What a difference a good school makes! Persistence in academic performance and the impact of school quality

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What a difference a good school makes! Persistence in academic performance and the impact of school quality

Marisa von Fintel[1] and Servaas van der Berg[2]

ABSTRACT

In this paper we utilise a unique longitudinal school dataset from the Western Cape province of South Africa. We first explore the degree of persistence in the academic performance of learners over time in order to illustrate the importance of early detection of poor performance within the system. Thereafter, we make use of the longitudinal nature of the dataset in order to estimate the impact of school quality on academic performance following a fixed effects approach. We find that moving from a weaker school to a top performing school (a school within the top 20% of the performance distribution) is associated with an increase of 28% of a standard deviation in performance in mathematics, which translates to almost 1 additional year of education. For language, the impact is smaller at 6% of a standard deviation. However, this grows to 12% of a standard deviation for the sample of black learners, who might benefit the most from moving to a high performing school where the language used for instruction in all other subjects is taught well. These findings have important policy conclusions within the South African context, where school quality is heterogeneous and the weak performance of schools at the bottom of the performance distribution contribute to the perpetuation of poverty over time.

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1. **Introduction and background**

The aim of this paper is to consider the academic performance of learners in the Western Cape province of South Africa, making use of a unique administrative dataset which is longitudinal in nature as it follows learners over time as they move through the school system.

The study is centred around two questions: First, how well do past test scores predict the performance of learners in later grades (i.e. how persistent is performance), and do these results change if one considers additional factors, such as the school quintile[1], school phase, race and geographic location? Second, what is the impact on learners' performance if they attend a high performing (well-functioning) school, compared to a low performing (poorly functioning) school?

Finding answers to these questions is important to policy makers as it may address the issue of early detection of weak performance and focus scarce resources on the areas where they will be most effective.

In addition, the paper adds to the broader body of literature which considers the impact of school quality on the academic performance of learners, and specifically aims at separating the causal impact of school quality from other factors which may have an influence on learners' performance at school, including home background and inherent ability. Other studies within this literature include those estimating the private school effect in India and Pakistan (for example, Muralidharan and Kremer, 2009; Andrabi, Das, Khwaja and Zajonc, 2011; Muralidharan, 2012 and Singh, 2013); the impact of attending an elite public school in Kenya (Lucas and Mbiti, 2014); the effect on the performance of black children attending a formerly white school in South Africa (Shepherd 2013; Coetzee 2014); as well as the impact of attending a charter school in the context of the United States (for example, Hanuschek, Kain, Rivkin and Branch, 2007; Hoxby and Murarka, 2009 and Angrist, Pathak and Walters, 2012).

In the next section, the data used in this study is discussed in more detail. Section 3 considers the persistence of past performance of learners, first as they progress from primary to secondary school and then as they progress through secondary school to the school-leaving (matric) exam in Grade 12. Section 4 presents the evidence regarding the causal impact of school quality on learner performance, and section 5 concludes.

2. **Data**

In order to answer the questions set out above, a unique data set was constructed. This dataset was constructed from three sources.

In the first place, the Centralised Education Management Information System (CEMIS) data from the Western Cape Education Department (WCED), which contains detail on the schools which learners attended in each year, were utilised. CEMIS data make it possible to follow learners as they move through the Western Cape public school system and also as they switch between schools.

Second, the Systemic Evaluation data were used, which contain the test scores from the standardised language and mathematics tests which learners take during the fourth quarter of Grades 3, 6 and 9.

Third, matric data were also used, specifically details from the school which learners matriculated in, as well as their test scores from the Grade 12 school-leaving (matric) exam.

[1] In South Africa schools are categorised into quintiles, which broadly reflect the socio-economic status of the communities that the schools draws its learners from. In the Western Cape, an economically more advanced province, fewer schools are in the lower quintiles.

To answer the research questions, the sample was limited to two separate cohorts, i.e. learners who entered the schooling system in the Western Cape in two separate years. By linking the three datasets, it is possible to observe the cohort who was in Grade 3 in 2008, Grade 6 in 2011 and Grade 9 in 2014, when this cohort wrote the Systemic Evaluation tests. The second cohort observed are the learners who were in Grade 6 in 2007 and Grade 9 in 2010, when they wrote the Systemic Evaluation tests, and in Grade 12 in 2013, when they wrote the National Senior Certificate or matric examination.

Descriptions of the progression of these two cohorts in the data are set out below. Table 1 clearly illustrates the attrition in the first cohort, i.e. the cohort of learners who started Grade 3 in 2008. While approximately 79 000 learners were observed in Grade 3 in 2008, only about 44 000 of these learners are again observed in Grade 9. Dropout is rampant as learners progress from primary school into secondary school (i.e. from Grade 7 to Grade 8) and again when they move from Grade 8 to Grade 9.

Table 1: Progression of Grade 3 cohort of 2008

Year	2007	2008	2009	2010	2011	2012	2013	2014
Gr 3	N/A	**79 158*** **(100%)**	4 527 (6.02%)	171 (0.23%)	21 (0.03%)	4 (0.01%)	1 (0.00%)	0
Gr 4	N/A	0	**70 477** **(93.77%)**	11 594 (15.86%)	956 (1.34%)	79 (0.11%)	13 (0.02%)	3 (0.00%)
Gr 5	N/A	0	130 (0.17%)	**61 188** **(83.68%)**	13 998 (19.67%)	1 608 (2.31%)	139 (0.21%)	21 (0.03%)
Gr 6	N/A	0	25 (0.03%)	142 (0.19%)	**56 043*** **(78.75%)**	15 488 (22.25%)	1 918 (2.95%)	142 (0.23%)
Gr 7	N/A	0	0	22 (0.03%)	127 (0.18%)	**52 305** **(75.14%)**	14 678 (22.59%)	2 399 (3.95%)
Gr 8	N/A	0	1 (0.00%)	2 (0.00%)	21 (0.03%)	108 (0.16%)	**48 141** **(74.08%)**	14 223 (23.40%)
Gr 9	N/A	0	0	1 (0.00%)	2 (0.00%)	18 (0.03%)	93 (0.14%)	**43 985*** **(72.38%)**
Total	N/A	79 158 (100%)	75 160 (100%)	73 120 (100%)	71 168 (100%)	69 610 (100%)	64 983 (100%)	60 773 (100%)
Dropouts	N/A	0	3 998	6 038	7 990	9 548	14 175	18 385
Repeaters	N/A	0	4 527	11 765	14 975	17 179	16 749	2 565

Notes: Number of learners in sample with column percentages. *Test scores available for these years. Note that these are 'uncleaned' data and thus includes some obvious errors in the CEMIS data, such as the 130 learners who were recorded in Grade 8 in 2008 but in Grade 5 in 2009, or the 25 recorded in Grade6 in that year, and even 1 in Grade 8. However, these capturing and verification errors have little effect on the broad picture.

For the second cohort, i.e. the cohort who commenced with Grade 6 in 2007, sample attrition is illustrated in Table 2. What is quite striking from these results is the high repetition rates as these learners near Grade 12. While approximately 77 000 learners is observed in Grade 6 in 2007, the number of these learners in Grade 12 in 2014 shrinks to under 30 000.

Table 2: Progression of Grade 6 cohort of 2007

Year	2007	2008	2009	2010	2011	2012	2013	2014
Gr 6	**77 633** (**100%**)	3 680 (5.00%)	201 (0.31%)	31 (0.05%)	3 (0.01%)	1 (0.00%)	1 (0.00%)	N/A
Gr 7	0	**69 863** (**94.95%**)	5 772 (8.77%)	649 (1.04%)	50 (0.09%)	5 (0.01%)	0	N/A
Gr 8	0	38 (0.05%)	**59 844** (**90.88%**)	8 404 (13.44%)	1 288 (2.24%)	158 (0.31%)	8 (0.02%)	N/A
Gr 9	0	0	30 (0.05%)	**53 437*** (**85.44%**)	14 645 (25.51%)	5 842 (11.32%)	1 435 (3.18%)	N/A
Gr 10	0	0	0	19 (0.03%)	**41 410** (**72.13%**)	12 299 (23.83%)	5 101 (11.31%)	N/A
Gr 11	0	0	0	0	12 (0.02%)	**33 301** (**64.52%**)	9 331 (20.69%)	N/A
Gr 12	0	0	0	0	0	8 (0.02%)	**29 224*** (**64.80%**)	N/A
Total	**77 633** (**100%**)	**73 581** (**100%**)	**65 847** (**100%**)	**62 540** (**100%**)	**57 408** (**100%**)	**51 614** (**100%**)	**45 100** (**100%**)	**N/A**
Dropouts	4 052	7 734	3 307	5 132	5 794	6 514	4 052l	N/A
Repeaters	0	3 680	5 973	9 084	15 986	18 305	15 876	N/A

Notes: Number of learners in sample with column percentages. *Test scores available for these years. Note that, as in the previous table, errors in the data were left uncorrected, but have little effect on the broad picture.

An additional constraint to following the learners over time is that it was not possible to match all of the learners in the Systemic Evaluation data with the learners in the CEMIS dataset. In earlier years of the CEMIS implementation, CEMIS numbers were not standardised to the Systemic Evaluation survey. This means that matching of learners had to take place on the observed characteristics of learners (name and surname, date of birth, gender and race). This makes it more difficult to match learners in the earlier years, i.e. the Grade 3 learners in 2008 (for the first cohort) and the Grade 6 learners in 2007 (for the second cohort). It was possible to match 47 737 learners from the 2008 Grade3 in the Systemic Evaluation data from their records in the CEMIS data., but unfortunately there were still 31 421 learners who could not be matched using this technique and for whom test scores in Grade 3 were thus not available. For the Grade 6 cohort in 2007, it was not possible to conduct a meaningful number of successful matches using this technique. It was therefore decided to leave out the Grade 6 cohort of 2007 from this analysis, and to analyse the performance of this second cohort only when they were in Grade 9 in 2010 and Grade 12 in 2013.

For the later years (2009 – 2014), it was possible to use the standardised CEMIS numbers and to match the various cohorts relatively well, with only a small proportion of learners not matched to their Systemic Evaluation test scores.

The characteristics of the matched and unmatched learners, as well as the sample size of each per grade, are set out in Table 3 below. Observed characteristics of these two types of learners are compared to get a sense of the sub-sample that will be considered in the current analysis (since the analysis will focus only on the sample of matched learners with their test scores). The first two columns of each grade provide information on the average characteristics of the learners in the sample, and the third column of each grade provides information on whether the characteristics of the matched and unmatched groups within each grade are statistically significantly different from each other.

It is clear from the table that the matched and unmatched groups are significantly different within each grade, and most of the characteristics seem to indicate that learners in the unmatched sample are from poorer households and are more likely to attend schools in the bottom 3 quintiles. (Note, though, that there are there are considerably more learners in quintiles 4 and 5 in both groups, due to the fact that the Western Cape have fewer learners from very poor communities than the national average). This could fit in with two possible reasons why it was not possible to match these learners:

- A perfect match for the learners' unique identifying characteristics (name, gender, date of birth) could not be found, most likely because of mistakes made by these learners in the surveys (for example, spelling errors in their name or mistakes in their date of birth). They are therefore expected to be weaker learners who would be from poorer households; and
- A perfect match for the learners could not be found because their unique identifying numbers were entered incorrectly, which could be a reflection of the administrative capacity of the school. Learners who could not be matched are therefore more likely to be attending schools with weaker administration.

These conclusions have implications for the current analysis. Clearly, the learners which could be matched performed better than those who could not be matched. Therefore, any estimates from this study would most likely be over-estimations of the actual situation. In future, as more learners move through the school system in the Western Cape, it would be possible to track more learners and future analyses of this type will therefore suffer less from this bias.

Table 3: Description of the matched and unmatched sample of learners

First cohort									
	Grade 3 (2008)			Grade 6 (2011)			Grade 9 (2014)		
	Sample average (standard error)			Sample average (standard error)			Sample average (standard error)		
	Matched	Unmatched		Matched	Unmatched		Matched	Unmatched	
Proportion female	0.521 (0.002)	0.454 (0.003)	Yes	0.534 (0.002)	0.516 (0.019)	No	0.564 (0.002)	0.523 (0.010)	Yes
Age in years	9.11 (0.003)	9.25 (0.005)	Yes	12.06 (0.003)	12.41 (0.043)	Yes	14.96 (0.003)	15.25 (0.016)	Yes
Proportion speaking isiXhosa as home language	0.173 (0.002)	0.252 (0.002)	Yes	0.160 (0.002)	0.566 (0.019)	Yes	0.147 (0.002)	0.148 (0.007)	No
Proportion receiving child support grants (CSG)	0.308 (0.002)	0.361 (0.003)	Yes	0.292 (0.002)	0.582 (0.019)	Yes	0.233 (0.002)	0.311 (0.009)	Yes
Proportion attending quintile 4 or 5 schools	0.626 (0.002)	0.529 (0.003)	Yes	0.641 (0.002)	0.243 (0.016)	Yes	0.714 (0.002)	0.662 (0.009)	Yes
Number of observations	47 737	31 421		55 341	701		41 277	2 708	

	Second cohort					
	Grade 9 (2010)			Grade 12 (2013)		
	Sample average (standard error)			Sample average (standard error)		
	Matched	Unmatched		Matched	Unmatched	
Proportion female	0.547 (0.002)	0.520 (0.008)	Yes	0.583 (0.003)	0.589 (0.008)	No
Age in years	15.212 (0.003)	15.536 (0.015)	Yes	18.07 (0.003)	18.12 (0.010)	Yes
Proportion speaking isiXhosa as home language	0.151 (0.001)	0.148 (0.006)	No	0.105 (0.002)	0.204 (0.006)	Yes
Proportion receiving CSG	0.202 (0.002)	0.231 (0.007)	Yes	0.123 (0.002)	0.158 (0.006)	Yes
Proportion attending quintile 4 or 5 school	0.694 (0.002)	0.683 (0.008)	No	0.778 (0.003)	0.697 (0.007)	Yes
Number of observations	49 909	3 528		25 026	4 198	

Notes: sample excludes 1 child who was dropped because of mistakes in the date of birth data

3. The persistence of academic performance

This section first considers the persistence of academic performance in earlier grades, namely Grades 3, 6, and 9, for the first cohort. Thereafter, it considers the persistence between academic performance in Grade 9 and Grade 12, which is the final school-leaving exam, for the second cohort.

3.1. Grades 3, 6, and 9

This subsection explores the relationship between the Systemic Evaluation test scores in Grades 3, 6 and 9 and specifically to what extent the test scores in earlier years inform the performance of learners in later grades.

For this purpose, the focus is exclusively on the first cohort defined above, i.e. learners who were in Grade 3 in 2008, in Grade 6 in 2011 and in Grade 9 in 2014. Table 4 below sets out the performance of learners in each of these grades in both the language and mathematics tests. Test scores are expressed as a percentage. It is clear from the table how test scores decreased over grades, especially for the language test. However, this could be due to unintended differences in the difficulty level of the tests, although all the tests are meant to be grade appropriate.

Table 4: Learner performance per grade and subject

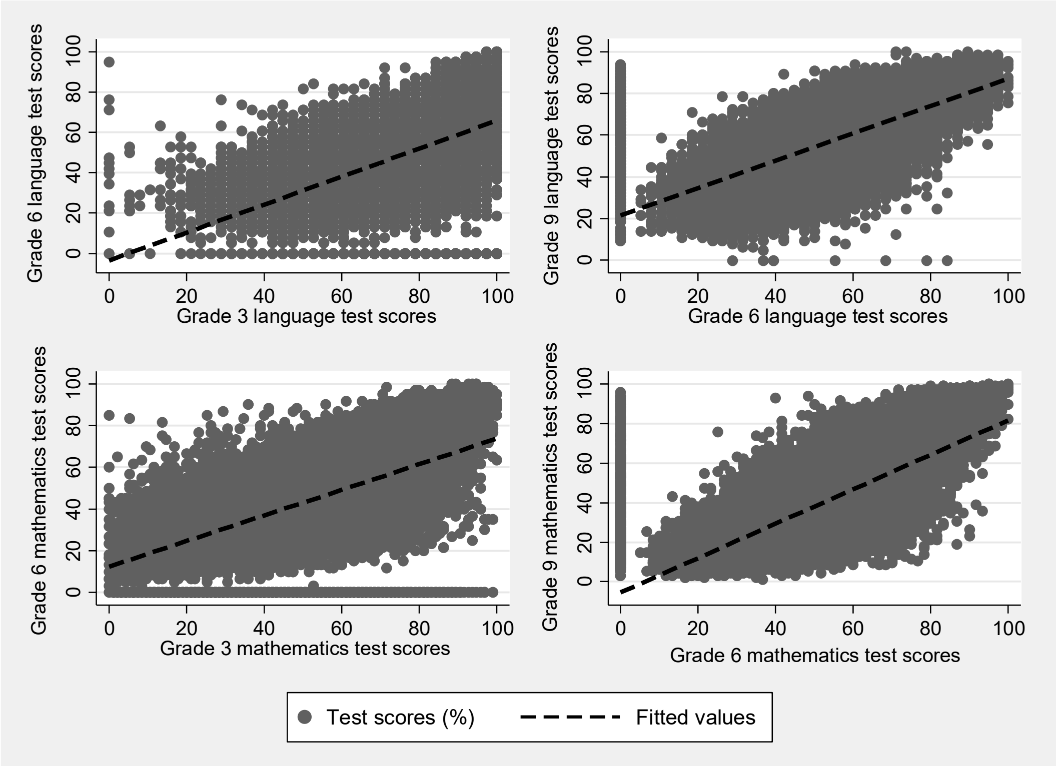
	Grade 3 (2008)	Grade 6 (2010)	Grade 9 (2013)
Average language test scores (standard deviation)	73.47 (19.18)	49.60 (19.18)	56.18 (16.98)
Average mathematics test scores (standard deviation)	44.81 (23.88)	41.93 (19.68)	33.83 (21.37)
Number of learners	47 737	55 341	41 238

Figure 1 below plots the language and mathematics test scores of two grades – on the left the test scores for Grades 3 and 6, and on the right the test scores for Grades 6 and 9. The figure also includes a linear regression line to provide some indication of how predictive the previous grade’s scores are of the subsequent grade’s scores.

The regression line for the mathematics test scores between the two grades is generally steeper than the regression line for the language test scores. This indicates that there is a stronger positive relationship for mathematics test scores between grades than for language test scores, i.e. that language scores are more inclined to deteriorate at higher grades. In addition, the regression line relating the test scores between Grades 3 and 6 is not very steep, implying that in higher grades, learners find the tests and academic material more difficult. The test scores by themselves therefore become more informative of the future performance of these learners (unlike in primary school, where past test scores is a weaker predictor of future test scores.)

It may also be that the inter-grade relationship of test scores is not linear. The assumption of linearity was therefore relaxed and the relationship of test scores between two grades was explored in a non-parametric way, making use of local polynomial smoothing to plot the test scores. This allows the data to speak for itself and to reveal the real shape of the relationship in test scores between grades. The results are set out in the Appendix as Figure 5 and Figure 6.

Figure 1: Grade 3, Grade 6 and Grade 9 performance in language and mathematics



Both these figures confirm that at low levels of performance test scores are not informative at all. This may be because test scores at such a low levels may mostly consist of random guessing and contain a substantial amount of measurement error. For mathematics, past mathematics test scores remain a strong and consistent predictor of future performance in mathematics, although this relationship is stronger between Grade 6 and 9. The persistence of the mathematics test scores over time seem to indicate the usefulness of the mathematics test scores as a measure of ability – learners who performed well in mathematics in the past are likely to perform well in the future.

The language test scores are weaker predictors of future performance, especially in lower grades. However, for later grades language test scores between grades are highly correlated, even at low levels of performance.

In order to explore this relationship further, a multivariate regression analysis is conducted which relates the performance of learners in Grade 9 to their past performance in Grades 3 and 6, while taking into consideration all other factors which might have an influence on their Grade 9 performance. These factors include the available individual learner characteristics (the gender of the learners, whether the learners were over-aged or not, whether the learners received the Child Support Grant and the race of the learners), as well as the quintile and district of the school in which learners are observed.

The result of the multivariate regressions for both mathematics and language are set out in Table *6* below, with the dependent variable performance in Grade 9.

Table 5: Relationship between Grade 3, Grade 6 and Grade 9 language and mathematics test scores (dependent variable is test score in Grade 9)

	Language				Mathematics			
	1	2	3	4	1	2	3	4
Grade 6 language test scores	0.661***	0.449***	0.394***	0.366***				
	(0.004)	(0.005)	(0.005)	(0.005)				
Grade 3 language test scores		0.431***	0.390***	0.353***				
		(0.005)	(0.005)	(0.005)				
Grade 6 maths test scores					0.879***	0.653***	0.569***	0.534***
					(0.004)	(0.006)	(0.006)	(0.006)
Grade 3 maths test scores						0.278***	0.230***	0.217***
						(0.005)	(0.005)	(0.005)
Over-age			-4.107***	-3.762***			-3.021***	-2.878***
			(0.189)	(0.184)			(0.217)	(0.213)
Child support grant			-3.471***	-1.432***			-1.936***	-0.966***
			(0.165)	(0.171)			(0.190)	(0.198)
Female			0.855***	0.931***			0.843***	0.733***
			(0.131)	(0.127)			(0.151)	(0.147)
Coloured			1.005***	0.040			-1.368***	-2.611***
			(0.171)	(0.186)			(0.193)	(0.214)
Indian/Asian			7.349***	4.193***			11.395***	8.549***
			(0.790)	(0.770)			(0.906)	(0.892)
White			5.785***	3.285***			12.360***	8.929***
			(0.263)	(0.288)			(0.301)	(0.334)
Constant	21.474	-1.809***	3.841***	5.462***	-5.898***	-10.145***	-4.102***	-2.080***
	(0.233)	(0.359)	(0.397)	(0.496)	(0.215)	(0.218)	(0.303)	(0.471)
N	26 682	26 682	26 682	26 682	26 689	26 689	26 689	26 689
R-squared	0.489	0.587	0.612	0.637	0.605	0.646	0.686	0.700
School quintile controls	N	N	N	Y	N	N	N	Y
School district controls	N	N	N	Y	N	N	N	Y

Notes: Regression coefficients and standard errors from Ordinary Least Squares regressions. Test scores are in %. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level

We first test the relationship between Grade 6 and 9 test scores, and then add the Grade 3 test scores as an additional control in the regression. For both the language and mathematics regressions, adding the Grade 3 test score as an additional control diminishes the size of the coefficient on the Grade 6 test score variable. The earlier test score from Grade 3 therefore adds additional information about the learner's performance in Grade 9, over and above what could be gleaned from their Grade 6 test score. Test performance seems to therefore be persistent, and test scores from earlier grades - even as far as six years back - are a predictor of future performance. This seems to be more relevant for language than for mathematics, as the Grade 3 test score coefficient is much larger in the language regression than in the mathematics regression.

After taking into consideration the learner-specific characteristics, as well as the school quintile and district, the following relationships between performance in Grade 9 and past performance in Grade 3 and Grade 6 are observed:

- For language, an additional 1 percentage point increase in the Grade 6 language test score is associated with a 0.37 percentage point increase in the Grade 9 language test score.
- For language, an additional 1 percentage point increase in the Grade 3 language test score is associated with a 0.35 percentage point increase in the Grade 9 language test scor.
- For mathematics, an additional 1 percentage point increase in the Grade 6 mathematics test score is associated with a 0.53 percentage point increase in the Grade 9 mathematics test score.
- For mathematics, a 1 percentage point increase in the Grade 3 test score is however only associated with a corresponding 0.22 percentage point increase in the Grade 9 test score.

Therefore, as indicated in the figures discussed above, the mathematics test scores are generally more correlated with the outcome in later grades than the language test scores.

In addition, the results from Table 5 indicate that, as expected, over-aged learners perform much worse than their peers who are either of the correct age for their grade or under-aged. Typically, all things considered, over-aged learners perform on average 3.8 percentage points worse than their peers in the Grade 9 language test and 2.9 percentage points worse than their peers in mathematics in Grade 9. Even after controlling for the quintile of the school the learner is from as well as earlier performance, there is a separate advantage for white and Indian learners in Grade 9 test scores compared to the reference group, black learners. Note also that once these factors are considered, coloured learners are at a disadvantage compared to all other groups in Grade 9 Mathematics performance.

3.2. **Grades 9 and 12**

In this subsection the relationship is explored between the Grade 9 Systemic Evaluation test scores and the Grade 12 matric exam results of the cohort who entered Grade 9 in 2010 and wrote the Grade 12 matric exam in 2013.

Table 6 provides some descriptive statistics of 2013 matric learners who were in Grade 9 three years earlier by matric status.[2] The aggregate Grade 12 mark (expressed as a percentage) as well as the

[2] Note that 24 213 learners who were in Gr 9 in 2010 did not reach matric in 2013. This includes 8 337 who had dropped out of the Western Cape public school system before matric, while the remaining 15 876 still in the schools had to repeat one or more grades and thus did not reach matric by 2013.

average language and mathematics test scores from the Systemic Evaluation tests written in Grade 9 in 2010 are also listed.[3]

The average characteristics set out Table 6 illustrate again how divided the school system is – learners from poor households (who are more likely to be receiving the child support grant and are more likely to be black) are more likely to attend low quintile schools and more likely to not achieve a diploma or bachelor's level pass in matric.

The question is whether these learners who perform poorly could have been identified in Grade 9 already. To get a better sense of the relationship between Grade 9 test scores and Grade 12 test scores, the mathematics and language test scores of these two grades are plotted in Figure 2 and Figure 3. The regression line of a linear regression of Grade 12 aggregate score on Grade 9 scores is also included. There is not as clear a distinction between the slopes of the regression lines as there was when considering the relationship between the Grade 3, 6 and 9 test scores.

[3] It was decided to focus the analysis here on the aggregate matric score rather than on the matric score for mathematics or home language. The reason is that subject choices have an important influence and that this is likely to be endogenous.

Table 6: Average characteristics of learners by matric status (standard deviation in parenthesis)

	Incomplete	Did not achieve	Higher certificate	Diploma	Bachelors pass
			Average score:		
Gr 12 aggregate score (%)	22.45	39.44	43.13	50.22	64.31
	(18.08)	(4.62)	(3.30)	(4.83)	(8.64)
Grade 9 mathematics score (%)	25.25	20.52	20.28	26.88	45.01
	(13.57)	(9.09)	(8.56)	(12.28)	(19.83)
Grade 9 language score (%)	58.99	51.83	52.30	59.24	70.26
	(13.55)	(14.37)	(12.85)	(12.41)	(11.37)
			Learner characteristics (proportion):		
Proportion female	0.650	0.612	0.617	0.551	0.591
	(0.478)	(0.487)	(0.486)	(0.497)	(0.492)
Over-age	0.115	0.194	0.171	0.120	0.075
	(0.319)	(0.395)	(0.376)	(0.325)	(0.264)
Receiving child support grant	0.213	0.205	0.215	0.143	0.076
	(0.410)	(0.404)	(0.411)	(0.351)	(0.265)
Black	0.245	0.309	0.254	0.169	0.121
	(0.431)	(0.462)	(0.435)	(0.375)	(0.326)
Coloured	0.653	0.678	0.731	0.712	0.531
	(0.477)	(0.467)	(0.444)	(0.453)	(0.499)
White	0.102	0.012	0.011	0.112	0.336
	(0.303)	(0.109)	(0.104)	(0.316)	(0.472)
			School quintiles (proportion):		
Quintile 1	0.061	0.065	0.052	0.036	0.019
	(0.239)	(0.247)	(0.223)	(0.187)	(0.137)
Quintile 2	0.099	0.109	0.100	0.053	0.026
	(0.299)	(0.312)	(0.300)	(0.224)	(0.159)
Quintile 3	0.242	0.223	0.270	0.160	0.089
	(0.429)	0.417)	(0.444)	(0.367)	(0.284)
Quintile 4	0.261	0.266	0.276	0.256	0.133
	(0.440)	(0.442)	(0.447)	(0.436)	(0.339)
Quintile 5	0.338	0.336	0.303	0.495	0.733
	(0.474)	(0.473)	(0.460)	(0.500)	(0.442)
			School district (proportion):		
Cape Winelands	0.172	0.171	0.173	0.164	0.173

	Incomplete	Did not achieve	Higher certificate	Diploma	Bachelors pass
	(0.378)	(0.377)	(0.378)	(0.370)	(0.378)
Eden and Central Karoo	0.131	0.094	0.166	0.134	0.111
	(0.337)	(0.293)	(0.372)	(0.341)	(0.314)
Metro Central	0.137	0.153	0.122	0.131	0.145
	(0.334)	(0.360)	(0.327)	(0.338)	(0.352)
Metro East	0.102	0.176	0.153	0.132	0.128
	(0.303)	(0.381)	(0.360)	(0.339)	(0.334)
Metro North	0.156	0.165	0.154	0.190	0.189
	(0.363)	(0.371)	(0.361)	(0.392)	(0.392)
Metro South	0.194	0.180	0.142	0.155	0.162
	(0.396)	(0.384)	(0.349)	(0.362)	(0.368)
Overberg	0.045	0.022	0.045	0.039	0.035
	(0.207)	(0.148)	(0.208)	(0.193)	(0.184)
West Coast	0.064	0.039	0.046	0.055	0.058
	(0.245)	(0.193)	(0.210)	(0.228)	(0.234)
Number of learners	314	2 149	2 296	7 904	12 440

Notes: The table includes descriptive statistics for 25 103 learners who were among the 53 437 learners who were in grade 9 in 2010 and reached matric in 2013. The remaining 24 213 learners had either repeated a grade or dropped out of the Western Cape education system between 2010 and 2013. Although we were able to match 29 224 learners in the 2013 matric cohort, data on matric pass rates were only available for 25 103 of these learners.

Figure 2: Grade 9 language test scores and matric aggregate exam scores (matric 2013 cohort)

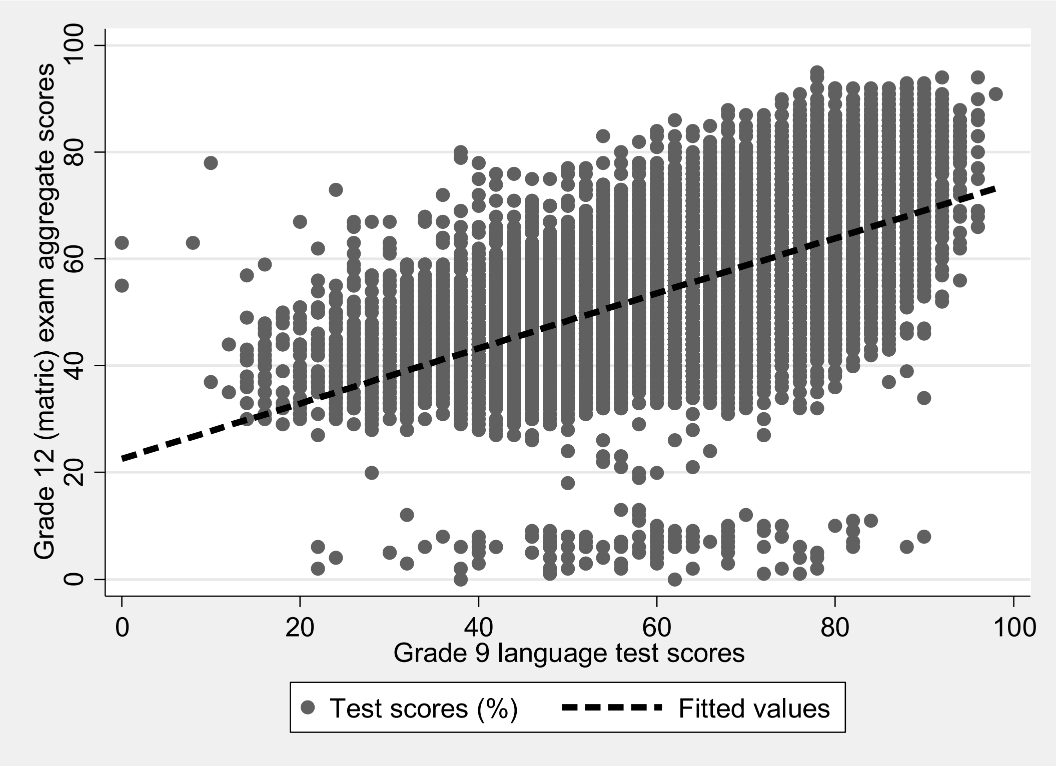
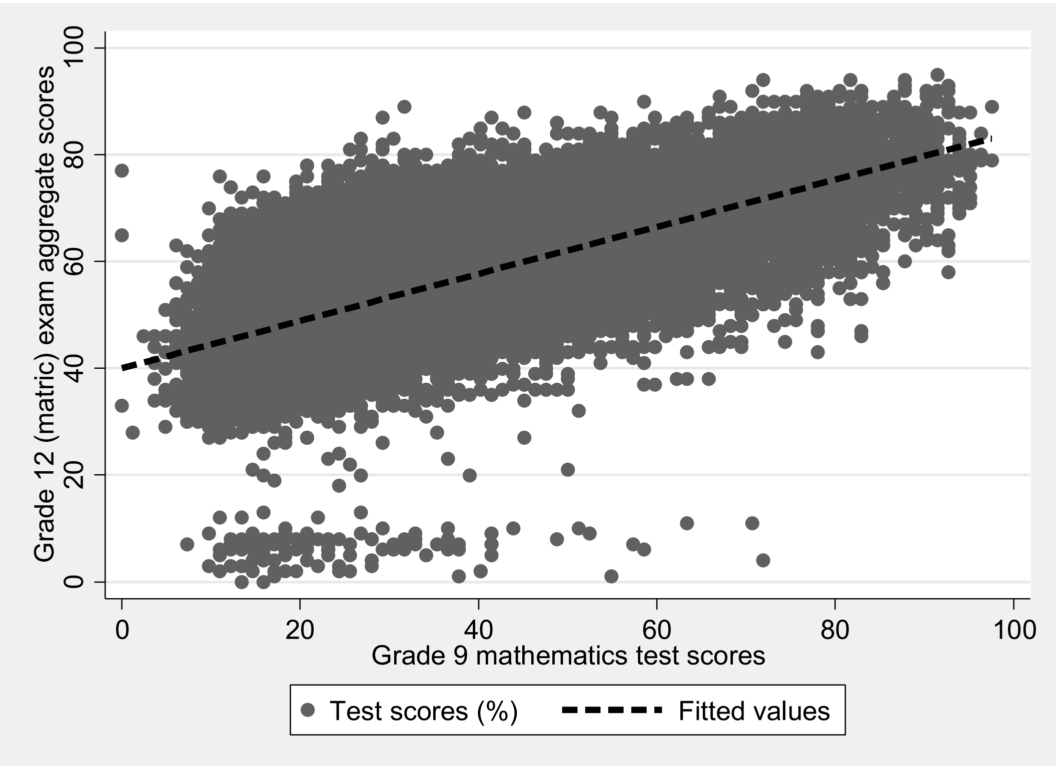


Figure 3: Grade 9 mathematics test scores and matric aggregate exam scores (matric 2013 cohort)



To explore further, the non-parametric relationship between the Grade 9 test scores and matric performance is shown in Figure 7 in the Appendix. While the relationship between the mathematics test scores and the matric aggregate score seems almost linear, the relationship between the language test scores and the matric aggregate score has a clear convex relationship.

This seems to indicate that, *at low levels of performance*, performance in the Grade 9 language test scores does not provide much information about later performance in the matric exam. The same is not true for the mathematics test scores in Grade 9, which remains highly correlated with matric test scores at all performance levels.[4]

However, from approximately a mark of 20%, performing well in the Grade 9 language test has increasing rewards for learners in terms of their matric aggregate score. This may indicate that mathematics performance in Grade 9 should be seen as an indicator of ability. On the other hand, the fact that the relationship between language test scores in Grade 9 and matric performance is convex seems to indicate that there are many advantages to being functionally literate. Since the Grade 9 language test was conducted in either Afrikaans or English, and since these are the languages in which the Grade 12 exams are conducted, it makes sense that learners who did better in the language test in Grade 9 would reap the benefits in their overall matric score.

To further consider this possibility, various multivariate regressions are run on the aggregate matric scores, which are reported in Table 7 below.

The first two regressions only relate the language test scores and mathematics test scores in Grade 9 to the matric aggregate score. Since the relationship seemed to be non-linear, both the level of the Grade 9 score as well as the score squared are included, which allows for a quadratic relationship. In the first two regressions, the coefficients seem to indicate a turning point of Grade 9 test scores to matric aggregate score at approximately 21% for language test scores and 140% for numeracy. In other words, the regressions predict a negative relationship between language test scores in Grade 9 and matric performance up to 20%, after which the relationship becomes positive, and higher Grade 9 language test scores are correlated with a higher matric aggregate. The high turning point for the mathematics test scores merely indicates that the relationship between the Grade 9 mathematics test score and matric aggregate test score is positive for the entire range of test score values (0% to 100%).

Regression 3 in Table 7 compares the importance of mathematics and language test scores in Grade 9 for future performance in matric, and indicates that learners with high mathematics test scores are more likely to perform well in matric than learners with high language test scores in Grade 9. More specifically, a 1 percentage point increase in the Grade 9 math score is associated with a 0.35 percentage point increase in the matric overall results, all other things held constant. Mathematics test scores therefore are a stronger predictor of aggregate matric performance than language test scores.

[4] This is borne out by the large confidence intervals at low levels of performance.

Table 7: Relationship between Grade 9 test scores and Grade 12 matric results

	1	2	3	4	5
Grade 9 lang score	-0.298***		-0.012	0.028	0.033
	(0.028)		(0.025)	(0.025)	(0.025)
Grade 9 lang score squared	0.007***		0.002***	0.002***	0.002***
	(0.000)		(0.000)	(0.000)	(0.000)
Grade 9 maths score		0.577***	0.352***	0.366***	0.366***
		(0.012)	(0.013)	(0.013)	(0.013)
Grade 9 maths score squared		-0.002***	-0.000**	-0.001***	-0.001***
		(0.000)	(0.000)	(0.000)	(0.000)
Over-aged				-1.164***	-1.123***
				(0.169)	(0.169)
Child support grant				0.175	0.017
				(0.164)	(0.168)
Female				1.506***	1.500***
				(0.106)	(0.106)
Coloured				-2.542***	-2.498***
				(0.152)	(0.172)
Indian/Asian				-1.134	-0.851
				(0.569)	(0.573)
White				1.565***	0.835***
				(0.205)	(0.233)
Constant	45.67***	37.81***	35.68***	35.49***	36.28***
	(0.832)	(0.225)	(0.729)	(0.735)	(0.782)
N	24 992	24 992	24 992	24 992	24 992
R-squared	0.391	0.500	0.544	0.562	0.566
School quintile controls	N	N	N	N	Y
School district controls	N	N	N	N	Y

Notes: Regression coefficients and standard errors from Ordinary Least Squares regressions. Test scores are in %. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level

Regressions 4 and 5 again introduce various learner characteristics that could be controlled for, and also introduce school quintile and district controls (not reported). The introduction of these variables does not significantly change the results discussed previously. The additional information it yields though is that performance of coloured learners in matric is lower than expected given their Gr 9 test scores and other variables in the regression. One can think of this as a measure of value added between Gr 9 and matric, indicating that such value added is less for coloured learners than for learners from other population groups.

4. **Estimating the causal impact of school quality**

Measuring the causal impact of school quality on the academic performance of learners is important because such performance is likely to also affect subsequent labour market outcomes. However, separating the impact of school quality from other factors which influence the academic performance of learners is not a simple matter. Learners who perform well in school typically also come from wealthy households, with educated parents. In addition, such learners almost certainly have attributes which are unobserved (and unobservable) in data sets. For example, one would expect more motivated and more ambitious learners to perform better at school, and the same would hold for learners with high inherent ability. However, motivation, ambition and ability are not characteristics captured in typical surveys.

Various previous studies have attempted to estimate the causal impact of school quality on the academic performance of learners in South Africa. Shepherd (2013) used the Progress in International Reading Literacy Study (PIRLS) data from 2006 and decomposed the performance gap between historically white and black schools into differential returns to inputs and school structure. She found that approximately 18.9% of the average performance gap between historically white and historically black schools may be explained by the differential return to inputs. This finding illustrates the importance of school quality (specifically the ability of schools to translate inputs into improved academic outputs) as a driving force behind the academic performance of learners. Coetzee (2014) echoes this finding, and estimates that attending a historically white school adds more than a year's worth of learning to the performance of black learners, using data from the National School Effectiveness Study (NSES). In addition, much has been said about the positive impact which high quality schooling could potentially have on improving the opportunities for learners to escape poverty later in their lives (Van der Berg, et al., 2011).

These studies have shown how learners attending high performing, well-functioning schools, are more likely to score at the top of the distribution in standardised tests. However, since it is uncertain whether it is the unobserved characteristics of learners or the school quality that is driving this result, it has thus far not been possible to draw any ***causal*** conclusions from the results. In other words, it has not been possible to determine how much of the difference in performance between high and low performing schools is driven by the school quality and how much by learner (and household) characteristics.

However, the availability of the CEMIS data makes it possible to disentangle these two effects. This is because, for the first time, it is possible to control for the unobserved leaner- and household-level characteristics, since the same learners are followed over a period of time.

We know from previous research that there is substantial mobility of learners between schools in the Western Cape (Van Wyk et al 2017). Using this fact and identifying learners who switched between schools, in some cases the same learners can be observed as they attend a low performing (and generally poorly functioning) school and then again as they attend a high performing (and generally well-functioning) school. By comparing the average differences in test scores between learners when they attended a high performing and low performing school, an indication of the causal impact of attending a high performing school can be obtained, since all of the other factors which might "contaminate" the results (such as learner ability and motivation) remain constant (since the same learners are compared in different situations).

4.1. Identifying high performing schools and switchers

To measure the impact of attending a high performing school, it is first necessary to identify the high performing schools. High performing schools are here identified by rankings schools according to the average performance of learners in the school, and then selecting the top 20% of primary schools and the top 20% of secondary schools.[5] The rule applied is that if a school was ranked in the top 20% of schools because of either its mathematics or language test scores in the Systemic Evaluation, it should

[5] As there are more primary schools than secondary schools, the primary schools defined as top performing schools amount to slightly more than 20% of the primary school sample.

be included in the sample of top schools. This rule was implemented by first constructing an average test scores for each school at each grade level in which the Systemic Evaluation tests were applied, i.e. grades 3, 6 and 9. Schools were ranked according to the grade-level average test score, one ranking for mathematics and language for each of the grades. Schools were then designated as a “top performing” school if they ranked within the top 20% in any one of the subject-grade rankings. This was done separately for primary schools and secondary schools. If a school is a primary school, it could therefore be labelled a top performing school if it was ranked in the top 20% in any of the four categories of mathematics Grade 3, language Grade 3, mathematics Grade 6, or language Grade 6.

In theory this rule may allow for considerably more than 20% of schools to be included. However, average mathematics and language test scores of schools across grades are very highly correlated and accordingly this procedure leads to approximately 25% of primary schools and 19% of secondary schools to be included (combined schools were treated as secondary schools).

This criterion of identifying high performing schools was used because other, more institutionalised classifications (such as wealth quintile or ex-department) are often a crude method of identifying good schools. This is borne out by the fact that not all of the schools included in the top 20% list are from quintiles 5 and 4, with some primary schools from quintiles 1-3 also meeting this criterion. The number of schools in the top 20% sample per quintile is set out in Table 8, along with an indication of the total number of schools in each quintile, in order to provide some context.

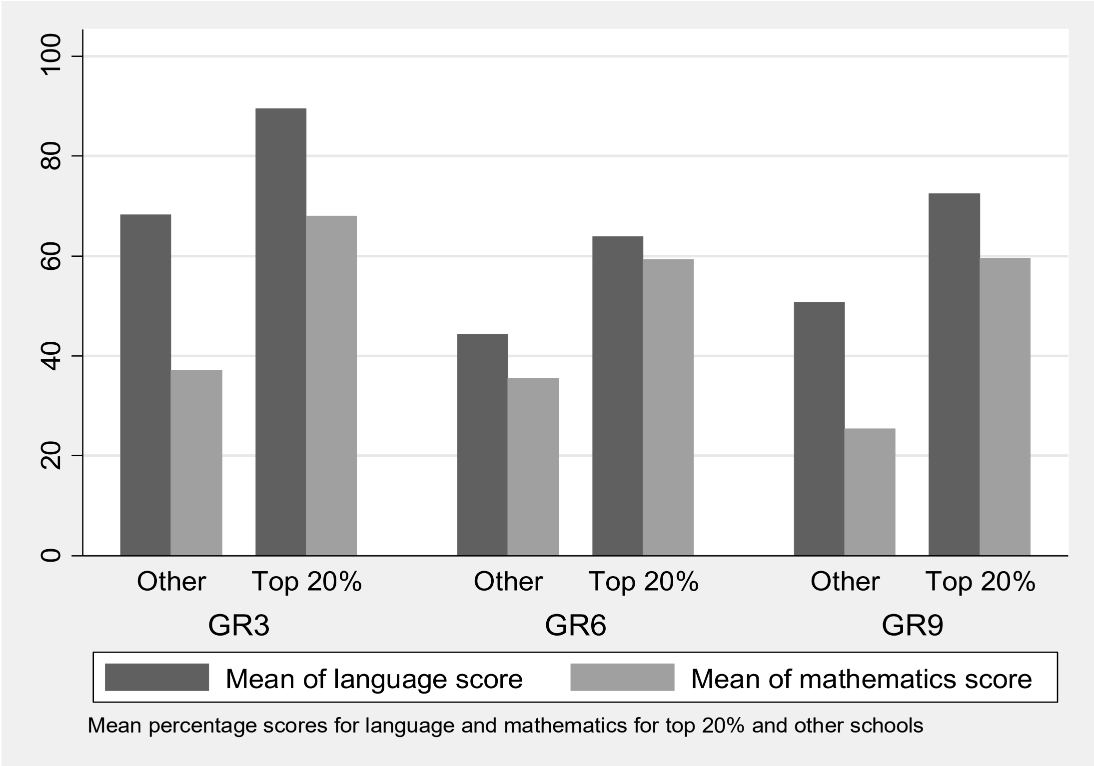
Table 8: Number of top performing schools per quintile (total number of schools in parentheses)

	Number of Primary Schools	**Number of Secondary/Combined Schools**	**Number of Combined Schools**	**Total number of schools***
Quintile 1	30 (289)	0 (20)	0 (18)	30 (327)
Quintile 2	6 (123)	0 (27)	0 (16)	6 (166)
Quintile 3	6 (112)	1 (62)	0 (22)	7 (196)
Quintile 4	27 (229)	0 (81)	2 (22)	29 (332)
Quintile 5	196 (295)	72 (144)	7 (20)	275 (459)
Total	265 (1 048)	73 (334)	9 (98)	347 (1 480)

Notes: * Excludes schools with missing quintile data

Figure 4 illustrates the difference in average test scores for learners attending the top performing schools *versus* those attending the other approximately 80% of schools, per grade.

Figure 4: Performance of learners in systemic tests within top performing and other schools for each grade



Notes: School ranking based on average performance within each school for each year.

As the CEMIS data tracks the same learners within all public schools in the Western Cape, all switches between schools are therefore observed. Table 9 below provides a breakdown of the number and percentage of learners who switched from another school to a top performing school. Since identifying the causal impact of school performing relies on a fixed effects approach (as described below), it is important to measure the performance of these learners to determine the impact that a move to a high performing school had on their subsequent performance. From the table below, it is interesting to observe the large move from low to high performing schools which took place in Grade 8, the year when learners started secondary school. Clearly, this is a period in which many parents want to change the school their children attend so as to increase the children's academic opportunities in the all-important secondary school.

Table 9: Learners switching from other schools to top performing schools per year and grade for the 2008 Grade 3 cohort

Year	2009	2010	2011	2012	2013	2014	Total per grade
Gr 4	1 174 (1.67%)	228 (1.96%)	29 (3.03%)	2 (2.5%)	0	0	1 433 (1.72%)
Gr 5	4 (3.08%)	703 (1.15%)	248 (1.77%)	32 (1.99%)	4 (2.88%)	0	991 (1.29%)
Gr 6	0	0	549 (0.98%)	168 (1.08%)	28 (1.46%)	3 (2.11%)	748 (1.01%)
Gr 7	0	0	0	481 (0.92%)	207 (1.41%)	33 (1.38%)	721 (1.04%)
Gr 8	0	0	0	14 (12.96%)	5 959 (12.38%)	1 446 (10.17%)	7 419 (1.10%)
Gr 9	0	0	0	0	1 (33.33%)	679 (1.54%)	680 (1.54%)
Total per year	1 178 (1.57%)	931 (1.27%)	826 (1.16%)	697 (1.00%)	6 199 (9.54%)	2 161 (3.56%)	11 992 (2.43%)

Notes: Number of switchers to top performing schools with percentage in parentheses. Switchers were counted in the year in which they changed schools. Therefore, since learners are observed from Grade 3, Grade 3 is omitted from the table and treated as a baseline year. Learners who repeated a grade are not included in the analysis.

Table 10: Summary of average characteristic of learners in top performing schools and other schools

	Grade 3 in 2008			**Grade 6 in 2011**			**Grade 9 in 2014**		
	Top schools Average (sd)	Other schools Average (sd)	Significant statistical difference (Yes/No)	Top schools Average (sd)	Other schools Average (sd)	Significant statistical difference (Yes/No)	Top schools Average (sd)	Other schools Average (sd)	Significan t statistical differ-rence (Yes/No)
Average Maths Score	68.01 (17.86)	37.24 (20.47)	Yes	59.28 (19.79)	35.50 (15.25)	Yes	59.55 (20.05)	25.35 (13.60)	Yes
Average Language Score	89.54 (11.25)	68.22 (18.30)	Yes	63.91 (18.96)	44.29 (16.33)	Yes	72.52 (12.12)	50.80 (14.76)	Yes
Proportion over-age	0.169 (0.375)	0.294 (0.455)	Yes	0.133 (0.340)	0.235 (0.424)	Yes	0.097 (0.296)	0.177 (0.382)	Yes
Proportion female	0.500 (0.500)	0.493 (0.500)	No	0.519 (0.500)	0.539 (0.498)	Yes	0.530 (0.499)	0.572 (0.495)	Yes
Proportion Xhosa home language	0.029 (0.169)	0.259 (0.438)	Yes	0.018 (0.133)	0.219 (0.414)	Yes	0.009 (0.096)	0.191 (0.393)	Yes
Proportion receiving CSG	0.088 (0.284)	0.404 (0.491)	Yes	0.068 (0.251)	0.379 (0.485)	Yes	0.029 (0.168)	0.304 (0.460)	Yes
Proportion repeating current year	0.031 (0.031)	0.069 (0.254)	Yes	0.024 (0.152)	0.058 (0.234)	Yes	N/A	N/A	N/A
Number of learners	11 754	35 983		14 974	40 367		10 221	31 017	

Table 10 above contains the average characteristics of learners in the top performing schools and other schools, per grade. Clearly, learners who are in the top performing schools performed much better in school than those learners in other schools, as expected. However, other characteristics are also statistically different between these two groups – those in the other schools are more likely to be receiving the child support grant, speak isiXhosa at home (in the Western Cape, these are both associated with a greater likelihood of household poverty) and to be over-aged learners. All of these differences between these two groups of learners, as well as any unobserved differences, are taken care of in a fixed effects regression, the results from which are discussed in the next sub-section.

4.2. **Estimating the causal impact of school quality**

Finally, regressions are run to estimate the impact of attending a top performing school. In order to execute the strategy described above, a fixed effects regression is used. Essentially, this ensures that the same learners are compared over time, and estimating the average difference in their performance in the language and mathematics tests while attending a top performing or other school.

The results from these regressions are set out in Table 11 below. Columns 2 and 3 refer to the results from the fixed effects regression on the full sample of learners for language and mathematics. These regressions are then repeated on the sample of black learners only. The results from these regressions are set out in columns 4 and 5.

Table 11: The impact of switching to a top performing school for full sample and black sample

	Full sample		**Black learners**	
	Language	**Math**	**Language**	**Math**
Top performing school	0.064***	0.281***	0.123***	0.293***
	(0.008)	(0.008)	(0.020)	(0.019)
Grade 6	-1.440***	-0.425***	-1.597***	-0.583***
	(0.071)	(0.073)	(0.084)	(0.081)
Grade 9	-1.247***	-0.930***	-1.390***	-1.149***
	(0.141)	(0.144)	(0.166)	(0.160)
Age	0.248***	0.169***	0.291***	0.339***
	(0.027)	(0.028)	(0.036)	(0.034)
Age squared	-0.010***	-0.006***	-0.011***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.001)
Child support grant	0.016*	0.033***	0.027	0.028*
	(0.009)	(0.010)	(0.016)	(0.016)
Constant	-0.672***	-0.754***	-1.285***	-2.151***
	(0.228)	(0.232)	(0.288)	(0.278)
Number of learners	67 289	67 289	17 256	17 256
R-squared (overall)	0.242	0.140	0.351	0.116

Notes: Regression coefficients and standard errors from fixed effects regressions. Test scores have been standardised to have a mean of 0 and a standard deviation of 1. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level

Apart from controlling for the grade of the learner and their age, the regressions also control for whether the learner started receiving the child support grant during this period. This is important to control for any changes which might have taken place in the lives of the learners during the period in which they switched schools, since these other changes might also have an impact on their academic performance. If the learner started receiving a child support grant, it might provide some indication of changes in the learner's home circumstances.

It should also be noted that the test scores used in these regressions have been standardised to have an average of 0 and a standard deviation of 1.

From the regression output, it seems that attendance of a top performing school has a positive and significant impact on the performance of learners, both for mathematics and language. However, the coefficient for the regression on the language scores is smaller than on the mathematics test scores. For mathematics, the results seem to indicate that attendance of a top performing school improves the test scores of a learner by approximately 28% of a standard deviation, while the equivalent improvement in language test scores is approximately 6% of a standard deviation.

For the black sample (typically a sample of learners whom would be expected to come from poorer households), the impact of attending a top performing school on mathematics test scores is virtually the same as for the sample as a whole. However, the result for the language test is much larger than for the full sample (though still less than for mathematics) and seems to indicate that, for black learners, moving to a top performing school improves test scores by approximately 12% of a standard deviation. This is double the impact observed in the sample as a whole. This result seems to hint at the fact that home language might have something to do with these results. Since most black learners do not speak Afrikaans or English at home, and since the Systemic Evaluation language tests were conducted in either English or Afrikaans, it might be that learners who have had less exposure to the test language benefit the most when moving to a top performing school where either English or Afrikaans is taught well.[6]

In order to provide some context to the size of these estimates, it is useful to consider previous work on the subject of performance measurement using standard deviations in test scores by Spaull and Kotzè (2015). Using other test score data from longitudinal studies, they argued that 30% of a standard deviation represents approximately one year worth of learning at the Grade 3 level (Spaull & Kotzè, 2015). Using this as a rough indication of the size of the coefficients, it seems like attendance of a top performing school is equivalent to approximately 1 year worth of learning, at least as far as mathematics is concerned.

In order to explore the impact further by sub-group, the regressions are repeated; however, now only moves between Grades 3 and 6 on the one hand, and then moves between Grade 6 and Grade 9 on the other, are considered. The results are presented in Table 12 below.

The mathematics results are again virtually unchanged and appear to be very persistent – being in a top performing school adds approximately 20%-26% of a standard deviation to the mathematics test scores of learners, irrespective of whether they move within primary school (Grade 3 to 6) or between primary and secondary school (Grade 6 to 9). This translates to almost 1 year worth of learning.

The results from the regression on the language test scores, however, seem to be differentiated by school phase. For learners switching in primary school (between Grade 3 and 6), the impact of being in a top school is small, at 5% of a standard deviation. However, for learners switching between primary and secondary school (Grade 6 and 9), the impact of attending a top performing school is much larger, at approximately 18% of a standard deviation. This could be interpreted as being more than half a year's worth of learning.

[6] Since this is a fixed effects regression, it cannot control for home language, since it is largely time invariant and will therefore be partialled out by the inclusion of the fixed effects.

Another interesting result from these regressions is the fact that the child support grant coefficient is positive and significant in most specifications. This suggests that if learners started receiving the child support grant during the period under consideration, it had a positive and significant (albeit small) impact on their test results for both mathematics and language.

Table 12: Estimating impact of switching to a top performing school in primary and secondary school

	Switch between Grade 3 and Grade 6		Switch between Grade 6 and Grade 9	
	Language	Mathematics	Language	Mathematics
Top performing school	0.182***	0.203***	0.049**	0.260***
	(0.063)	(0.061)	(0.02)	(0.019)
Grade 3	1.465***	0.716***		
	(0.117)	(0.112)		
Grade 9			0.131	-0.741***
			(0.164)	(0.150)
Age	0.178***	0.471***	0.425***	0.262***
	(0.058)	(0.056)	(0.064)	(0.059)
Age squared	-0.008***	-0.016***	-0.015***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
Child support grant	0.019	0.055	0.036**	0.038**
	(0.051)	(0.049)	(0.017)	(0.016)
Constant	-2.037***	-3.789***	-3.833***	-2.471***
	(0.556)	(0.536)	(0.703)	(0.642)
Number of learners	16 946	16 946	13 383	13 383
R-squared (overall)	0.413	0.013	0.033	0.090

Notes: Regression coefficients and standard errors from fixed effects regressions. Test scores have been standardised to have a mean of 0 and a standard deviation of 1. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level

These results provide evidence of the impact of school quality on the academic performance of learners which may be interpreted as causal, something which has not been possible prior to the existence of the CEMIS longitudinal dataset.

4.3. Impact of the length of attending high performing school after switching

Another interesting related question is the impact of the "intensity" of exposure to a high performing school, in other words, does the timing of the switch from a lower performing to high performing school matter? One would expect that learners who switched gained more than learners who only switched in later grades.

In order to explore this question, we consider children who switched during primary school and children who switched during secondary school (or, more accurately, who switched between grades 7 and 9) separately. We estimate the impact of the length of attendance of a high performing school by running ordinary least squares (OLS) regressions on first the grade 6 test marks for both the language and mathematics test and then again for the grade 9 test marks. We are unable in these regressions to include individual learner fixed effects since it would not make sense to estimate the impact of the length of attendance using variation in the length of attendance per individual learner.

We therefore include a host of control variables in order to try and control for any unobserved differences between children who never switch schools, learners who switch earlier and those who switch later. These control variables include individual learner characteristics (age, gender, and race), school characteristics (quintile of current school which the learner attends) and household characteristics (whether the learner receives a Child Support Grant). We also control for whether learners switched school more than once during this period (only approximately 2% of the learners in the sample actually switch schools more than once).)

The output from these regressions is reported in the table below. From all four estimations it is clear that the length of the time after the switch makes a difference to the performance of learners. Typically, learners who switched to a high performing school earlier in their schooling benefit from higher marks in comparison to their peers who switched later. Specifically:

- Switching to a top performing school at the beginning of grade 6 (1 year before writing the grade 6 test), has no statistically significant impact on the performance of learners, either for mathematics of language.
- Learners who switched to a top performing school at the beginning of grade 5 (two years before writing the grade 6 test) on average perform approximately 10-11% of a standard deviation better than their peers who remained in one pf the other 80% of schools in both mathematics and language. These results are statistically significantly different from the results for switching at the beginning of grade 6.
- Learners who switched to a top performing school at the beginning of grade 4 (three years before writing the grade 6 test) perform on average 12% of a standard deviation better in the language test and approximately 14% better in the mathematics test. These results are, however, not significantly different from the results for learners who switched at the beginning of grade 5.
- Switching at the beginning of grade 9, learners perform on average 15-16% of a standard deviation better than their peers who remain in other weaker performing schools. These results are statistically significant.
- On average, learners who switch between primary and secondary school (at the beginning of grade 8) perform 28% of a standard deviation for language and 54% of a standard deviation for mathematics better than their peers remaining in a weaker performing school. This result is statistically significantly different from that of learners who only switched at the beginning of grade 9.

Table 13: Estimating impact of duration after switching to a top performing school in primary and secondary school

	Switch between Grade 3 and Grade 6		Switch between Grade 7 and Grade 9	
	Language test score grade 6	Mathematics test score grade 6	Language test score grade 9	Mathematics test score grade 9
Switched to top performing school:				
1 year ago	-0.042	-0.008	0.157***	0.152***
	(0.058)	(0.055)	(0.024)	(0.028)
2 years ago	0.096*	0.117**	0.281***	0.541***
	(0.054)	(0.051)	(0.018)	(0.021)
3 years ago	0.118***	0.135***		
	(0.045)	(0.043)		
Age	0.408***	0.202***	1.715***	1.625***
	(0.061)	(0.058)	(0.119)	(0.138)
Age squared	-0.023***	-0.015***	-0.061***	-0.057***
	(0.002)	(0.002)	(0.003)	(0.005)
Child support grant	-0.162***	-0.178***	-0.157***	-0.147***
	(0.009)	(0.008)	(0.009)	(0.011)
Female child	0.150***	-0.041***	0.109***	-0.052***
	(0.007)	(0.007)	(0.007)	(0.008)
Coloured	0.200***	0.002	0.168***	-0.053***
	(0.009)	(0.009)	(0.009)	(0.011)
Indian/Asian	0.798***	0.685***	0.783***	1.021***
	(0.043)	(0.040)	(0.041)	(0.048)
White	0.881***	0.821***	0.691***	1.151***
	(0.015)	(0.014)	(0.013)	(0.015)
Switched school twice	0.016	-0.058**	-0.072**	-0.124***
	(0.029)	(0.027)	(0.029)	(0.034)
Current school quintile:				
2	0.060***	0.078***	-0.078***	-0.057***
	(0.016)	(0.015)	(0.018)	(0.021)
3	0.086***	0.052***	0.036**	0.073***
	(0.016)	(0.015)	(0.016)	(0.019)
4	0.197***	0.281***	0.149***	0.082***
	(0.014)	(0.013)	(0.017)	(0.019)
5	0.563***	0.688***	0.637***	0.654***
	(0.014)	(0.014)	(0.016)	(0.019)
Constant	-2.6245***	-0.604*	-12.735***	-12.187***
	(0.380)	(0.361)	(0.907)	(1.047)
Number of learners	48 875	48 875	36 459	36 459
Adjusted R-squared	0.286	0.341	0.385	0.449

Notes: Regression coefficients and standard errors from OLS regressions. Test scores have been standardised to have a mean of 0 and a standard deviation of 1. * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level

There appears to be significant benefits to switching to a high performing school earlier rather than later, for both learners who switch during primary as well as secondary school. The value added by attending a high performing school therefore seems to accumulate over time.

5. **Conclusions**

In this paper, we considered the persistence in academic performance of learners in the Western Cape, by specifically looking at the relationship between the Grade 3, 6 and 9 Systemic Evaluation test scores in both mathematics and language, as well as the relationship between the Grade 9 Systemic Evaluation test scores and matric performance. The paper also considered the impact of school quality on the performance of learners in the Western Cape.

It was found that earlier grade test scores are a good measure of whether a learner will perform well in the Systemic Evaluation tests in later grades. Specifically, the mathematics test scores from the Systemic Evaluation tests are persistently good indicators of performance in later grade tests. Mathematics test scores seem to be acting as a proxy for natural ability. Looking at the different grades, it was found that the test scores from Grade 3 and 6 were not as highly correlated as the test scores from Grade 6 and Grade 9. This makes sense as one would expect past test scores to be better predictors of current test scores as the difficulty level of the test increases.

When considering the role of Grade 9 test scores in explaining the matric outcomes of learners in the Western Cape, it was found that Grade 9 mathematics test scores were again a better indicator of the performance of learners in matric than language test scores in Grade 9. However, a convex relationship was found between Grade 9 language test scores and matric aggregate performance. Gains (in terms of matric performance) for learners with a high language test score in Grade 9 are much larger than for those learners at the bottom of the distribution. This could perhaps be explained by the fact that language ability assists learners in overall matric performance.

It was also found that, after taking into consideration unobserved time invariant characteristics, as well as controlling for various other differences in learners which may vary over time, the impact of attending a top performing school for learners between Grade 3, 6 and 9, is approximately a year's worth of learning, based on mathematics test scores. Although the impact of attending a top school in terms of gains in language test scores was much smaller, it was differentiated across different sub-groups: for black learners, and learners who switch to a top performing school when moving to secondary school, the gain in language test scores for attending a top performing school is somewhat less than a year's worth of learning. These results seem to indicate that the gain in language test scores is at its biggest for learners who are less exposed to English or Afrikaans at home, and who move from a school where the instruction of English or Afrikaans was not of a high quality.

Last, it was found that the timing of a switch to a high performing school makes a significant difference to the performance of learners. Learners who switched to a high performing school from a low performing school in earlier grades perform better than their peers who switched at a later stage.

In highlighting the persistence between academic performance in earlier and later grades, this paper emphasises the importance of an effective early-warning system to identify and support weak learners. In addition, it accentuates the impact of school quality on the academic performance of learners.

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Appendix B: Additional figures and regression tables

Figure 5: Non-parametric relationship between grades for language and mathematics test scores

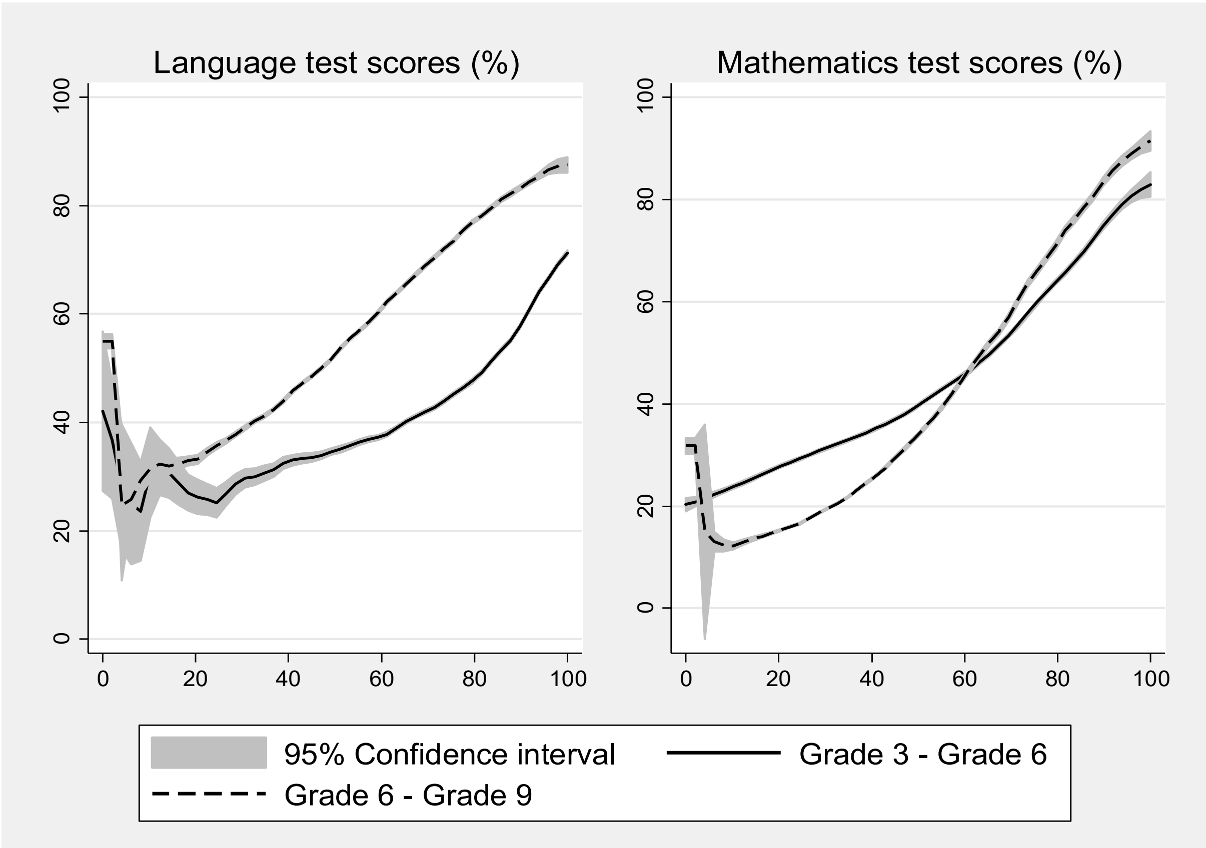

Figure 6: Non-parametric relationship between Grade 3, Grade 6 and Grade 9 test scores

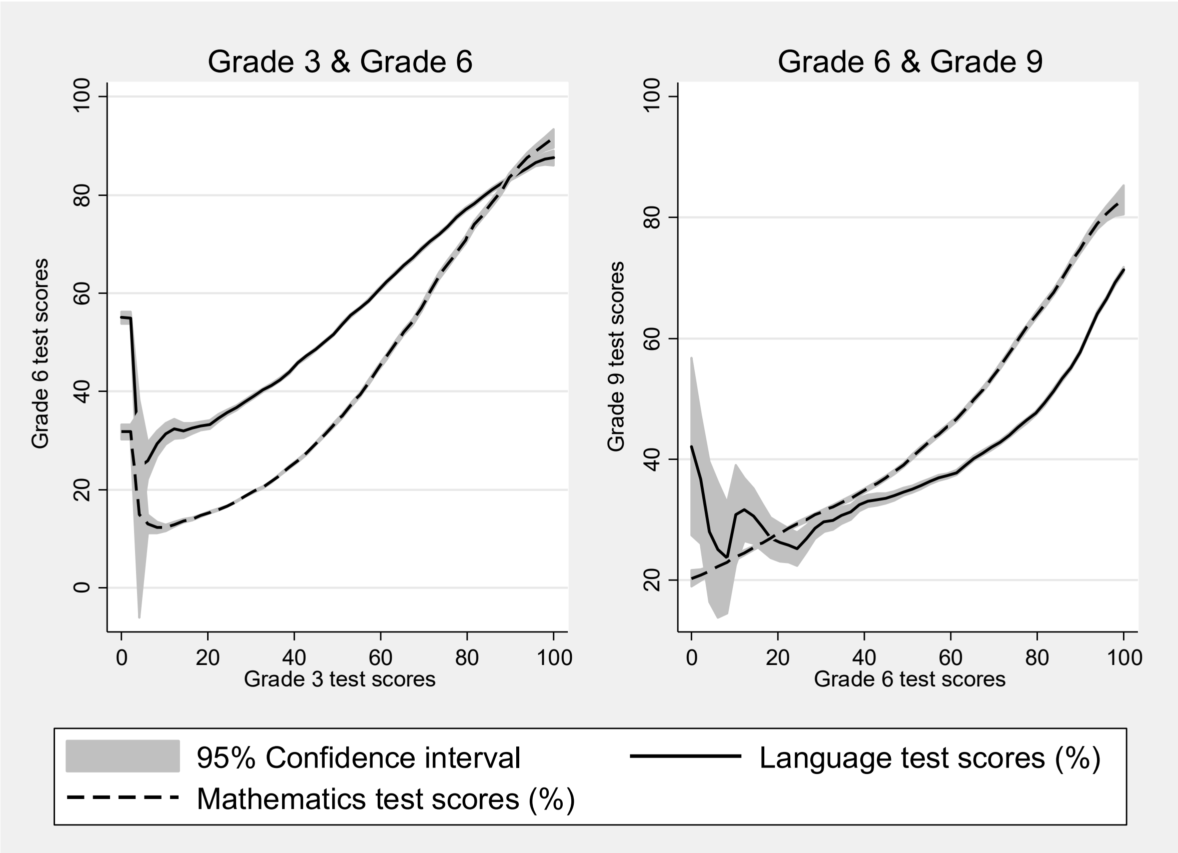

Figure 7: Non-parametric relationship between Grade 9 test scores and Grade 12 exam scores