10% level, with reference categories marked with an asterisk (*). Province emerges as the strongest factor from the analysis, relative to quintile or ex-department, suggesting that above all it is the province a school finds itself in which is likely to determine whether improvement over time is weak or strong.

Turning to the quintiles, it is encouraging that the largest improvements have occurred in relatively poor quintiles (see fourth column). This is clearly good for equity. It is furthermore encouraging that historically black African schools ('Homeland' and DET) have displayed relatively strong rates of improvement, larger than the improvement rates seen in formerly white schools.

The fifth column represents the total increase in the number of high-performing black African learners between 2008 and 2015. The 2015 and 2008 figures used are based on the linear trend, meaning data points across all years are taken into account. Using this approach, if either the 2015 or 2008 figures are exceptionally high or low, they would be brought in line with the overall trend. To illustrate, schools in the former 'homelands' would account for 4,071 of the additional high-level performers seen in 2015, relative to 2008.

A reduced version of Table 2 above is reproduced below for coloured learners. One thing that stands out in Table 3 is that Northern Cape has been relatively unsuccessful in getting coloured learners to excel in mathematics in the Grade 12 examinations. The probability of becoming a high-level achiever, at 2.2%, is low and the improvement for the 2008 to 2015 period has been weak. Also noteworthy is the fact that the least poor schools, in quintile 5, have been the most successful at improving their (already relatively high) levels of output. For black African learners, improvements in quintile 5 were relatively low, compared to the other quintiles. Improvements for coloured learners in relatively poor schools have moreover been low, between zero and 0.1 percentage points a year, compared to between 0.2 to 0.3 for similarly poor black African learners. All this suggests better interventions are needed to support schools serving poorer coloured learners. The bottom panel of Table 3 suggests that focus needs to be directed towards historically coloured schools. In 2014, 62% of coloured Grade 12 learners were attending historically coloured schools, yet these schools accounted for only 23% of 'high-level' coloured mathematics learners.

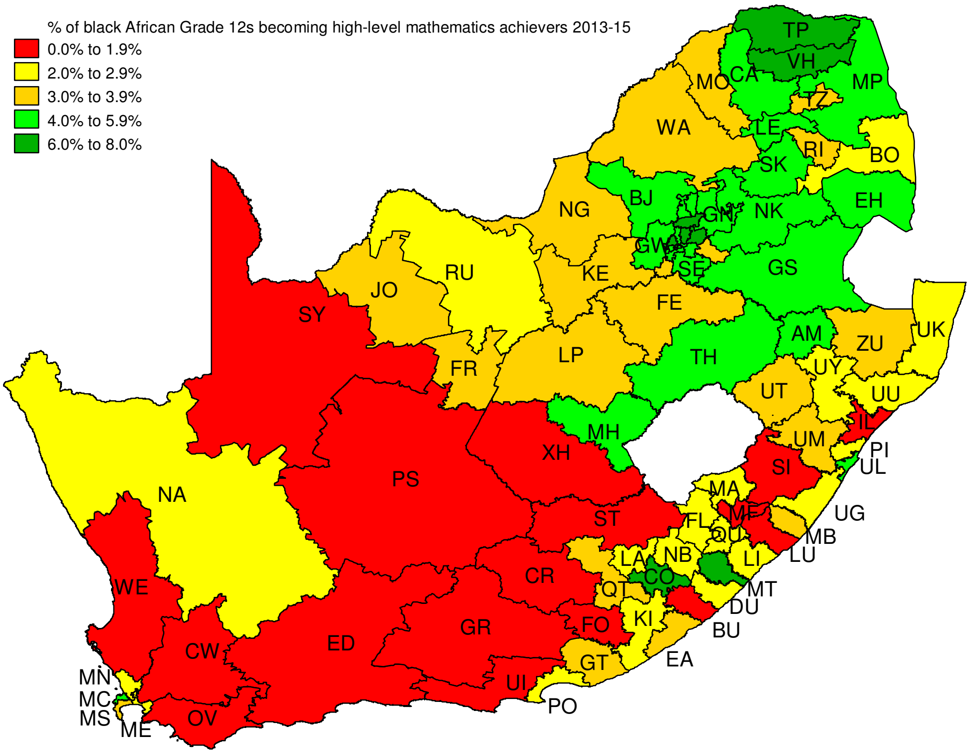
Table 3: Factors associated with coloured 'high-level' mathematics outputs

Category	2013-2015 output	Probability 2013-2015	Annual change in probability 2008-2015	2015 output minus 2008 output
Provinces				
EC	145	3.2	0.1	60
FS	32	3.8	0.2	15
GP	246	5.3	0.3	104
KN	125	7.6	0.3	44
LP	5	4.8	0.3	1
MP	14	5.6	0.4	9
NC	89	2.1	0.1	40
NW	12	2.9	-0.1	-4
WC	1,290	4.9	0.2	563
SA total	1,958	4.6	0.2	831
Quintiles				
Q1	4	0.8	0.0	0
Q2	13	1.1	0.1	10
Q3	67	1.2	0.1	38
Q4	168	1.4	0.1	31
Q5	1,349	7.4	0.4	617
Total	1,601			
Ex-department				
Homeland	25	11.7	0.6	9
DET	19	2.1	0.1	5
White	1,096	10.4	0.3	473
Coloured	407	1.7	0.1	190
Indian	43	5.1	0.2	19
Independent	158	14.0	0.7	77
Other	75	3.5	0.2	57
Total	1,823			

4.2 Outstanding districts and schools

Turning to achievement at the district level, the next map (Figure 9) reflects the average annual percentage of black African Grade 12 learners who were 'high-level' mathematics achievers in the years 2013 to 2015 (the statistic is thus the one from the second column of Table 2, and a mark of 60% is again considered the high-level threshold). The success of certain Limpopo districts is clearly visible, in particular that of the districts Tshipise Sagole (TP) and Vhembe (VH). What is very noteworthy is that despite the below average performance of Eastern Cape, certain districts in this province have performed well, in particular Mthatha (MT) and Cofimvaba (CO). In the case of Western Cape, it is clear that the most serious problems with respect to black African learners are in the hinterland of the province, specifically West Coast (WE), Cape Winelands (CW) and Overberg (OV).

Figure 9: Levels of black African high-level achievement in 2013-2015



The next two maps deal with improvement over the 2008 to 2015 period, focussing just on black African learners. The first map (Figure 10) looks at the average annual improvement with respect to the probability of being a high-level achiever (as in the fourth column of Table 2). The second map (Figure 11) looks instead at the average annual percentage increase in the *number* of high-level passes. It is possible for a district to, for instance, fare better in the first map than the second map if its overall Grade 12 enrolment has been decreasing over time, but the percentage of learners becoming 'high-level' has increased. We see that the indicator one uses does make a bit of a difference. For instance, Tshipise Sagole and Vhembe are amongst the best performers in Figure 10, but not Figure 11 (though their performance in the second map is not bad). Districts which emerge in the top category in both of the following maps are: Namakwa (NA), Cofimvaba, Sekhukhune (SK), Thabo Mofutsanyana (TH) and Gauteng West (GW).

Figure 10: Improvement in probability of black African high achievement in 2008-2015

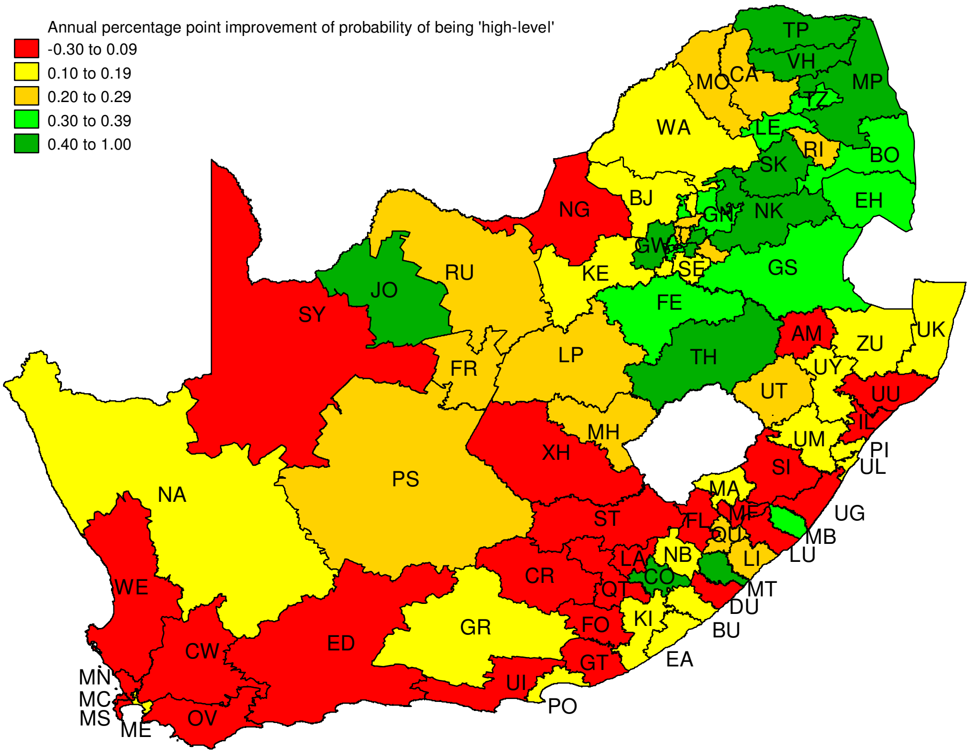
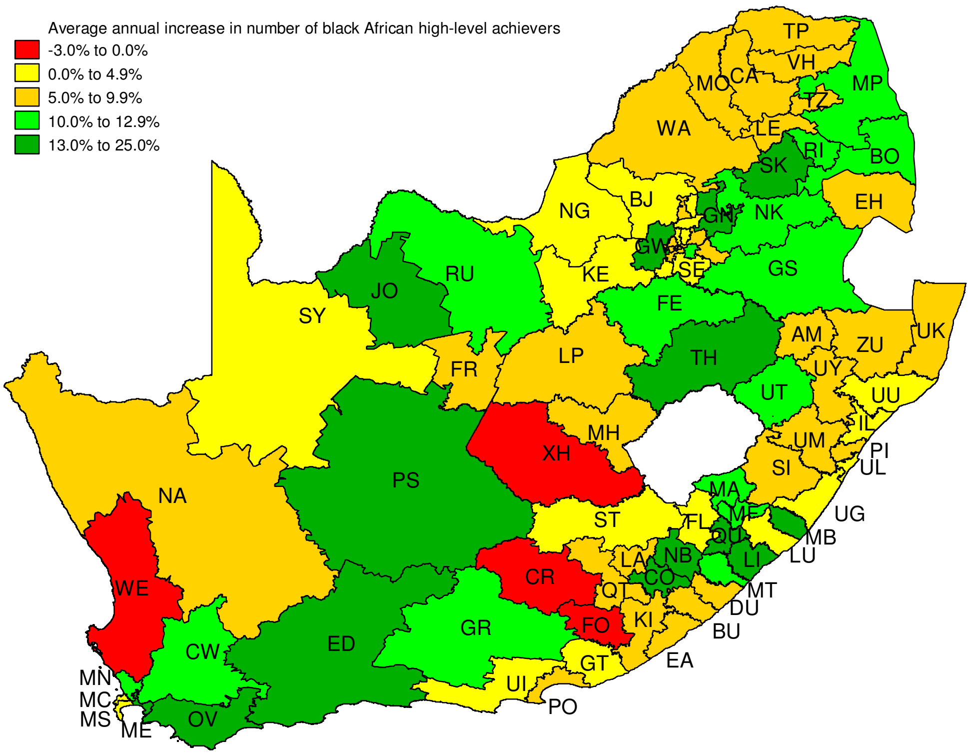


Figure 11: Average annual increase in black African high-level achievers 2008-2015



Note: Annual improvement is considered the slope in the linear trend across all years. For the current graph, the slope was divided by the mean across all years to obtain an annual percentage.

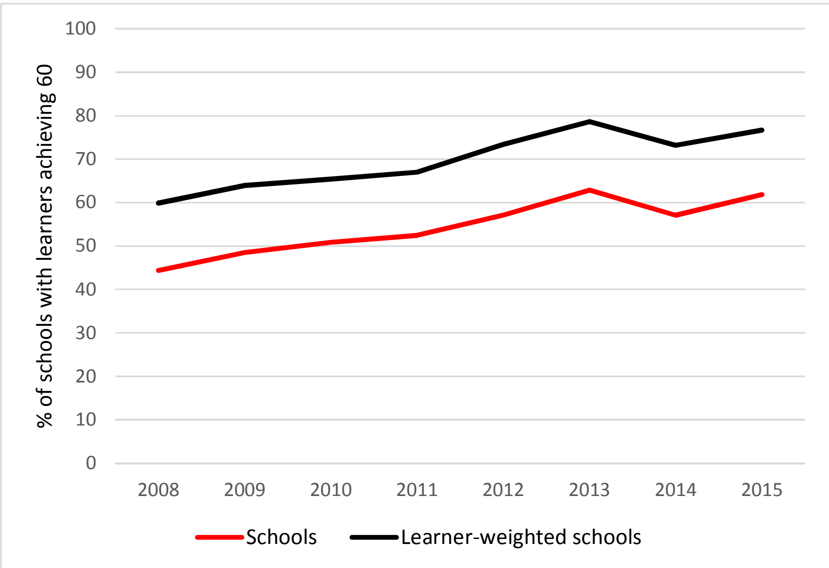
Table 4 below sums up which districts are top performers in terms of the preceding three maps.

Table 4: Outstanding districts

District	Outstanding levels of black African high-level achievers in 2013-2015. (Top category in Figure 9.)	Outstanding *improvements* in black African high-level achievers across 2008-2015. (Top category in *both* of Figure 10 and Figure 11.)
Cofimvaba (CO)	✓	✓
Ekurhuleni North	✓	
Gauteng West (GW)		✓
Johannesburg East	✓	
Johannesburg West	✓	
John Taolo Gaetsewe (JO)		✓
Mthatha (MT)	✓	
Sekhukhune (SK)		✓
Thabo Mofutsanyana (TH)		✓
Tshipise Sagole (TP)	✓	
Tshwane South	✓	
Vhembe (VH)	✓	

What none of the statistics seen so far reflect is the degree to which improvements are concentrated in specific schools, as opposed to spread across an increasing number of schools. Fortunately, the latter is what has happened. This can be seen in Figure 12 below. The percentage of public ordinary schools with '60 plus' mathematics achievers increased from 44% in 2008 to 64% in 2015. The percentage of all public ordinary school learners studying in these schools increased from 60% to 77%. The difference between the two curves in the graph is due to the fact that larger schools are more likely to have high-level mathematics achievers, as one might expect.

Figure 12: Spread across public schools of '60+ achievers'



With a view to establishing a 'list of honour' consisting of individual schools which contributed exceptionally to the positive trends outlined in the above analysis, a couple of school-level statistics were devised. A first statistic dealt with numbers of black African and coloured high-level mathematics achievers, over the 2008 to 2015 years, using the adjusted

60% mark level devised for the current report. Specifically, the statistic is the minimum, across the years, in the percentage of learners (black African or coloured) who excelled in mathematics. Clearly one would be interested in a minimum above zero. The statistic would thus capture consistency in the output of high-level mathematics achievers.

A second statistic deals with improvement over time, and is simply the average annual increase in the number of learners (black African or coloured) reaching the 'high-level' mathematics status, expressed as a percentage of the average number of high-level achievers over the years. This second statistic is thus the same as the statistic dealt with by the last map (Figure 11). For this statistic, only schools with at least some high-level achievers in all years (black African or coloured) were counted. Schools with a negative improvement statistic were discarded.

One filter was applied. The average number of high-level passes per year in school had to be at least eight. Without this filter, it seemed too many very small independent schools emerged with high rankings.

To obtain the list, all schools were ranked according to each of the two statistics. Thereafter an average rank was found where the first ranking (level of achievement) was given a weight of 2.0 and the second ranking (speed of improvement) a weight of 1.0. Then within five groups the top seven schools, according to the average rank, were found. One group was all quintile 1 schools which were historically black African ('homeland' or DET) or historically coloured. Similar groups were formed for quintiles 2, 3 and 4. All schools not in one of the first four groups were placed in a fifth group. The top seven schools in five groups gave a list of 35 schools, which appears below. Better schools, according to the average rank, appear higher up in the list within each of the five groups. The average Grade 12 and 'average high-level' columns refer to the average annual number of black African plus coloured learners, and high-level mathematics achievers, across the years 2008-2015. The last two columns contain the two statistics used to rank the schools. Minimum probability refers to the percentage of Grade 12 learners (black African or coloured) who were high-level mathematics achievers, with 'minimum' referring to the fact that the worst year in the range 2008 to 2015 was chosen. The average annual increase in the final column is the average annual increase in the number of high-level mathematics achievers (only black African and coloured).

Table 5: List of exceptional contributors to growth in black high-level mathematics achievers

Group	Prov	District	Public or indep-endent	Quin-tile	Ex-depart-ment	EMIS number	School name	Aver-age Gr 12	Aver-age high-level	Mini-mum proba-bility	Annual % increase
Note rankings are based on trends for black African and coloured learners only. These are the two population groups which have historically performed worst in terms of the probability that a learner would become a high-level mathematics performer. The first four of the five groups are based on the quintiles 1 to 4 categories, but with only historically black African ('homeland' or DET) and historically coloured (HOR) schools considered. The fifth group is schools from any *quintile not included in the first four groups. Only the fifth group can contain independent schools.*											
1	LP	GREATER SEKHUKHUNE	P	1	HL	925611042	MOLOKE COMBINED SCHOOL	63	13	14	5
1	GP	TSHWANE WEST	P	1	HL	700910512	HOLY TRINITY SEC SCHOOL	119	10	6	7
1	EC	MALUTI	P	1	HL	200500582	MARIAZELL SENIOR SECONDARY SCHOOL	115	12	4	13
1	LP	GREATER SEKHUKHUNE	P	1	HL	924642589	REBONE SECONDARY	67	9	3	28
1	KN	UGU	P	1	HL	500113257	BUHLEBETHU H	89	12	7	4
1	KN	VRYHEID	P	1	DET	500201946	MATHUNJWA S	121	17	5	8
1	FS	THABO MOFUTSANYANA	P	1	DET	445105203	MMATHABO SS	142	11	3	17
2	LP	CAPRICORN	P	2	HL	923260260	KGAGATLOU SECONDARY	245	26	7	15
2	EC	FORT BEAUFORT	P	2	HL	200200705	SELBORNE COLLEGE BOYS HIGH	48	14	21	3
2	LP	CAPRICORN	P	2	HL	923241412	ST. BEDE SENIOR SECONDARY	109	17	7	8
2	LP	GREATER SEKHUKHUNE	P	2	HL	924641517	MATSHUMANE SECONDARY	126	13	3	20
2	LP	VHEMBE	P	2	DET	930360962	MILTON M.P. FUMEDZENI SECONDARY	127	11	4	10
2	LP	VHEMBE	P	2	HL	930320735	LWAMONDO HIGH	161	16	4	13
2	MP	GERT SIBANDE	P	2	HL	800002766	Dlomodlomo Secondary School	140	9	3	10
3	EC	COFIMVABA	P	3	HL	200600987	ST. JAMES SENIOR SECONDARY SCHOOL	166	46	12	19
3	LP	VHEMBE	P	3	HL	929311434	THENGWE SECONDARY	292	89	21	11
3	FS	THABO MOFUTSANYANA	P	3	DET	445101260	BEACON SS	81	18	9	20
3	KN	UMLAZI	P	3	HL	500305916	ADAMS COLLEGE	150	35	9	20
3	LP	VHEMBE	P	3	HL	911360832	E.P.P. MHINGA SECONDARY	210	33	8	15
3	LP	WATERBERG	P	3	HL	921121327	RAMOGABUDI SECONDARY	66	12	13	7
3	MP	EHLANZENI	P	3	DET	800022509	Suikerland Secondary School	129	19	7	14
4	KN	UMLAZI	P	4	HL	500207681	MENZI H	119	33	21	14
4	LP	VHEMBE	P	4	HL	930350064	THOHOYANDOU SECONDARY	175	32	12	12
4	LP	VHEMBE	P	4	HL	930351395	MBILWI SECONDARY	346	152	34	7
4	EC	MTHATA	P	4	HL	200401288	ST JOHNS COLLEGE	393	76	9	18
4	LP	CAPRICORN	P	4	HL	904221241	PAX HIGH	68	22	20	7
4	LP	GREATER SEKHUKHUNE	P	4	HL	925661658	ST. MARK`S COMPREHENSIVE COLLEGE	90	20	10	13

Group	Prov	District	Public or independent	Quintile	Ex-department	EMIS number	School name	Average Gr 12	Average high-level	Minimum probability	Annual % increase
4	LP	VHEMBE	P	4	HL	930350057	THOHOYANDOU TECHNICAL HIGH	173	38	13	7
5	WC	METRO CENTRAL	I			105007284	STAR INTERNATIONAL HIGH SCHOOL	12	8	53	17
5	GP	TSHWANE SOUTH	I			700230219	CRAWFORD COLLEGE PRETORIA	31	15	31	15
5	WC	METRO CENTRAL	I			105000844	HERSCHEL HS	17	12	50	13
5	WC	METRO SOUTH	P	5	White	105310321	WYNBERG GIRLS` HS.	83	30	27	12
5	WC	METRO EAST	P	5	White	107310218	DE KUILEN HS.	151	31	13	16
5	WC	METRO SOUTH	P	5	White	105310269	NORMAN HENSHILWOOD HS.	131	27	10	23
5	LP	MOPANI	I			995503201	ST GEORGE COLLEGE	63	16	11	18

5 Final national and provincial figures for several subjects

5.1 Mathematics

This final section provides further details for mathematics, as well as details for physical science and a few other subjects. Figure 13 below includes both the 'at face value' trends (also seen in Figure 2 above) and the more meaningful (from a planning perspective) trends derived from adjusted values. Provincial versions of the statistics illustrated in the graphs are provided in Table 6.

Figure 13: Number of mathematics achievers before and after adjustments

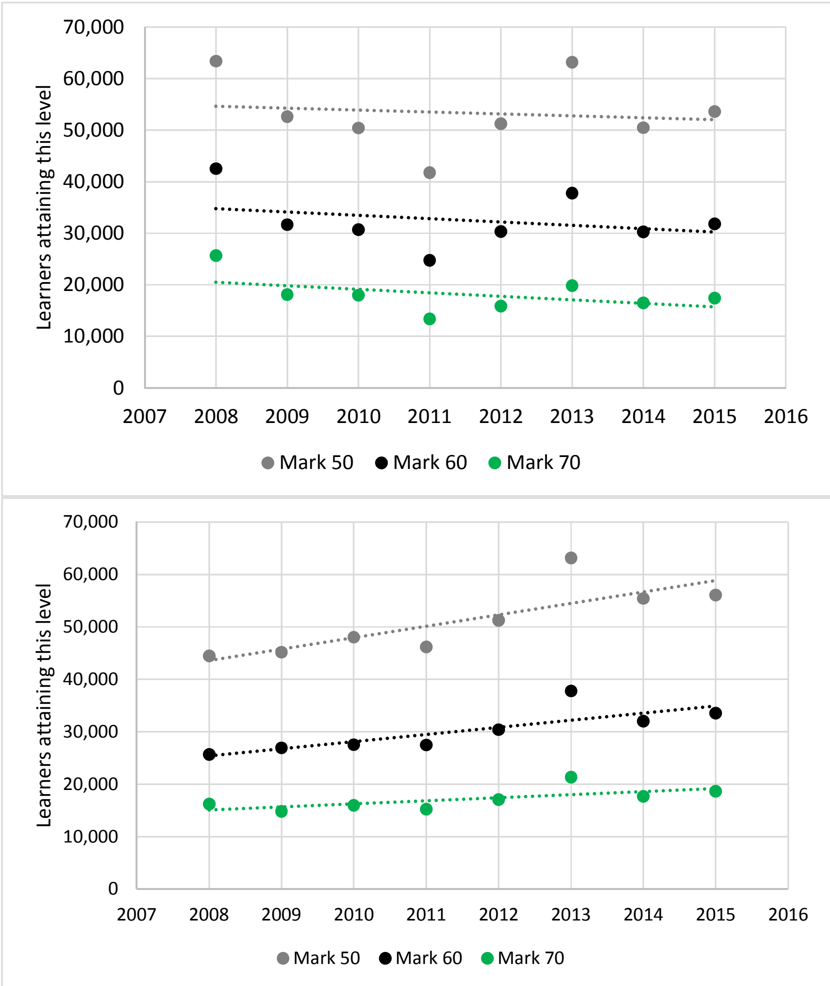


Table 6: Mathematics details

	2008	2009	2010	2011	2012	2013	2014	2015	Avg. annual % change
At face value, before adjustments									
Mark 50									
EC	5,363	4,935	4,469	4,170	4,599	5,626	4,672	5,018	0.0
FS	3,615	2,661	2,110	2,096	2,594	3,148	2,827	3,118	0.4
GP	15,310	12,862	11,958	10,092	12,291	13,882	12,481	12,623	-1.2
KN	15,037	11,814	11,343	8,015	11,165	16,016	10,397	10,188	-2.4
LP	7,298	6,775	6,694	5,451	7,219	8,701	6,886	7,922	2.1
MP	4,230	3,474	3,762	3,518	3,929	4,889	3,751	4,627	2.4
NC	899	607	765	639	661	770	658	732	-1.5
NW	3,604	2,890	2,709	2,058	2,417	3,103	2,369	2,379	-4.3
WC	8,032	6,606	6,600	5,737	6,385	7,018	6,456	6,983	-1.1
SA	63,388	52,624	50,410	41,776	51,260	63,153	50,497	53,590	-0.7
Mark 60									
EC	3,300	2,587	2,468	2,326	2,461	3,077	2,558	2,737	-0.9
FS	2,345	1,538	1,324	1,219	1,557	1,847	1,708	1,791	-0.8
GP	10,951	8,358	7,770	6,292	7,726	8,862	7,893	7,935	-2.7
KN	9,720	6,722	6,631	4,414	6,292	9,320	5,995	5,821	-3.6
LP	4,471	3,643	3,639	2,976	4,005	4,885	3,867	4,400	1.6
MP	2,672	1,994	2,196	1,928	2,184	2,810	2,054	2,677	1.3
NC	602	346	471	374	391	433	373	442	-3.0
NW	2,367	1,720	1,578	1,203	1,388	1,754	1,351	1,266	-6.7
WC	6,111	4,785	4,652	4,033	4,368	4,796	4,515	4,743	-2.5
SA	42,539	31,693	30,729	24,765	30,372	37,784	30,314	31,812	-2.0
Mark 70									
SA	25,665	18,089	17,995	13,393	15,912	19,854	16,495	17,453	-3.8
After adjustments									
Mark 50									
EC	3,483	4,044	4,219	4,695	4,599	5,626	5,186	5,279	5.7
FS	2,463	2,230	2,008	2,343	2,594	3,148	3,122	3,279	6.2
GP	11,382	11,271	11,455	10,932	12,291	13,882	13,521	13,141	3.1
KN	10,174	10,005	10,757	9,040	11,165	16,016	11,542	10,698	3.1
LP	4,758	5,660	6,309	6,148	7,219	8,701	7,694	8,332	7.5
MP	2,804	2,961	3,573	3,942	3,929	4,889	4,161	4,855	7.4
NC	632	515	724	698	661	770	710	763	3.5
NW	2,481	2,497	2,573	2,274	2,417	3,103	2,594	2,521	1.2
WC	6,285	6,001	6,389	6,095	6,385	7,018	6,877	7,219	2.4
SA	44,462	45,184	48,007	46,167	51,260	63,153	55,407	56,087	4.3
Mark 60									
EC	1,796	2,164	2,161	2,601	2,461	3,077	2,737	2,897	6.3
FS	1,401	1,257	1,192	1,363	1,557	1,847	1,805	1,896	6.5
GP	6,905	7,220	7,024	6,940	7,726	8,862	8,295	8,331	3.4
KN	5,756	5,656	5,916	4,975	6,292	9,320	6,333	6,168	3.4
LP	2,364	3,013	3,192	3,358	4,005	4,885	4,088	4,665	8.8
MP	1,450	1,638	1,950	2,163	2,184	2,810	2,190	2,824	8.3
NC	325	295	420	416	391	433	403	466	4.7
NW	1,404	1,437	1,397	1,333	1,388	1,754	1,435	1,360	0.7
WC	4,264	4,254	4,295	4,324	4,368	4,796	4,704	4,958	2.3
SA	25,665	26,934	27,547	27,473	30,372	37,784	31,990	33,565	4.5
Mark 70									
SA	16,231	14,829	15,974	15,236	17,092	21,345	17,673	18,631	3.4

5.2 Details for several key subjects

Table 7 provides details on the school samples selected for subjects other than mathematics (as well as the details for mathematics). The method followed was essentially the same as that for mathematics. Parameters for the five criteria were exactly the same for physical science as for mathematics, except that criteria 1, 4 and 5 now referred to physical science instead of mathematics. However, for all other subjects parameters had to be adjusted somewhat. Specifically, they had to be made slightly more lenient in order to avoid a situation in which an unacceptably low number of schools was selected. The method outlined in this report is primarily designed with mathematics in mind, a subject where one can be fairly certain that learners with exceptional aptitudes in the subject would take the subject, given the high status of the subject. The method also seemed appropriate for physical science. However, many of the other subjects are not high-demand ‘gateway’ subjects, so who takes the subject would work differently compared to mathematics. For this reason the figures for these other subjects should be interpreted carefully. Ideally, methods for gauging trends over years in these subjects should be taken up as a separate project. Applying the methods outlined in the report to gauge trends in mathematical literacy was deliberately avoided as this subject would be particularly poorly suited for these methods.

Table 7: Equivalent marks at mark level 60 for several key subjects

	Schools	Quantile (out of 200)	2008	2009	2010	2011	2012	2013	2014	2015	Δ
Mathematics	32	122	70	63	62	58	60	60	59	59	-1.2
Physical science	34	136	58	50	62	63	65	60	61	60	0.8
Accounting	22	153	61	62	58	59	62	58	59	60	-0.2
Agricultural sciences	9	184	49	55	57	61	58	62	62	63	1.7
Business studies	22	155	58	59	58	62	61	63	58	59	0.2
Economics	9	180	57	61	65	54	63	59	60	56	-0.3
Geography	14	160	59	60	59	60	59	62	60	61	0.3
History	9	136	56	55	61	61	58	60	60	63	0.8
Life sciences	22	124	63	61	63	61	59	60	57	59	-0.7

The equivalent marks, for the 50% and 70% mark levels, for mathematics and physical science are provided below.

Table 8: Equivalent marks at levels 50 and 70 for mathematics and physical science

	Schools	Quantile (out of 200)	2008	2009	2010	2011	2012	2013	2014	2015	Δ
Mathematics 50	32	98	59	53	51	48	50	50	48	49	-1.1
Mathematics 70	32	147	77	73	72	68	69	69	69	69	-1.0
Physical science 50	34	136	50	42	52	51	54	49	51	50	0.5
Physical science 70	34	136	66	58	73	73	74	70	71	70	1.0

5.3 Physical science

Detailed results for physical science are provided in Figure 14 and Table 9 below. What stands out as far as physical science is concerned is that the ‘at face value’ figures point to large improvements in the 2008 to 2015 period, whilst adjusted figures also point to improvements, but less steep ones. The upward trend using the equivalent scores approach and a sample of 34 stable schools (see Table 7) is around half as steep as the corresponding mathematics trends (compare, for instance, the 2.4% annual increase in learners at the ‘60 plus’ level for physical science seen in Table 9 against the corresponding figure of 4.5% seen in Table 6).

Figure 14: Number of physical science achievers before and after adjustments

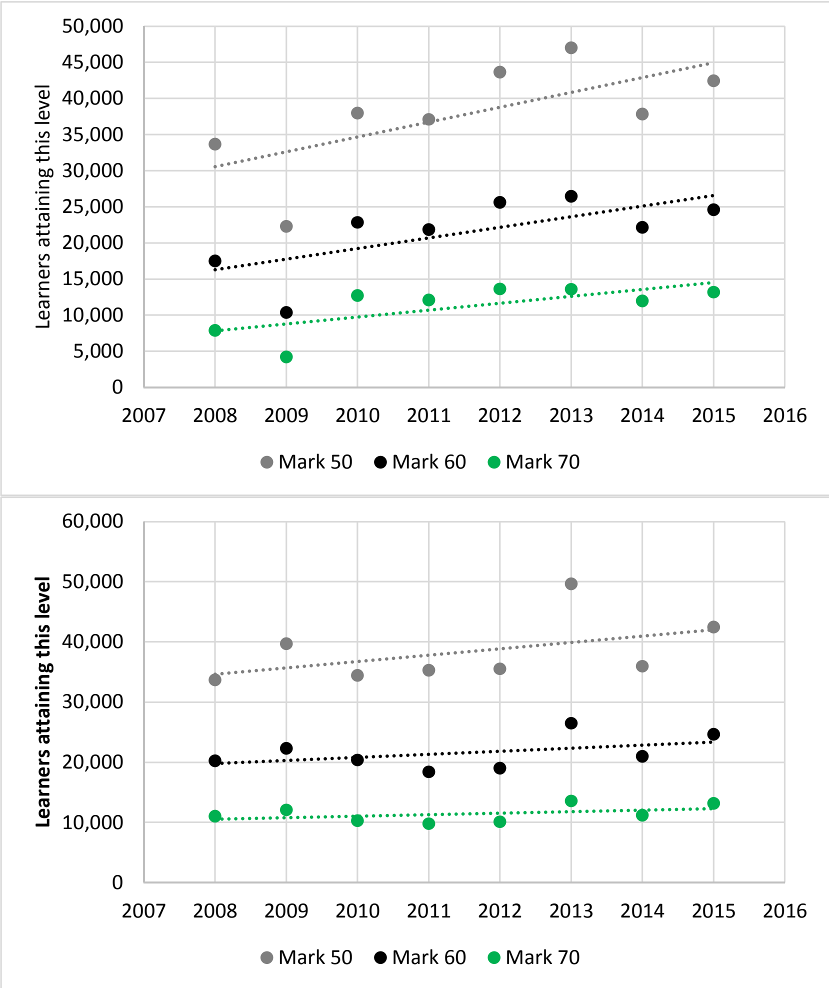


Table 9: Physical science details

	2008	2009	2010	2011	2012	2013	2014	2015	Avg. annual % change
At face value, before adjustments									
Mark 50									
EC	2,569	1,738	3,365	3,761	3,722	3,922	3,164	3,827	6.4
FS	2,062	1,233	1,787	2,057	2,311	2,416	2,194	2,518	5.8
GP	8,804	5,603	8,871	8,343	10,005	10,463	8,883	9,340	3.6
KN	7,159	5,117	8,613	7,873	9,515	12,156	8,174	8,741	5.5
LP	3,816	2,705	5,409	5,203	6,480	6,779	5,977	6,795	9.4
MP	2,285	1,362	2,987	3,442	4,235	3,985	3,080	4,053	9.3
NC	518	282	518	453	527	508	463	538	2.7
NW	2,103	1,260	2,102	1,863	2,183	2,406	1,754	1,808	1.0
WC	4,351	3,013	4,323	4,136	4,670	4,396	4,142	4,841	2.8
SA	33,667	22,313	37,975	37,131	43,648	47,031	37,831	42,461	5.4
Mark 60									
EC	1242	673	1829	1979	1921	1950	1679	2051	7.9
FS	996	587	1052	1212	1381	1304	1269	1417	7.5
GP	4813	2814	5672	5405	6419	6396	5515	5820	5.3
KN	3741	2219	5011	4287	5290	6697	4602	4934	6.8
LP	1589	1036	2922	2691	3424	3468	3249	3522	11.7
MP	1043	539	1716	1906	2392	2129	1697	2292	11.3
NC	250	130	305	269	315	288	236	300	4.0
NW	1064	553	1220	1097	1215	1258	967	949	1.7
WC	2760	1814	3124	3025	3286	2978	2922	3335	3.8
SA	17,498	10,365	22,851	21,871	25,643	26,468	22,136	24,620	6.9
Mark 70									
SA	7,874	4,226	12,719	12,098	13,632	13,589	11,970	13,175	8.5
After adjustments									
Mark 50									
EC	2,569	3,575	2,968	3,532	2,837	4,201	2,990	3,827	3.2
FS	2,062	2,253	1,599	1,964	1,890	2,559	2,088	2,518	2.9
GP	8,804	9,228	8,180	8,020	8,456	10,911	8,496	9,340	1.2
KN	7,159	9,445	7,772	7,405	7,599	12,892	7,758	8,741	2.5
LP	3,816	5,485	4,807	4,908	5,056	7,228	5,634	6,795	6.3
MP	2,285	2,707	2,681	3,266	3,443	4,219	2,922	4,053	6.8
NC	518	477	472	426	434	542	440	538	0.4
NW	2,103	2,299	1,900	1,749	1,731	2,551	1,657	1,808	-2.0
WC	4,351	4,225	4,068	4,023	4,083	4,554	3,995	4,841	1.1
SA	33,667	39,694	34,447	35,293	35,529	49,657	35,980	42,461	2.8
Mark 60									
EC	1486	1738	1588	1617	1348	1950	1592	2051	2.9
FS	1209	1233	949	1007	1000	1304	1194	1417	2.4
GP	5495	5603	5109	4646	4888	6396	5230	5820	1.0
KN	4281	5117	4421	3565	3901	6697	4349	4934	2.0
LP	1941	2705	2545	2177	2414	3468	3058	3522	6.9
MP	1241	1362	1502	1561	1713	2129	1613	2292	7.6
NC	299	282	269	214	241	288	218	300	-1.0
NW	1243	1260	1087	919	857	1258	907	949	-3.8
WC	3061	3013	2897	2706	2658	2978	2818	3335	0.5
SA	20,256	22,313	20,367	18,412	19,020	26,468	20,979	24,620	2.4
Mark 70									
SA	11,011	12,088	10,290	9,824	10,125	13,589	11,214	13,175	2.2

5.4 Results from learners outside the full-time public system

In 2015, around 33,565 full-time mathematics learners performed at the 60% mark level or above, after the adjustments described in this report had been applied (see Table 6). To provide a more complete picture, ideally the following should also be taken into account:

- **Around 134 additional full-time following the supplementary examinations.** 2010 supplementary examinations data were examined as these were easily accessible. These revealed that only 120 learners achieved a mark of 60% or more after the supplementary examinations (with no mark adjustment of the type described in the current report applied). Thus the supplementary examinations raised the number of ‘60 plus’ achievers by just around 0.4% (above the base of 30,729 seen in Table 6). If one applies this 0.4% to 34,000, one obtains 134 additional learners.

- **Around 657 additional part-time learners in the public system.** In 2010, 410 part-time mathematics learners obtained 60% or more (no adjustment applied). There were 82,835 part-time examination candidates in 2010, so 0.5% of these candidates become ‘60 plus’ learners in 2010. In 2015, there were 131,381 part-time candidates. Applying the 0.5% to this number yields 657 learners.

- **Around 2,900 additional IEB learners.** Available details on Independent Examinations Board results suggest that around 2,900 learners obtained a mark of 60% in mathematics in 2014. One can assume the figure would be fairly similar in 2015.

The above three bullets point to an additional 3,691 mathematics learners at the 60% level, meaning the full-time pre-supplementary figure of 33,565 under-states the outcome by 11%. Clearly ‘mopping up’ the figures to include elements of the larger system usually not reported on is important.

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