TECHNICAL REPORT

TEACHER SUPPLY AND DEMAND IN SOUTH AFRICA: 2013 to 2025

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March 2015

TABLE OF CONTENTS

LIST OF TABLES

MAIN REPORT

APPENDIX 2

APPENDIX 3

APPENDIX 4

APPENDIX 5

LIST OF FIGURES

MAIN REPORT

APPENDIX 3

1 INTRODUCTION

For some time there has been anxiety about whether recruitment into initial teacher education is sufficient to meet the requirements of South Africa's schools. As Table 1 indicates, graduates from initial teacher education nearly doubled between 2009 and 2013, but they may well need to increase further.

Table 1: Graduates from initial teacher education, 2009 - 2012

Year	Enrolments			Graduates			Employed educators	Graduates as per cent of educators
	B Ed	PGCE	Total	B Ed	PGCE	Total		
2009				4 446	2 532	6 978	413 067	1.69%
2010	52 063	7 371	59 434	4 917	3 056	7 973	418 109	1.91%
2011	68 190	11 254	79 444	6 178	4 415	10 593	420 608	2.52%
2012	81 905	12 332	94 237	8 003	5 705	13 708	425 167	3.22%
Sources:	Education Statistics in South Africa							
	Trends in Teacher Education In Ordinary Schools							
	Education Statistics, 2009-2012							

This paper sets out the processes and procedures followed to model the demand for teachers, supply of teachers to the system, and the match between the supply and demand over the next 10 years.

2 PROJECTING TEACHER DEMAND

The mathematical basis for the projection is set out in Appendix 1.

To construct this new CDE model, a number of datasets were used:

- The population statistics from the Spectrum database used by Statistics South Africa to project the growth in the learner population over the next 10 years;
- The General Household Survey (2013) to investigate Grade R enrolments.
- The supply of teachers to the system from audited figures in DHET internal reports, *Trends in Teacher Supply*, for four consecutive years, 2009 to 2012;
- The number of teachers in the system for five consecutive years, 2009 to 2012, obtained from the DBE's *Education Statistics* and *School Realities*; and
- The movement of teachers in the system from two sources of teacher information: PERSAL (the government's personnel salary database) based on a secondary analysis of two internal DBE reports[1], and two consecutive years (2012 and 2013) of the DBE's Annual Schools Survey (ASS) data. The ASS data contain information on educators by characteristics relevant to the analysis, notably gender, age, citizenship, qualification level, years of experience, identity of employer (whether government or a school governing board).

In the case of the PERSAL and the ASS databases used, which is more reliable?

On the one hand, PERSAL should be complete, but the Department of Basic Education acknowledges that it is not reliable. At the time of this study the PERSAL database was not made available to the researcher on grounds of confidentiality. Consequently, this study has had to draw inferences from Gustafsson's work which had a slightly different focus from this study. Moreover, there is no systematic age structure in Gustafsson's reports. On the other, although ASS data have an age structure, they are not complete either. Both data sets are considered in this report, with an appendix devoted to each.

Coverage in this study is limited to public and independent ordinary schools.

The estimation issues follow:

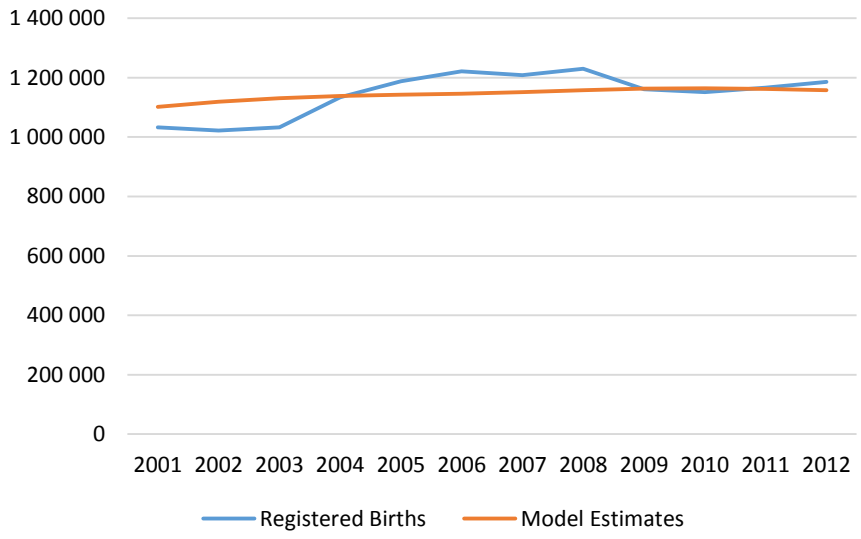
2.1 Demography

Entry into Grade 1 is determined by:

- births some years earlier (ideally one needs an age breakdown of new Grade1 enrolments)
- mortality between birth and first enrolment
- the proportion of each age cohort entering school

The first issue is that of births. Birth registration statistics are kept and they are ultimately reasonably complete. But late registrations of births are frequent and so the number of births occurring in 2012 are considerably higher than the number of births occurring and recorded in 2012. By looking at the pattern for earlier years, adjustments can be made for each successive year, which project late registration in years to come. The birth registration data in Figure 1 is estimated on that basis. One may also look at births estimated by the most up to date demographic model (Spectrum 5) used by Statistics South Africa. These estimates are represented by Model estimates in Figure 1.

Figure 1: Births over period 2001 - 2012



The model estimates are smooth, since they are based on an assumption of smoothly declining fertility (the number of births continues to rise because the population of mothers is rising faster than fertility falls). The estimates based on birth registrations show something of a bust in births between 2001 and 2003 and a boom in births between 2005 and 2008. Which is the more reliable?

Table 2 sets out enrolments in Grades 1 to 4 between 2008 and 2013. Total enrolments dropped between 2008 and 2010 and then rose again. This may have been due to a dip in fertility in 2002 and 2003, followed by a rise in the succeeding years. But the evidence is not conclusive. Mortality rates may have changed as well, and so may have promotion and repetition rates. What Table 2 does show is that there can be substantial variation around the trend in learner numbers, which from the point of view of projections amounts to noise which cannot be predicted.

Table 2: Enrolments by grade, 2008 – 2013

Grade	2008	2009	2010	2011	2012	2013
1	1122114	1106827	1116899	1177009	1208973	1222851
2	1031821	1004311	994101	1003353	1074788	1116427
3	1017656	1004585	972668	957289	967373	1025185
4	1050880	1019886	1002645	974860	966349	964630
Total	**4222471**	**4135609**	**4086313**	**4112511**	**4217483**	**4329093**
Increase		-2.06%	-1.19%	0.64%	2.55%	2.65%

Sources: *Education Statistics* in South Africa (2008-2012) and *School Realities* (2013)

2.2 Progress through school and leavers

For every learner in one year, there are three possibilities for the next:

- the learner has been promoted to the next grade
- the learner is repeating the same grade
- the learner has left school

In aggregate, this translates into a promotion rate, a repetition rate and a dropout rate which must sum to one for each grade. The Department of Basic Education admitted to the Basic Education Portfolio Committee in parliament in 2011 that it has been unable to calculate the dropout rate and referred to data from the National Income Dynamics Survey for 2007/2008. This is the only dropout data we have and it will be used throughout the projection. The DBE does not provide promotion and repetition rates, but these can be estimated indirectly from enrolment data in successive years by fitting a projection as closely as possible to actual enrolment data. The results of this exercise are presented in Table 3.

Table 3: Estimated promotion, repetition and dropout rates

Grade	Average of 2009 and 2010			Average of 2011 and 2012		
	Promotion	Repetition	Drop out	Promotion	Repetition	Drop out
1	0.900	0.090	0.010	0.895	0.095	0.010
2	0.985	0.010	0.005	0.995	0.000	0.005
3	0.985	0.003	0.012	0.985	0.003	0.012
4	0.970	0.027	0.003	0.995	0.002	0.003
5	0.970	0.010	0.020	0.980	0.000	0.020
6	0.965	0.020	0.015	0.985	0.000	0.015
7	0.940	0.033	0.027	0.970	0.003	0.027
8	0.860	0.102	0.038	0.925	0.037	0.038
9	0.765	0.170	0.065	0.770	0.165	0.065
10	0.610	0.275	0.115	0.625	0.260	0.115
11	0.655	0.227	0.118	0.675	0.207	0.118

The estimates are coherent with promotion rates static or rising a little, apart from a small drop in Grade 1. First time arrivals in Grade 1 are proportional to births seven years earlier.

In the projections of enrolment to 2025:

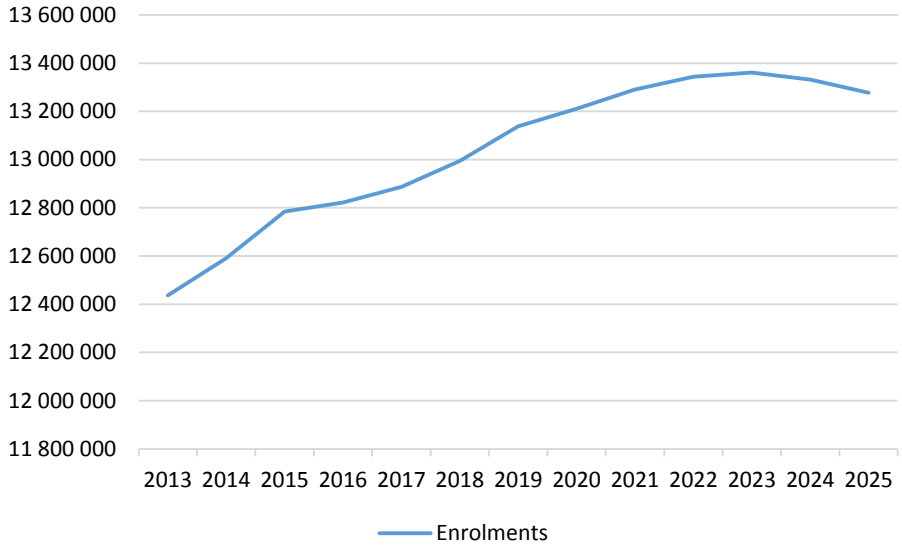
- Registered birth rates seven years earlier will be used to project new arrivals in Grade 1 where these are available. Thereafter model estimates of births are used.
- The 2011/12 promotion, repetition and dropout rates are used throughout to calculate enrolments
- Grade R enrolments have averaged 63.2 per cent of Grade 1 between 2010 and 2013, without a trend. Grade R enrolments are projected at 64 per cent of Grade 1 enrolments throughout.

Figure 4 presents the projections at three year intervals and Figure 2 graphs aggregate enrolments by year.

Table 4: Projected enrolments in three year intervals

Grade	2013	2016	2019	2022	2025
R	779370	784117	795278	761663	747984
1	1222851	1225182	1242622	1190098	1168726
2	1116427	1153622	1094390	1071802	1052355
3	1025185	1128678	1081391	1077913	1056539
4	964630	1078135	1080364	1095370	1049187
5	923562	1093739	1130518	1072525	1050480
6	909095	986544	1086168	1040754	1037443
7	902099	929184	1038696	1040944	1055189
8	942345	900863	1063204	1101616	1045584
9	1073060	1004445	1076237	1189959	1151981
10	1146285	1067502	1063891	1200544	1229217
11	834611	870898	823798	917094	983641
12	597196	598485	561728	582970	649526
Total	**12 436 716**	**12 821 396**	**13 138 285**	**13 343 252**	**13 277 853**

Figure 2: Projected R-12 Enrolments, 2013-2025



2.3 The learner-educator ratio and its determinants

One can calculate learner-educator ratios (LERs) for the following categories of school:

- Primary schools (Grades 1- 7)
- Secondary schools (Grades 8 - 12)
- Combined schools (any number of primary school grades and secondary school grades up to grades 9, 10, 11 or 12)
- Intermediate schools (Grades 7-9)

This is an untidy categorization since combined and intermediate schools include both primary and secondary school grades. In order to simplify the calculation of the LER, the assumption made is that the LERs in the system as a whole are those for primary and secondary schools categorized as such, multiplied by a constant factor which reproduces the total number of educators in all four categories. Table 5 sets out the ratios for 2009 to 2012.

Table 5: Learner-educator ratios

	2009	**2010**	**2011**	**2012**
Primary	31.4	31.2	31.0	31.1
Secondary	26.5	26.2	26.3	26.2
All	29.6	29.3	29.2	29.2

There is no clear trend in the data so the average LERs are used in the projections: 31.2 for primary and 26.3 for secondary.

The projected educator requirement can be calculated for:

- Lower primary (Grades R to 3)
- Higher primary (Grades 4 to7)
- Secondary (Grades 8 to12)

It should be noted that these categories do not correspond exactly to the curriculum phases identified by the Department of Basic Education, which are:

- Foundation phase (Grades R to 3)
- Intermediate phase (Grades 4 to 6)
- Senior phase (Grades 7 to 9)
- FET phase (Grades 10 to 12)

The phases will be considered later in this report because they are relevant to Initial Teacher Education qualifications.

2.4 Educator requirement

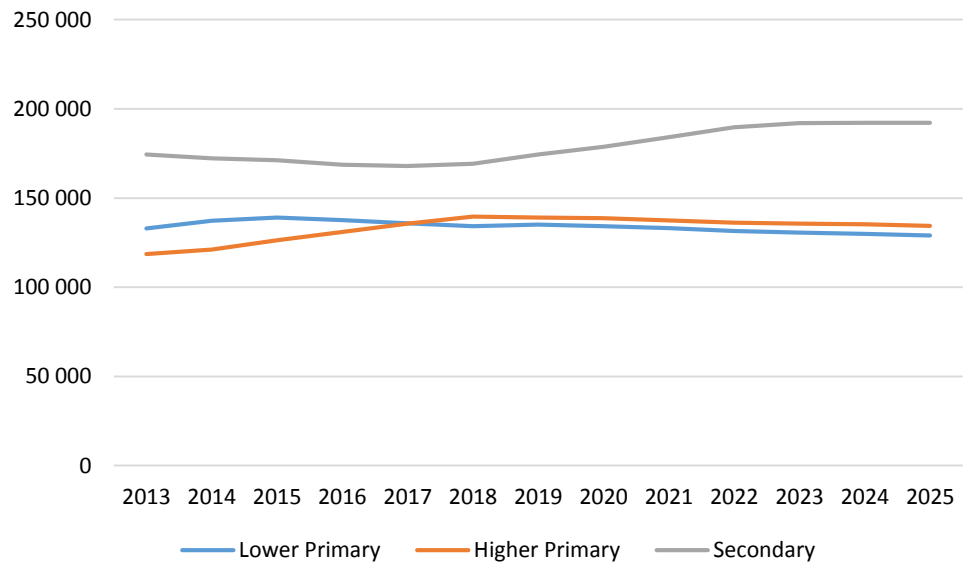
From the LERs the requirements for educators are projected at three-year intervals in Table 6 and graphed in Figure 3.

Table 6: Projected educator requirements

	2013	2016	2019	2022	2025
Lower primary	132872	137610	135112	131514	129081
Higher primary	118621	131069	139026	136263	134426
Secondary	174497	168749	174320	189642	192216
Total	**425989**	**437428**	**448458**	**457419**	**455723**

Note: The number of teachers in 2013 is a requirement, not an estimate of actual employment. The projected numbers of educators are calculated by applying the assumed learner: educator ratio (31.2 for primary and 26.2 for secondary to the projections of learners.

Figure 3: Teacher Requirements



Thus far, there is no further baseline information which would improve the projections.

There are a number of issues surrounding Grade R, which we deal with in Appendix 4. The scope of this study is confined to public and independent ordinary schools only. Thus what we need for this study is a projection of Grade R learners in public and independent ordinary schools, and not what happens elsewhere (e.g. in ECD centres).

The approach here is as follows. First a projection of pupils in Grades 1 to 12 was made. Then the projection of Grade R learners in ordinary schools was added. This was done by considering the ratio of Grade R enrolments to Grade 1 enrolments. This ratio showed no trend between 2010 and 2013 and this rate is assumed flat in the projections to 2025. In Appendix 4 we consider other possibilities.

3 PROJECTING TEACHER SUPPLY

3.1 What we don't know

When it comes to teacher supply and utilization, there are a number of issues on which there is no statistical information. This report works around the gaps in the best way it can, but readers should be aware of the limitations. The box below sets out the problems:

Gaps in statistical information

1. We have no cohort studies of student progress which would enable us to fully project intake into, enrolments in and graduations from, initial teacher education. Some simplifying assumptions have to be made.
2. Some people qualify as teachers before they start employment in teaching. For this group, we do not know how many people qualify as teachers, but never enter employment as teachers. Other people qualify after they have started employment as teachers. This group we know about to the extent that teacher records are complete.
3. We have no information on teacher utilization. Therefore we cannot compare the number of teachers teaching subjects or learning areas with the number of teachers required for each subject or learning area, given the pattern of enrolments. It follows that we cannot identify shortages of teachers by subject or learning area. DHET's *Trends in Teacher Education* contain information about graduates by subject or learning area only for 2009. All we can do here is compare teachers who qualified by phase and subject or learning area in that year with the pattern of demand. This is done in Sections 3.3 and 3.4.
4. No one keeps meticulous, accurate and complete databases. Our analysis shows that the Annual Schools Survey (ASS) teacher records are incomplete. And at least 6 per cent of the records that do exist contain inaccurate information. It has been reported to us that the Personnel Salary System (PERSAL) is also incomplete. The best that can be done is to compile a synthetic data base by comparing the ASS and PERSAL information. That task lies in the future. No access to primary PERSAL data was available for this study and we have had to work from secondary sources with limited relevant information. We present analyses based on both ASS data and the secondary PERSAL data. The two analyses come to different conclusions about the adequacy of current plans for initial teacher education.

   Nonetheless, we are releasing this report because it offers a number of insights and raises some key new questions.

3.2 Educator joins and educator attrition

The PERSAL and ASS data lead to substantially different conclusions about teacher attrition. The details of the analysis are contained in the appendices. Table 7 compares the results.

Table 7: Gross and net attrition rates of teachers

	Gross	Net
PERSAL	5.37%	2.73%
Annual Schools Survey	8.31%	3.37%

Gross attrition is the number of leavers divided by employed teachers. Net attrition subtracts returning joiners from leavers. The PERSAL net attrition rate seems too low, since it implies very long average periods of completed service (36 years as opposed to 30 on the ASS estimates). While the PERSAL attrition rate seems too low, the ASS estimates may be too high. The reason is that imperfection in the data means that matching teachers in 2012 and 2013 is less than complete, though every effort has been made to limit this error. This implies that some teachers will be counted as joiners or leavers, whereas they were in fact stayers. Accordingly, the difference between the PERSAL and the ASS based data and projections establishes the reliability of the estimates in this study[2]. As indicated later, future work may be capable of reducing this range.

Note that the stock of teachers who return each year is continually replenished by some of the leavers in previous years.

3.3 The production of new qualified teachers

The Department of Higher Education and Training has produced an enrolment plan for the period 2014 to 2019. The projection presented below in Table 8 assumes the DHET plan to 2019, followed by a 6 per cent per annum increase in B Ed graduates from 2020 to 2025 and an 8 per cent per annum increase in PGCE graduates. The differential between the two qualifications comes from Figure 3 which shows an upcoming increase in the demand for secondary school teachers relative to primary school teachers.

Table 8: DHET enrolment plan extended to 2025

	B Ed			PGCE			Total
	Enrolments	**Graduates**	**Rate***	**Enrolments**	**Graduates**	**Rate***	**Graduates**
2012	81905	8003	9.8%	12332	5705	46.3%	13708
2013	92759	8732	9.4%	12332	5871	47.6%	14604
2014	85047	11053	13.0%	14050	6492	49.4%	17545
2015	91050	11374	12.5%	15236	6941	45.4%	18315
2016	98427	11932	12.1%	16608	7471	45.0%	19403
2017	105010	12531	11.9%	18433	8214	44.6%	20745
2018	109609	13204	12.0%	19989	8827	44.2%	22031
2019	113890	13909	12.2%	21881	9602	43.9%	23511
2020	122867	14744	12.0%	23568	10370	44.0%	25114
2021	130233	15628	12.0%	25455	11200	44.0%	26828
2022	138050	16566	12.0%	27491	12096	44.0%	28662
2023	146333	17560	12.0%	29687	13063	44.0%	30623
2024	155108	18613	12.0%	32064	14108	44.0%	32722
2025	166417	19730	12.0%	34630	15237	44.0%	34967

Projecting graduates from enrolments is no easy task. To get a good baseline, one needs an analysis of progress by one or more entering cohorts from the time of entry until all entrants have either graduated or dropped out. We do not have such a cohort study.

Instead we use the graduation rate. The graduation rate* refers to the number of students who graduate from a programme in a particular year, expressed as a percentage of the number of all students enrolled in that programme in the same year. In the case of a four year qualification with constant intake, the maximum possible graduation rate is 25 per cent. For a one year qualification, the rate would be 100 per cent. It is sensitive to changes in the pattern of enrolment and whether or not the programme is offered through contact or distance education, and full-time or part-time study.

The 2012 graduation rate for the system as a whole was 9.8 per cent for the B Ed (a four-year qualification) and 46.3 per cent for the PGCE (a one-year qualification).

Table 9 below compares the graduation rates for the B Ed at UNISA (distance education programmes) and other campus-based institutions.

Table 9: B Ed graduation rates, 2010 - 2012

Year	UNISA			Other universities		
	Enrolments	Graduates	Graduation Rate	Enrolments	Graduates	Graduation Rate
2010	18582	488	2.6%	33481	4429	13.2%
2011	30086	611	2.0%	38104	5567	14.6%
2012	40124	1007	2.5%	41781	6996	16.7%

The graduation rate is not an entirely satisfactory indicator, since graduations in one year is actually a function of enrolments in earlier years, not the same year, but the indicator is good enough to make the central point.

3.4 The composition of educators by learning area (intermediate and senior phases)

The 2009 Trends in Teacher Education reports graduates by learning area for the intermediate and senior phases and graduates by subject in the FET phase. No such tables appear in the later Trends in Teacher Education, so the available data are out of date. These data form the supply side of the learning area/subject distribution. The demand side comes from the Department of Basic Education's Curriculum and Assessment Policy Statements (CAPS), the proportion of learning time on each area supplying the necessary information for the intermediate and senior phases. For the FET phase, candidates for the 2013 National Senior Certificate (NSC) are used as weights for the CAPS allocation of time.

Table 10 reports the results for the intermediate and senior phases and Table 11 the results for the FET phase. Table 11 is only an approximations for two reasons: one really needs the number of classes in the three years together, rather than the number of NSC candidates. The requirements are probably understated for the subjects with the smaller enrolments, since average class size is likely to be lower, and correspondingly overstated for the most popular subjects.

Table 10: Distribution of learning areas among graduates: intermediate and senior phases

Learning Area	Intermediate phase		Senior phase	
	2009 graduates	CAPS requirement	2009 graduates	CAPS requirement
Arts and Culture	8.4%	5.5%	10.4%	7.3%
Economic and Management	3.3%	0.0%	4.9%	7.3%
Languages	24.1%	40.0%	10.9%	32.7%
Life Orientation	14.4%	9.1%	11.6%	7.3%
Mathematics	12.1%	21.8%	10.3%	16.4%
Natural sciences	11.5%	6.4%	10.3%	10.9%
Social sciences	14.7%	10.9%	23.1%	10.9%
Technology	11.5%	6.4%	18.5%	7.3%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

The worst shortages are in language and mathematics, particularly in the intermediate phase.

3.5 The composition of educators by subject (FET phase)

Table 11: Distribution of subjects among graduates and requirement: FET phase

Subject	2009 graduates	CAPS requirement
Accounting	9.2%	4.4%
Agricultural management	0.2%	0.0%
Agricultural sciences	0.1%	2.3%
Agricultural technology	0.0%	0.0%
Business studies	14.3%	5.5%
Civil technology	0.9%	0.2%
Computer applications technology	4.9%	1.3%
Consumer studies	1.7%	0.9%
Dance studies	0.5%	0.0%
Design	1.3%	0.1%
Dramatic Arts	0.0%	0.2%
Economics	3.1%	4.0%
Electrical technology	0.3%	0.2%
Engineering graphics and design	0.0%	0.7%
Geography	3.6%	5.8%
History	4.1%	2.4%
Hospitality studies	0.4%	0.3%
Information technology	1.1%	0.1%
Languages	14.6%	30.8%
Life orientation	6.9%	7.5%
Life sciences	7.9%	7.8%
Mathematical literacy	3.0%	8.7%
Mathematics	12.1%	8.4%
Mechanical technology	0.6%	0.2%
Music	0.5%	0.0%
Physical sciences	6.5%	5.6%
Religion studies	0.6%	0.1%
Tourism	1.0%	2.2%
Visual arts	0.5%	0.2%
Total	**100.0%**	**100.0%**

Here the worst shortage is again in languages. There are enough mathematics educators, but there is a shortage of mathematics literacy educators. This is likely to worsen over the next few years as the demand for mathematical literacy is increasing.

It should be noted that we can deal with this issue from the demand side only. The supply side would require knowledge of the qualifications, experience and utilization of the existing teacher stock, information currently not available. It should also be noted that the restoration of the relevant tables (published in Teacher Trends in 2009, but not in later editions) to future issues of Teacher Trends would be useful.

Table 10 and Table 11 are compiled on the assumption of the structure of the NSC in 2013. If the rules and subjects required for the NSC change, there will be a change in these tables.

Foundation phase teachers are expected to teach across the curriculum, so learning areas and subjects are not an issue for them. However, the following points need to be made:

1. Foundation phase enrolments (here taken as Grades R to 3) constituted 33 per cent of all enrolments in ordinary schools. In 2012, 4 152 graduates who could teach in this phase were produced: 2 209 in the B Ed, 442 in the PGCE and 1 501 in the National Professional Diploma in Education. Altogether 16 683 graduates were produced in these three degrees, so the proportion of 2012 graduates who could teach foundation phase was 24 per cent. The misalignment is actually worse than this because (a) some of the teachers trained for foundation phase are also trained for intermediate phase, so that some of them will end up teaching in intermediate phase and (b) more than a third of graduates trained for foundation phase are NPDE graduates, and this qualification is being phased out. Of course, our lack of knowledge of the qualifications, experience and utilization of educators applies to this phase as well.
2. Although this report does not identify teachers by population group, gender or mother tongue, it is worth noting that the *Integrated Strategic Planning Framework for Teacher Education and Development 2011-2015* found that, of the 1 275 expected to graduate in 2009, 168 (13 per cent) had an African language as their mother tongue, 558 (44 per cent) were Afrikaans speakers and 549 (43 per cent) were English speakers. Since most learners have an African language as a mother tongue, there was a serious mismatch between the production of graduates in 2009 and the requirements of learners, a mismatch which becomes worse at the provincial level. 124 (74 per cent) of the African mother tongue graduates were produced in KwaZulu-Natal and only 44 (26 per cent) elsewhere.

4 MATCHING SUPPLY AND DEMAND

An educator is regarded as qualified if they possess one of the following:

- A four year degree in education (M+4)
- A degree or a three or four year national diploma or a national N6 diploma plus an educational qualification of at least one year (M+4 or higher)
- A three year education diploma (M+3).

This is not the same as REQV 13 and above, since qualifications are subject to individual assessment when assigning an REQV classification rather than mechanical application of criteria such as those above.

An educator is regarded as partly qualified (professionally unqualified) if they possess a degree, a three or four year diploma or a national N6 diploma without an educational qualification. In this section of the report, professionally unqualified teachers are regarded as unqualified[3].

Table 12 sets out the assumptions on which the projections is based, along with a summary of results. Note that these results apply only to educators who are South African citizens, between the ages of 22 and 65[4].

Table 12: Educator assumptions and outcomes, 2013-2025

	Increase all new educators	Increase all new qualified educators	Increase all new unqualified educators	Decreased attrition rate from 2013 level	All educators required	All educators supplied	Surplus/ deficit per cent	Per cent qualified
2013					423078	423078		81.1%
2014	18.0%	8.0%	25.0%	0.0%	427656	426701	-0.2%	80.0%
2015	21.8%	25.0%	20.0%	2.5%	433637	434419	0.2%	78.8%
2016	-22.4%	9.7%	-40.0%	5.0%	434439	436385	0.4%	78.8%
2017	-7.6%	-5.0%	10.0%	5.0%	436373	438022	0.4%	78.9%
2018	2.9%	6.2%	20.0%	5.0%	440017	439960	0.0%	78.7%
2019	13.5%	6.7%	0.0%	5.0%	445393	444929	-0.1%	77.9%
2020	-8.5%	6.8%	-20.0%	5.0%	448398	448709	0.1%	77.9%
2021	-6.2%	6.8%	-20.0%	5.0%	451759	451212	-0.1%	77.7%
2022	0.4%	6.8%	-15.0%	5.0%	454293	454336	0.0%	78.0%
2023	-10.6%	6.8%	-40.0%	5.0%	455496	454926	-0.1%	78.6%
2024	-5.5%	6.9%	-50.0%	5.0%	454324	454496	0.0%	80.1%
2025	-7.0%	6.9%	-80.0%	5.0%	452609	452542	0.0%	81.3%

Note: The estimate of teachers required refer to South African citizens only between the ages of 22 and 65. The total number of teachers has been adjusted in line with Appendix 3 Table 1.

Table 12 shows that the enrolment plan leads to a decrease in the proportion of qualified educators from 2013 to 2021 and an increase thereafter. The LER over the whole period remains very nearly constant. This data representing the projected match between the educators required (demand) and educators supplied over the next 10 years is shown in Figure 4.

Figure 4: Projected match between teacher supply and demand, 2013 - 2025

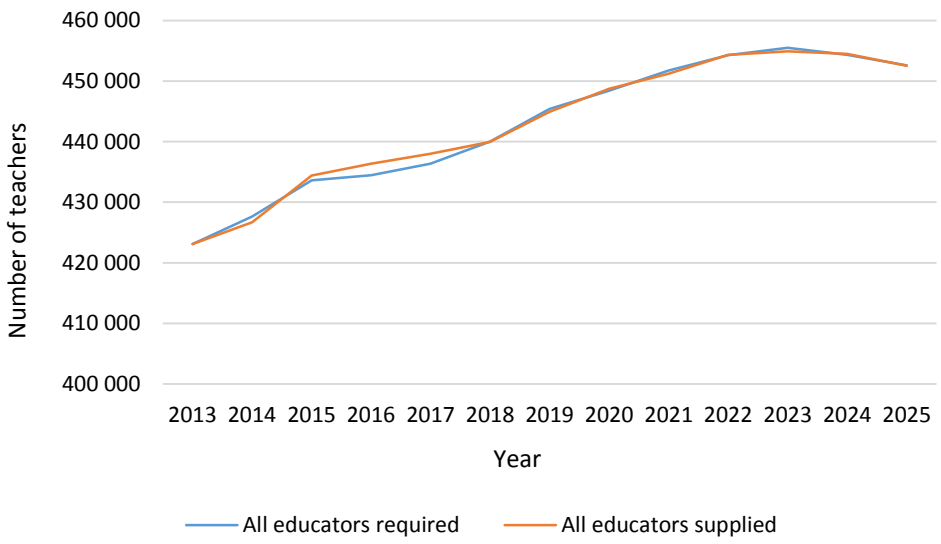


Table 13 and Table 14 set out the evolution of the employed qualified and unqualified teachers respectively.

Table 13: Qualified educators, 2013 - 2025

	Joins	Returns	Upgrades	Stock	Over 65	Leaves	Joins and upgrades	Graduates last year
2013				342096	1112	28256	18175	16683
2014	6886	11144	9468	340227	1353	27582	16354	19291
2015	8608	10770	10189	340857	1494	26913	18796	20793
2016	9443	10290	10297	342480	2184	26272	19740	19939
2017	8970	9998	10464	343456	2600	26173	19434	19403
2018	8504	10002	10550	343739	1236	26828	19054	20745
2019	8844	9855	11196	345570	3595	27151	20040	22031
2020	9905	9814	11373	345916	2454	27987	21279	23511
2021	11193	9765	11639	348073	4687	28028	22832	25114
2022	13096	9865	11454	349773	3031	28659	24550	26828
2023	15060	9935	11294	354372	6263	28902	26354	28662
2024	17771	10075	10588	357641	3190	30005	28359	30623
2025	20259	10228	9912	364846			30172	32722
							285139	**306344**

Table 13 shows that the main reason it is so difficult to increase the stock of qualified educators is not that teachers qualify and fail to enter employment, but that so many qualified teachers leave and do not return. The attrition of qualified teachers is so severe that the projected stock of qualified teachers in 2025 is only 7 per cent higher than in 2013, even if gross attrition rates drop a little as assumed by the projections. The projection assumes that attrition rates will be lower by 2.5 per cent in 2015 than they would be if projected forward as constant from 2013 and 5 per cent lower thereafter. So if gross attrition rates were 8.31 per cent in 2013, they would drop to 8.10 per cent in 2015 and 7.89 per cent thereafter.

A key result of this study is that pumping more new qualified educators in at the bottom of the system will not in itself suffice to improve the average level of qualification among employed teachers. Every effort needs be made to retain qualified teachers as well.

Table 14: Unqualified educators, 2013 -2025

	Joins	Returns	Upgrades	Stock	Over 65	Leaves	All educators
2013				79840	304	6354	421936
2014	12293	9052	-9468	85058	391	7548	425285
2015	15635	9252	-10189	91817	287	8641	432674
2016	10310	9223	-10297	92124	270	9025	434604
2017	10274	9473	-10464	92113	308	9726	435568
2018	12295	9489	-10550	93313	1038	9660	437051
2019	15814	9854	-11196	97085	0	9573	442655
2020	13745	10082	-11373	99965	674	10077	445881
2021	12117	10319	-11639	100011	0	9513	448085
2022	11419	10455	-11454	100918	961	10542	450691
2023	7950	10490	-11294	96561	0	0	450934
2024	5108	10322	-10588	92278	0	10014	449919
2025	1908	10246	-9912	83035			447881

Table 14 shows the stock of unqualified teachers fluctuating between 2013 and 2025, peaking in 2022, and higher in 2025 than at present.

5 CONCLUSIONS

No set of calculations should be regarded as an infallible guide to the future, especially when, as is the case here, baseline information is incomplete and assumptions have to be made. Rather, projections should be regarded as a way of bringing together the influences bearing on the system in a coherent and appropriately weighted way.

On the basis of the information and assumptions outlined above, the principal conclusions are these:

1. Demographic developments are crucial and while the general long term trend in fertility is reasonably clear, year to year fluctuations in births around the trend can be substantial. Planners need to keep their eyes closely on birth registration statistics to update what is coming down the pike in six or seven years' time in Grade R and Grade 1 enrolments.
2. On the basis of the best current demographic projections and current promotion, repetition and dropout rates, the school population will rise from just over 12.4 million in 2013 to just under 13.4 million in 2023. After that it will start to decline slowly.
3. Assuming constant LERs the required teacher stock in round figures will rise from 426 000 in 2013 to a maximum of 456 000 in 2023[5]. After that it will start to decline slowly.
4. The divergences between the conclusions drawn from the secondary analysis of PERSAL data and the analysis of ASS data are substantial. The PERSAL data indicates a low net attrition rate and it had to be assumed, on the basis of available data, that attrition rates of qualified and unqualified educators are the same. On the other hand, the ASS rates of attrition are upwardly biased because of the methodology adopted. The ASS also indicates considerably worse net attrition of qualified educators over unqualified educators. Both sets of results are presented to provide an implicit sensitivity analysis of the results.

5.1 Conclusions based on PERSAL data

5. The analysis of PERSAL data was based on secondary sources in the form of two papers by Martin Gustafsson. The study had no access to primary PERSAL data.

6. The average join rate as a proportion of employed educators in the previous year was 6.94 per cent and the average leave rate was 5.37 per cent per annum between 2004 and 2012. However, many of the leavers are qualified experienced teachers who will return to the system, mostly within two to four years. If we regard returning teachers as temporary absences rather than permanent departures, the attrition rate falls to 2.73 per cent

7. The required number of B Ed and PGCE graduates will rise from 7 500 in 2012 to just under 12 000 in 2019 and will decline slowly after that.

8. In the short run, there may be a very small decline in the proportion of teachers who are qualified, but the proportion should start to rise from 2019, provided that the proportion of unqualified teachers among joiners drops from 2013 to 2025.

9. The rapid increase in enrolments, particularly for the B Ed, during the period 2009 to 2012 will provide an increase in the number of graduates between 2013 and 2017. It is quite likely that first year intake into the B Ed will need to be decreased in absolute terms from 2015. Since the relative demand for secondary school teachers will rise from 2019, it would be wise to shift resources in to the PGCE, provided that sufficient Bachelor's graduates with degrees in teaching subjects can be recruited.

10. On the PERSAL estimate, the volume of initial teacher education is in the right ball park.

5.2 Conclusions based on ASS data

11. Joins and returns in 2013 as a proportion of employed teachers in 2013 were 8.62 per cent, and the leave rate was 8.31 per cent. The net leave rate was 3.37 per cent

12. The ASS projection suggests that a strategy of increasing the B Ed intake in accordance with the DHET plan to 2019 and by 6 per cent each year from 2020, and increasing the PGCE intake in accordance with the DHET plan to 2019 and by 8 per cent each year from 2020, will lead to a proportion of qualified teachers in the entire teaching stock projected for 2025 as it was in 2013.

13. The 8 975 upgrades from unqualified or partly qualified to fully qualified status during employment exceeded the 6 378 qualified teachers who entered employment for the first time in 2013. The median age of newly qualified teachers was 28, whereas the median age at upgrade was 43. While there are many teachers who enter employment in their early or mid-20s, there are also many older graduates. It follows that it would be a mistake to assign all B Ed and PGCE qualifications to new teachers. It would be helpful to compare this finding with an age profile of B Ed and PGCE graduates.

14. The ASS projections are based on an assumption which brings supply and demand for all teachers and qualified teachers into a close relationship. The supply of qualified teachers has been considered first, with recruitment of unqualified teachers filling the gap between supply and demand. The projection assumes a constant LER throughout the period.

5.3 Conclusions using both data sets

15. Both the PERSAL and the ASS data show a considerable degree of 'churning' in the teaching corps, with many of the teachers resigning and returning to teaching after a time.
16. There will be a shifting pattern of demand for new graduates. Up to 2017, the majority of teachers required will be primary school teachers. After that, the composition of demand will shift towards secondary school teachers.
17. Special efforts need to be continued to encourage students to specialize in language learning areas and subjects from the intermediate to the FET phases, in mathematics at the intermediate and senior phases and in mathematical literacy at the FET phase.
18. The great advantage of the ASS projections is that they have an age structure. Both the PERSAL and ASS data indicate that initial teacher education may be fitter for purpose than many think and that required increases in first time enrolments are attainable. The PERSAL data suggest that it may be time to think of measures designed to curb the over-production of teachers down the line. By contrast the ASS data suggest an increase in intake will be necessary in the next ten years. The disadvantage of the ASS projections is that the educator ID is not securely established for a significant minority of teachers. The next round of work should be based on a careful comparison between ASS and PERSAL data. Even that will not yield perfect results.
19. The gap between the PERSAL and ASS conclusions is uncomfortably wide. Access to PERSAL data for the same month as the ASS is undertaken in two successive years would make it possible to combine the best features of both in order to construct a single, and more reliable set of estimates.

6 A FINAL NOTE

An analogy with optics is useful here. The greater the number of pixels in a digital camera determines the sharpness of the image one can capture, or in technical terms, the resolution of the image. This study is in the low to medium resolution stage. Another study, integrating PERSAL with ASS data would increase the resolution. But it would be an absurd rationalist dream to suppose that any future model could provide the various agents in the system with a precise plan of what to do. Rather, modelling should be the basis for a dialogue to create greater consensus about general strategy, rather than prescribing a rigid system.

It should be apparent that this study is not the last word on South Africa's teacher supply and demand problem. Accordingly, extreme caution must be observed when interpreting the results for policy purposes. But it is the first word on aspects of teacher supply and demand processes. These need to be investigated further if current policy is to be refined.

APPENDIX 1: PROJECTING THE INTAKE OF TEACHERS

The general approach to projecting the required intake is as follows:

1 Project the number of learners in ordinary schools in each year of interest, indexed by t (L_t)
2 Project the learner-educator ratio in each year (r_t)
3 Divide the number of learners by the learner-educator ratio to get the required number of educators in employment ($E_t = L_t/r_t$)
4 Determine the annual attrition of educators in employment through resignations, dismissals, disability or death in service and retirements (A_t)
5 Determine the re-entry of experienced educators into employment as educators (X_t)
6 Determine the entry of foreign (F_t) and unqualified educators (U_t) into employment as educators
7 Calculate the required number of new qualified educators ($Q_t = E_t – E_{t-1} + A_{t-1} – X_t - F_t-U_t$)
8 Denote the number of students entering the B Ed by B_t and the number of students entering the PGCE by C_t.
9 Denote the probability that a student entering the B Ed qualifies n years later as p_n so that the number of B Ed graduates in year t (D_t) is $\Sigma B_{t-n}p_n$
10 Denote the probability that a student entering the PGCE qualifies n years later as q_n so that the number of PGCE graduates in year t (Y_t) is $\Sigma C_{t-n}q_n$
11 Denote the probability that a new educator enters employment i years after graduation as g_i so that the number of new educators entering employment is year t (N_t) is $\Sigma(D_{t-I} + Y_{t-i})g_i$
12 Set $Q_t = N_t$, i.e. the required number of new educators equal to the supply of new educators. Any combination of B_t and C_t which satisfies the equality will suffice.

In practice, one will not have baseline information from which to make projections for some of these variables and simplifying assumptions will be necessary. The results can be very sensitive to the assumptions one makes. Set t=0 at year 2012, and assume (contrary to fact, but for the sake of argument) no experienced, unqualified or foreign educators enter employment. Suppose we use the simplifying assumption that the attrition rate is a constant, *a*, so that A_t-1 = aE_{t-1} (not a good assumption over time, since the age composition of the teaching force may change). Suppose also that we estimate *a* to be 4.0 per cent, but that it could vary by 10 per cent of that magnitude either way, so that a could be 3.6 or 4.4. Using the employment figures above, the required entry of new educators would be 425,167 – 420, 628 + 0.036*420,628 = 19 682 or 425, 167 – 420,628 + 0.044*420,628 = 23 046, which varies by 15.8 per cent either way.

APPENDIX 2: RESULTS FROM THE SECONDARY ANALYSIS OF THE PERSAL DATA

Gustafsson takes a qualified educator to be one with REQV13 and above and an unqualified educator with REQV12 and below, although the system is moving to a definition of REQV14 and above as a qualified educator.

Table 1 sets out the best available estimates of joiners and leavers from 2004 to 2012. The basis for the estimates are Gustafsson's 2009 and 2014 studies, though they have been modified. Gustafsson's joiners and leavers comes from PERSAL, whereas the number of educators comes from *Education Statistics*, so they are not consistent and adjustments have been made to make them so. It is assumed that 80 per cent of educators qualified the year before entering the teaching force as new young educators (up to the age of 30)[6] and that older qualified joiners and unqualified joiners are in the same ratio as in Gustafsson's 2014 study. All the italicized entries in Table 1 are constructions to render the data consistent.

One important finding arises from Gustafsson's work: returning joiners of experienced educators outnumber new joiners. The experienced joiners must have been absent from the system for at least a year. Gustafsson found that almost 20 per cent of qualified educators left and returned within four years, based on data from 2004. At most a small proportion of them can come from the DBE's list of unemployed educators, currently at about 1 500.

Table 1: Joiners and leavers, 2004 - 2012

Year	Educators	Joiners	Leavers	Join rate	Leave rate	Qualified young joiners	Qualified older joiners	Unqualified joiners
2004	*375159*		19550		5.21%			
2005	382133	26524	*21163*	7.07%	*5.54%*			
2006	385860	*24891*	*19415*	*6.51%*	*5.03%*			
2007	394225	*27778*	*23053*	*7.20%*	*5.85%*			
2008	400953	*29783*	*21005*	*7.55%*	*5.24%*			
2009	413067	*33120*	*18081*	*8.26%*	*4.38%*			
2010	418109	*23124*	*27021*	*5.60%*	*6.46%*	*5582*	*16283*	*1259*
2011	420608	*30213*	*22156*	*7.23%*	*5.27%*	*6378*	*17311*	*6523*
2012	425167	*26713*		*6.35%*		*8474*	*11765*	*6474*
			Mean	6.97%	5.37%		56.7%	17.8%
Sources:	*Education statistics*							
	Gustafsson 2009 and 2014 studies							

Note: In the PERSAL projection, the number of teachers published in the DBE *Education Statistics* series was used.

Table 1 provides a baseline for projections. It will be assumed that the attrition rate remains constant at 5.37 per cent per year. This, with the required educator stock generates the required number of joiners each year. These have to be partitioned between young qualified educators, older qualified educators and unqualified educators. The approach taken in the projection is that the proportion of older qualified educators among joiners remains at 56.7 per cent, the average for 2010-2012 and that the proportion of unqualified educators tapers from the 2010-2102 average of 17.8 per cent to 5 per cent by 2025. This generates the requirement for new qualified educators each year. Table 2 presents the projection.

Table 2: Projection of required number of graduates, 2012-2024

Year	Educators	Leavers	Joiners	Qualified older	Unqualified	Required qualified	Required graduates
2012	425167	22839					7550
2013	425989	22884	23662	13408	4214	6040	9140
2014	430599	23131	27493	15579	4603	7312	10081
2015	436621	23455	29153	16519	4569	8065	8713
2016	437428	23498	24262	13748	3544	6970	9478
2017	439376	23603	25446	14419	3445	7582	10522
2018	443045	23800	27273	15454	3401	8418	11660
2019	448458	24091	29212	16553	3331	9328	11185
2020	451483	24253	27116	15365	2803	8948	11770
2021	454868	24435	27639	15661	2562	9416	11851
2022	457419	24572	26985	15291	2213	9481	11545
2023	458360	24623	25513	14457	1820	9236	11047
2024	457450	24574	23713	13436	1439	8837	10948
2025	455723	24481	22847	12946	1142	8759	
					Mean	2012-2017	9247
						2018-2024	11429

The result of Table 2 is interesting and unexpected. It implies that current teacher education capacity will suffice until 2017 and needs to be expanded by only 10 per cent thereafter. How is this possible? The re-entry of experienced qualified educators meets more than half the joiner requirement and unqualified educators add to this proportion. If one were to regard the qualified educators who resign and who will return (57 per cent of all qualified resignations) not as permanent attrition, but as temporarily absent, the net attrition rate in 2013 falls to 2.73 per cent This implies an average period of employment in education (with breaks counted) of about 37 years, which seems too long.

The Trends in Teacher Education reports identify graduating educators by school phase: foundation phase (FP) representing Grades R -3, the intermediate phase (Grades 4-6), the senior phase (Grades 7-9) and the FET phase (Grades 10-12). Phases do not hire educators; schools do. So the output is grouped as follows:

Lower primary: FP and FP/IP

Higher primary: IP, IP/SP and SP

Secondary: SP/FET and FET

On this basis, Table 3 can be compiled. It compares the composition of graduates between 2009 and 2012 with the new qualified educators required between 2013 and 2017 and between 2018 and 2025.

Table 3: Distribution of educator graduates, 2009- 2012 and required distributions 2013-2017 and 2018-2025

	Lower primary	Higher primary	Secondary	Total
2009-2012 graduates	7064	7271	24916	39251
Per cent distribution	18.0%	18.5%	63.5%	100.0%
2013-2017 additions				
Net new	2867	17112	-6592	13386
Replacement	11314	10489	14166	35969
Total	14180	27601	7574	49356
Per cent distribution	28.7%	55.9%	15.3%	100.0%
2018-2025 additions				
Net new	-5060	-5202	22939	12677
Replacement	21121	21896	29405	72422
Total	16061	16694	52344	85100
Per cent distribution	18.9%	19.6%	61.5%	100.0%

Table 3 shows that the composition of output over the four years 2009-2012 is not well matched to the requirements for additional new qualified educators between 2013 and 2017. Too many secondary educators and far too few higher primary educators are being produced for that period. On the other hand, the output is almost perfectly matched to the additions required between 2018 and 2025. The reason is that the smaller birth cohorts of 2001 to 2003 will be working their way through the secondary schools in the next few years, followed by the impact of the baby boom between 2005 and 2008.

Assuming that students who entered the B Ed in 2014 can be expected to graduate on average no earlier than the end of 2018, there is no point in altering the mix even if it remains as between 2009 and 2012. On the other hand, PGCE students graduate in a year or two, so there might be some point in expanding primary school places for two or three years and contracting secondary school places in that qualification. Whatever the case, it is likely that some educators trained for secondary education will have to find jobs in the higher primary sector over the next five years.

What will the joiner pattern in Table 3 do the distribution of employed educators between qualified and unqualified? SAIDE estimated several years ago that the proportion of unqualified educators in employment was 13 per cent if one assumes that this proportion applies to 2012 and that leavers will be distributed across qualified and unqualified educators in the same proportion as found among all employed educators[7], it is possible to compile Table 4.

Table 4: Composition of employed educators

Year	Educators Qualified	Educators Unqualified	Leavers Qualified	Leavers Unqualified	Joiners Qualified	Joiners Unqualified	Percent qualified
2010	363755	54354	23508	3513			87.0%
2011	362112	52100	19369	2787	21865	1259	87.4%
2012	366432	55836	19819	3020	23690	6523	86.8%
2013	366061	57030	19799	3085	19448	4214	86.5%
2014	369152	58548	19965	3166	22891	4603	86.3%
2015	373771	59951	20213	3242	24584	4569	86.2%
2016	374277	60253	20240	3258	20718	3544	86.1%
2017	376037	60440	20334	3268	22001	3445	86.2%
2018	379574	60573	20525	3275	23871	3401	86.2%
2019	384930	60629	20813	3278	25881	3331	86.4%
2020	388430	60154	21001	3252	24313	2803	86.6%
2021	392506	59463	21220	3215	25077	2562	86.8%
2022	396058	58462	21411	3161	24772	2213	87.1%
2023	398339	57122	21535	3088	23693	1820	87.5%
2024	399079	55472	21575	2999	22274	1439	87.8%
2025	399209	53616	21582	2899	21705	1142	88.2%

Table 4 indicates that the proportion of qualified educators will decline marginally from 2013 to 2016 and rise thereafter.

APPENDIX 3: RESULTS FROM THE 2012 AND 2013 ANNUAL SCHOOLS SURVEYS

The Framework

Information from the 2012 and 2013 Annual Schools Survey provides useful new information on the movement of educators through ordinary schools. The general approach is to estimate the number of joiners by teachers present in 2013 but not in 2012, the number of leavers by teachers present in 2012 but not in 2013 and survivors present in both years.

This methodology assumes accurate enumeration. The data have to be approached with care, because they are not complete. No information on educators were submitted by KwaZulu-Natal in 2012, and a number of schools have been missed in both years. Moreover, enumeration in some schools covered in both years was incomplete in one of them. Techniques to deal with these problems are detailed below.

The first task is to construct a sturdy framework of schools, educators and learners. No single source has a complete list of schools, so information was combined from the following sources:

- The master list of schools in the fourth quarter of 2013 and published on the Department of Basic Education's website. This list contains the number of educators and learners from the Snap Surveys of 2012 and 2013
- The master list of schools covered by the Annual Schools Survey in 2012 and 2013.
- The list of learners by school in 2012 and 2013 supplied by the Department of Basic Education

Table 1 sets out the results from the matching of these sources.

Table 1: Source matching

Master list Q4 2013			
	Educators	Learners	Schools
Educators only			
2012	45		5
2013	149		11
Learners only			
2012		22348	54
2013		6336	26
Both			
2012	432187	12569866	26238
2013	423771	12375251	25487
Total			
2012	432232	12592214	26297
2013	423920	12381587	25524
Learners 2012 and 2013			
	Educators	Learners	Schools
2012			25705
2013			25214
Q4 only			
2012		25719	299
2013		45998	214
Learners only			
2012	12017	342208	1051
2013	9473	249022	512
Both			
2012	420185	12250006	25406
2013	414447	12132565	25000
Total			
2012	432202	12617933	26756
2013	423920	12427585	25726
Snap Survey			
	Educators	Learners	Schools
Snap Survey + Q4 only			
2012			5
2013			2
Masterlist 2012_13 only			
2012	11960	341448	1044
2013	9348	245723	1446
Both			
2012	420272	12343472	25712
2013	414572	12191882	25225
Total			
2012	432232	12684920	26761
2013	423920	12437605	26673
Published estimates			
2012	425167	12428069	25826
2013	425090	12655436	25741

The educator data set contains information about 705 892 educators, distributed as shown in Table 2.

Table 2: Educators by year and citizenship

	2012	**2013**
South African	296394	391043
Foreign	7831	10624
Total	**304225**	**401667**

No data on age are available for foreign citizens and identity numbers have not been captured with sufficient accuracy for matching. Countries of origin of foreign citizens are set out in Table 3.

Table 3: Foreign educators by origin

	2012	**2013**
Zimbabwe	5467	6765
Other Africa	623	739
Elsewhere	474	466
No information	1267	2654
Total	**7831**	**10624**

Table 4 sets out educators by province.

Table 4: Educators by province

	2012	**2013**
Missing ID		
South African	30	69
Foreign	13	7
Duplicates		
South African	254	810
Foreign	19	25
Province		
Eastern Cape	65625	67348
Free State	21698	23544
Gauteng	67995	71977
KwaZulu-Natal		86681
Limpopo	56925	56666
Mpumalanga	30103	25843
Northern Cape	7160	8650
North West	21369	24467
Western Cape	33056	35580
Total	**303931**	**400756**
Excluding KwaZulu-Natal	303931	314075

The rest of the analysis is confined to educators who had South African citizenship.

An important issue is the qualifications of teachers. The qualifications of teachers were generally well completed, though with some confusion about the bewildering number of education diplomas and certificates which have been awarded over the last fifty years and some detectable (and repaired omissions) in 2013. The discussion of qualified and unqualified teachers at the beginning of Section 4 in the main report is relevant here.

An educator who has ***either*** a B Ed ***or*** a degree, or a three year or better post-school diploma, or an N6 certificate, plus a PGCE is described as highly qualified. These are identified separately from other qualified educators in Table 5. Professionally unqualified teachers are separated from other unqualified or underqualified teachers in Table 5.

There were 303 931 educators in the ASSA 2012 data set (which excluded KwaZulu-Natal) and 400 756 in the ASSA 2013 data set (including 86 681 in KwaZulu-Natal), distributed as follows:

Table 5: Teachers by qualification and type of appointment

Panel A - Qualifications			
			KZN
	2012	2013	2013
Highly qualified			
South Africans	43265	57289	13460
Foreigners	1206	1675	251
Total	44471	58964	13711
Qualified but not highly qualified			
South Africans	206551	259863	48349
Foreigners	4364	5455	624
Total	210915	265318	48973
Partly qualified (Professionally unqualified)			
South Africans	26891	34509	10193
Foreigners	1809	2169	272
Total	28700	36678	10465
Unqualified (including underqualified)			
South Africans	19425	38503	13342
Foreigners	420	1293	190
Total	19845	39796	13532
Grand Total	**303931**	**400756**	**86681**
Panel B - Contract type			
Permanent	274553	351425	70874
Temporary	26756	45881	14628
Substitute	2613	3393	1176
Missing	9	57	3
Total	**303931**	**400756**	**86681**

In what follows, only educators with South African citizenship are included.

KwaZulu-Natal is reported separately in the above table since it was excluded from the ASS educator data base in 2012 and included in 2013.

Method

The analytical strategy is to identify a set of schools where enumeration was complete, or nearly so, in both 2012 and 2013, to analyse transitions in these schools and then add back estimates for KwaZulu-Natal, a small number of missed educators in the core set and then the schools where enumeration was far from complete. The eventual outcome is a set of estimates of joiners, stayers and leavers for all teachers who were South African. This strategy was necessary since omitted teachers in 2012 would show up as joiners in 2013 and omitted teachers in 2013 would show up as leavers in 2012, biasing both joiner and leaver estimates upward.

Schools were eligible for inclusion in the core set if they satisfied all of the following conditions:

1. *Either* the difference between educators in 2012 and educators in 2013 was less than 20 per cent of the average *or* the absolute difference was less than three.
2. The difference in the number of learners between 2012 and 2013 was less than 20 per cent of the average in public schools with at least 60 learners on average.
3. The learner: educator ratio was below 20 in either year in public secondary schools.

Table 6 sets out information on schools excluded from the core set.

Table 6: Schools selected for the core set, KwaZulu-Natal schools excluded

			Schools
Schools 2012			20575
Schools 2013			20501
Criterion 1			
Pass			18000
Fail			2684
Criterion 2			
Pass			18954
Fail			1730
Criterion 3			
Pass			19419
Fail			1265
Eligible for comparison			16113
Ineligible for comparison			4551
Ineligible schools	**Educators**	**Learners**	**Schools**
2012	64099	1442487	4257
2013	56106	1413967	4368

Schools which were open only in one year were regarded as eligible unless they failed Criterion 3.

The method relies on accurate and complete enumeration of teachers in the ASS. In this respect:

- The absence of KwaZulu-Natal from the 2012 ASS is a major defect in the information available.
- It can be established that more than 6 per cent of teacher identity numbers have been incorrectly recorded in the existing data. This has been determined on the basis of the 11th, 12th and 13th digit of the ID Numbers in the data. The 11th digit should be a zero (South African citizen) or one (permanent resident) and the 12th digit should not be a 9. Relatively few ID Numbers fail the 11th and 12th digit test. The 13th digit is a check number, calculated using the Luhn algorithm, and an error is detected if the algorithm, based on the first 12 digits, yields a different check number than the recorded 13th digit. Paper based ASS enumeration creates two opportunities for mis-recording ID numbers: first when they are entered on the return, and secondly when the data is captured on the computer.

The matching process has been modified to:

- allow matching within each school to be based on the birth date alone (the first six digits of the ID Number) and not on the full ID number.
- allow matching if an educator is found anywhere in the 2013 ASS if they belong to an eligible school in 2012.

These measures reduce downward bias in matching (and therefore upward bias in join and leave rates) but they do not eliminate it completely. In future, ASS data needs to be compared with PERSAL data to provide further information on teacher identity, making measurement and estimation more reliable.

This sets up the framework.

Results

Descriptive statistics: 2013

All statistics in this section are taken from the education data base only.

Table 7 sets out schools by sector and educational phase.

Table 7: Schools by sector and phase, 2013

	Independent	**Public**
Combined	703	3518
Intermediate	38	817
Pre-primary	7	2
Primary	523	13717
Secondary	252	5647
Special needs	1	2
Total	**1524**	**23703**

Table 8 sets out educators by province.

Table 8: Educators by province, 2013

Eastern Cape	67348
Free State	23544
Gauteng	71977
KwaZulu-Natal	86681
Limpopo	56666
Mpumalanga	25843
Northern Cape	8650
North West	24467
Western Cape	35580
Total	**400756**

Table 9 sets out educators by gender.

Table 9: Educators by gender

Female	282223
Male	118515
Not known	18
Total	**400756**

Table 10 sets out educators by qualification level and type of employment.

Table 10: Educators by qualification and type of appointment

	Qualified	Partly qualified	Not qualified
Permanent	297001	27411	27013
Substitute	2310	579	504
Temporary	24946	8684	12251
Not known	22	7	28
Total	**324279**	**36681**	**39796**

Table 11 sets out educators by age.

Table 11: Educators by age, South African citizens only

24 and below	6551
25-29	24832
30-34	21303
35-39	37599
40-44	81242
45-49	87770
50-54	66480
55-59	46342
60-64	14801
65 and above	2768
Missing	476
Total	**390164**

This is a very odd distribution, with the number of educators between 45 and 49 being over four times as high as the number between 30 and 34. It has major implications for the required number of new teachers[8].

The analysis of transitions

The key new insights arise from the analysis of educator movement in and out of employment. The analysis in this section is confined to South African citizens only.

Table 12 reports the outcome of the matches by educator between 2012 and 2013.

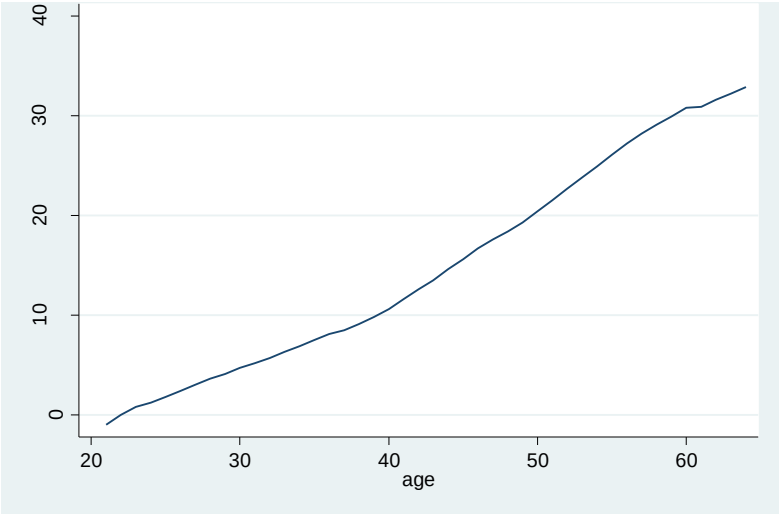
Table 12: Matches in the core set

	2012	**2013**
No	26147	33322
Yes	222738	222738
Total	**248885**	**256060**

These matches form the basis of the analysis which follows.

A key variable is years of teaching experience. This variable is reliable, since it relates well to age. However, years of experience sometimes exceed age minus 22, the minimum age for entry into teaching assumed throughout the analysis, and in these cases years of experience are corrected down. Figure 1 relates mean years of teaching experience to age.

Figure 1: Mean teaching years



The slope of the line between the ages of 40 and 60 is close to one. The slope is lower for younger educators and reflects the fact that educators enter employment at different ages. The mean years teaching reported by teachers age 65 is 33.6. Bear in mind that there are two concepts of the mean years of teaching:

1. The mean years of teaching completed by teachers who are in employment. Thus an educator who is age 40 might have ten years of experience.
2. The mean of years of experience by an educator between their first entry into teaching and when they leave the system for the last time. For instance, our teacher age 40 with 10 years of experience might go on teaching continuously until age 60 when she retires. Such a person would have 30 years of teaching experience at retirement. Only completed spells of teaching count in this calculation.

So the average educator in service in 2013 had 17 years of experience, but the average experience of educators who stayed until age 65 was 34 years. Different concepts, different numbers.

A new joiner is an unmatched educator who reported zero or one years of teaching experience in 2013. A returning joiner has more than one year of teaching experience. A stayer is an educator present in both years and a leaver is an educator present in 2012 but not in 2013. For each category – new joiners, returning joiners, stayers and leavers – track is kept of the total number of teachers and of (fully) qualified teachers.

Key assumptions in the building up of the final estimates are as follows:

1. No new educators enter employment from the age of 60. Educators who show up as joiners in this age range are reassigned as stayers.
2. No educator upgrades from unqualified or partly qualified to qualified after the age of 60. One can determine an upgrade by comparing qualifications of stayers between 2012 and 2013. It sometime happens that an educator is recorded as qualified in 2012 and not in 2013, in which case the qualification indicator in 2013 is revised. It also sometimes happens that an educator records an improvement in more than one detailed qualification between 2012 and 2013, in which case it is assumed that the 2012 record is defective and is revised to accord with the 2013 summary qualification.

3. It is assumed that matching in the core set of schools is representative of matching in the school system as a whole.

4. It is assumed that some teachers were missed even in the core set of schools. An adjustment was made to bring the number of return joiners in relation to the number of leavers close to the estimates derived from Gustafsson's analysis of PERSAL data.

In building up the estimates for the entire system, the following adjustments were made to the core matches:

1 Adjustment to the over 60 data

2 Adjustment for missed teachers in the core set of schools

3 Add back the KwaZulu-Natal system

4 Adjust the estimates upward to allow for non-eligible schools.

In what follows, qualified teachers comprise what have been called highly qualified and qualified teachers in Table 5. The rest are referred to as unqualified (i.e. includes the unqualified, underqualified and professionally unqualified).

Table 13 sets out the final estimates.

Table 13: Joiners, returners, stayers and leavers and upgrades, 2012-2013

Age	Joiners		Returners		Stayers		Leavers		Upgrades
	All	Qualified	All	Qualified	All	Qualified	All	Qualified	
22	1044	368	0	0	1044	368	174	36	9
23	2033	892	0	0	3224	1644	430	140	43
24	1625	727	237	59	4138	2091	390	179	170
25	1289	488	339	101	4593	2246	533	255	248
26	990	340	434	120	4781	2358	693	293	287
27	870	309	425	124	5375	2683	631	259	299
28	785	268	475	135	5630	2814	693	310	352
29	642	239	406	115	5297	2711	568	271	321
30	560	175	356	92	4734	2351	472	247	306
31	469	154	333	89	4369	2282	445	262	248
32	399	115	287	70	3943	2251	376	232	194
33	325	88	258	78	3987	2383	335	235	185
34	306	100	310	103	4523	3074	414	299	154
35	239	80	360	115	5348	3860	503	402	151
36	252	65	372	139	7223	5496	511	449	146
37	259	104	461	220	9223	7568	642	527	171
38	255	121	568	282	11567	9738	813	745	198
39	279	142	708	371	13856	11907	1028	928	216
40	245	109	834	471	16915	14806	1249	1159	235
41	340	186	901	534	17568	15318	1312	1241	270
42	236	142	932	584	19347	17112	1400	1311	254
43	255	123	952	600	19504	17209	1376	1325	282
44	233	132	1041	668	20798	18546	1583	1450	254
45	252	139	991	619	20051	17574	1457	1385	314
46	223	132	883	579	19264	17186	1298	1211	245
47	186	112	838	561	18599	16543	1200	1152	254
48	166	89	793	535	17592	15645	1140	1078	259
49	127	89	718	483	16664	14736	1010	972	251
50	109	61	645	415	15650	13671	936	869	251
51	120	66	603	398	14038	12029	862	769	291
52	76	36	554	374	14177	12173	816	716	248
53	86	50	527	308	13646	11414	751	665	322
54	73	31	514	339	13484	11188	734	635	312
55	58	28	653	403	11473	9168	1047	840	294
56	53	27	550	347	10391	8423	867	665	256
57	42	19	522	317	8673	6760	846	687	271
58	32	19	496	303	7834	6245	843	643	201
59	43	13	598	352	6262	4757	1114	858	213
60	0	0	0	0	6628	5313	1882	1461	0
61	0	0	0	0	4029	3245	468	401	0
62	0	0	0	0	2603	2142	312	262	0
63	0	0	0	0	2252	1764	233	233	0
64	0	0	0	0	1639	1308	223	196	0
65	0	0	0	0	1142	902	527	415	0
Total	**15576**	**6378**	**20874**	**11403**	**423078**	**343002**	**35137**	**28668**	**8975**

Note: Only upgrades which move an educator from unqualified to qualified are counted.

Table 13 has the following interesting features:

1 New joining teachers are 43 per cent and returning teachers are 57 per cent of total joins and returns

2 More important than qualifications among new joiners are qualifications added by teachers in employment.

The median and mean ages for new joiners and upgraders at time of upgrading are shown in Table 14:

Table 14: The median and mean ages for new joiners and upgraders at time of upgrading

	Median	Mean
All new joiners	27	31
Qualified new joiners	28	32
Upgraders	43	42

Returning joiners are, on average, less well qualified than leavers at the same ages. For example, 93 per cent of 40 year old educators who left in 2013 were qualified, whereas only 56 per cent of educators who returned at age 40 were qualified. Figure 2 shows that the discrepancy exists for all ages. This means that qualified teachers are more likely than unqualified teachers to leave the system permanently. One is in effect, working with a leaky bucket. As fast as new qualified teachers enter the system, experienced qualified teachers are leaving it in net terms. This can be seen by comparison of totals from Table 15 (for 2012-2013):

Table 15: Qualified joiners and leavers in the system, 2012 and 2013

New qualified teachers	6378	24%
Return qualified teachers	11403	43%
Upgrades	8975	34%
Total additional qualified	**26756**	
Qualified leavers	28668	
Net addition to qualified stock	-1912	

Figure 2: Qualified leavers (2012) and joiners (2013)

The percentage of teachers leaving at the end of 2012 by age is displayed in Figure 3 (all teachers), Figure 4 (qualified teachers) and Figure 5 (unqualified teachers). The fitted curves indicate that leaver rates are high among young teachers. The leaver rate drops up to age 48 for all teachers and qualified teachers and a couple of years younger for unqualified teachers, after which they start to rise again. Remember that many teachers who leave will return later.

Figure 3: Age distribution of leaver rates in 2012, all teachers

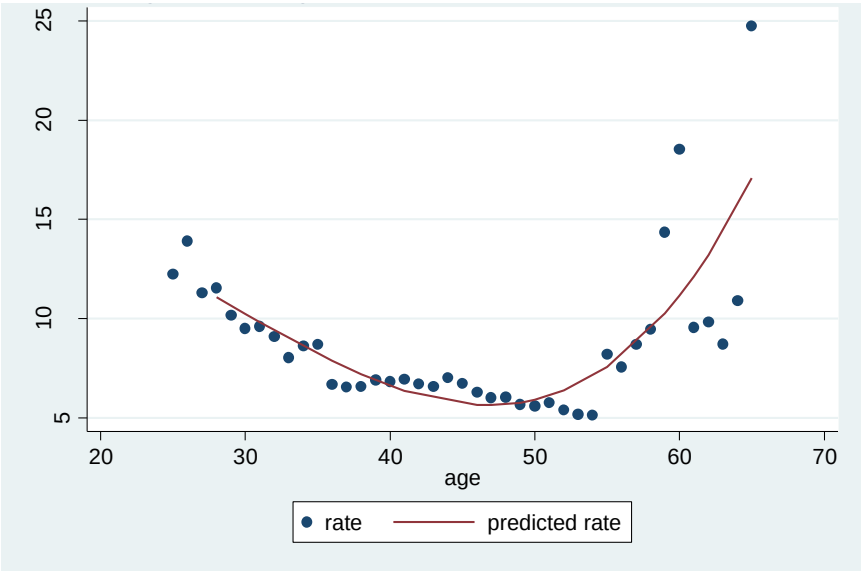


Figure 4: Age distribution of leaver rates in 2012, qualified teachers

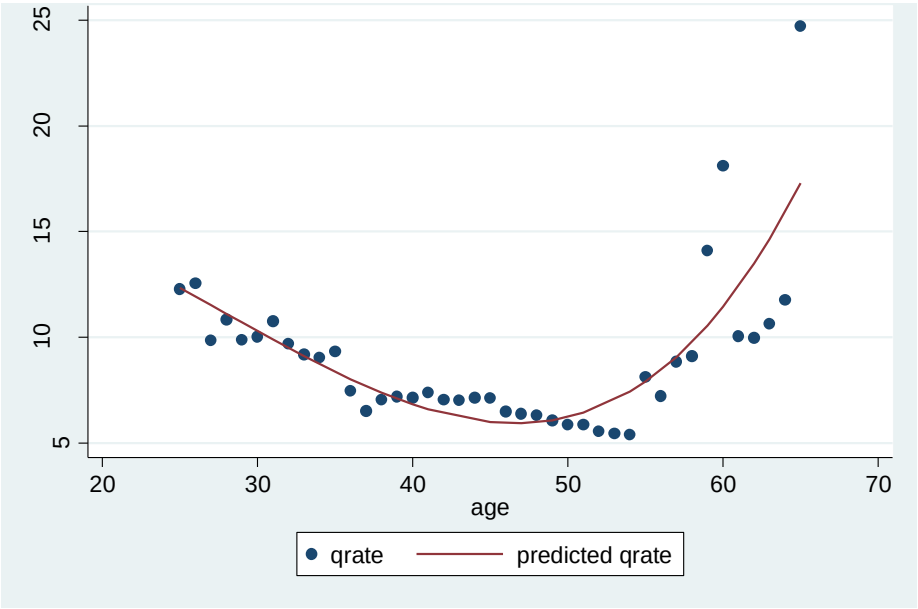
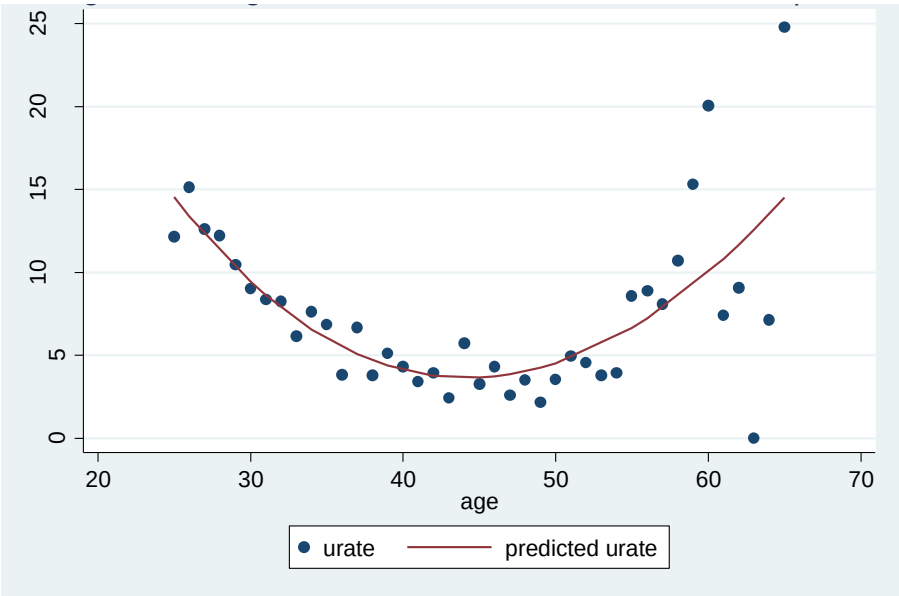


Figure 5: Age distribution of leaver rates in 2012, unqualified teachers



It is possible to construct, on the basis of existing transition rates (the joining, returning and leaving rates), a population of educators which would result if the rates remained constant forever. Such a construction is called a stable population and is counterfactual, but it indicates the implications of current rates. Figure 6, Figure 7 and Figure 8 compare the proportion of qualified teachers by age in 2013, in 2025 and in the associated 'stable' population. A stable population is not a normative 'ideal' population. Rather it illustrates the ultimate effect of the 2012-2013 rates if they were to be unchanged for ever.

Figure 6: Proportion of qualified teachers, 2013

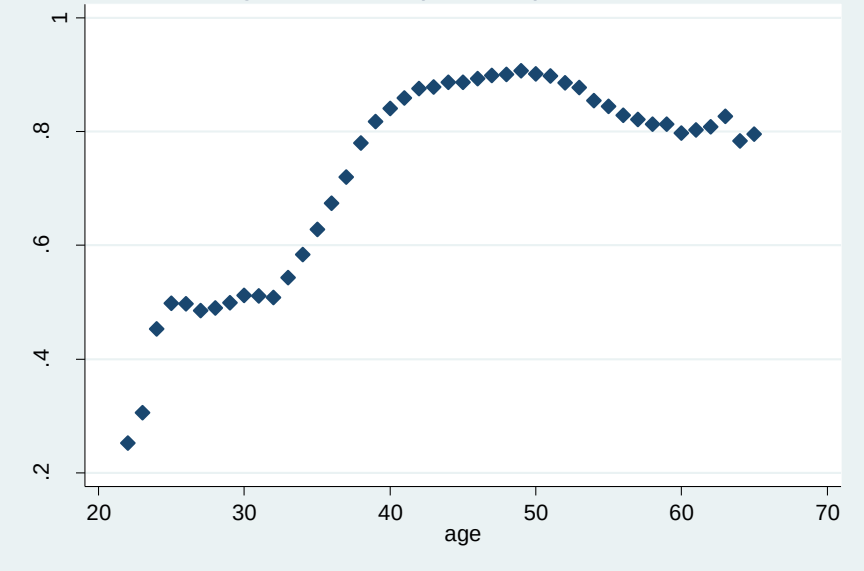


Figure 7: Projected proportion of qualified teacher in 2025

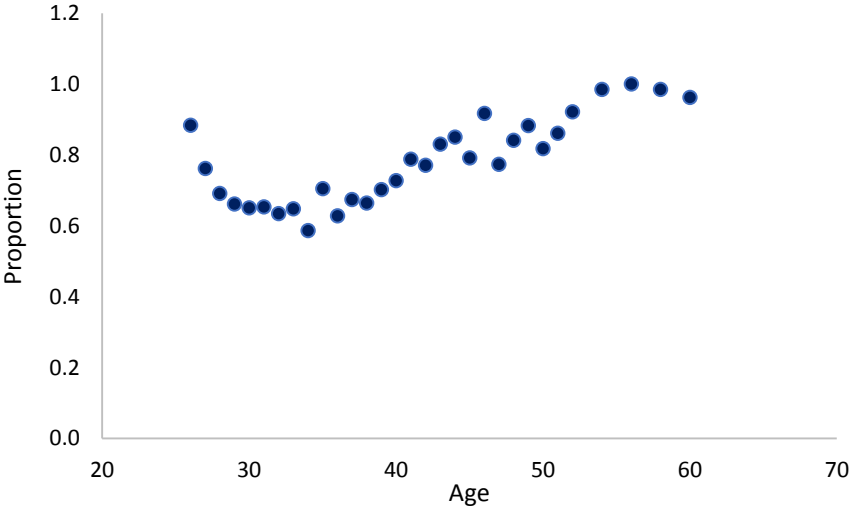
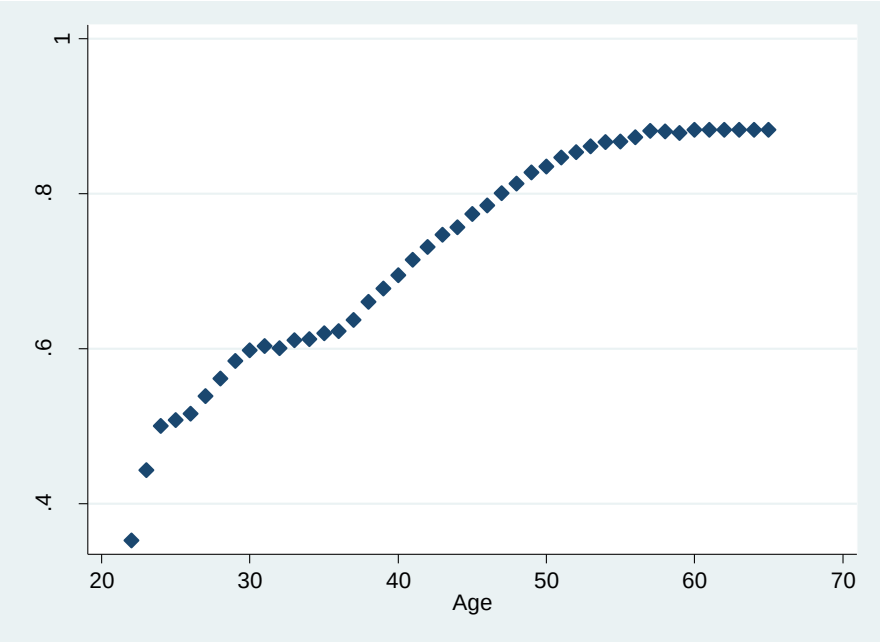


Figure 8: Proportion of qualified teachers, stable population



Again, the picture is very odd. In a developing system, one would expect younger teachers to be better qualified on average than older ones, but this is not the case in the actual distribution in 2013 up to age 50, after age 30 in the 2025 projection and not at all in the stable population. Figures Figure 6, Figure 7, and Figure 8 demonstrate, in accordance with Table 14, the slow build-up of full qualification with age. The reason is that the majority of teachers build up their qualifications on the job, often over many years.

It is also possible to construct age distributions of actual teachers in 2013, projected teachers in 2015 and the stable population. Figure 9, Figure 10, and Figure 11 set out the histograms.

Figure 9: Age distribution of teachers in 2013

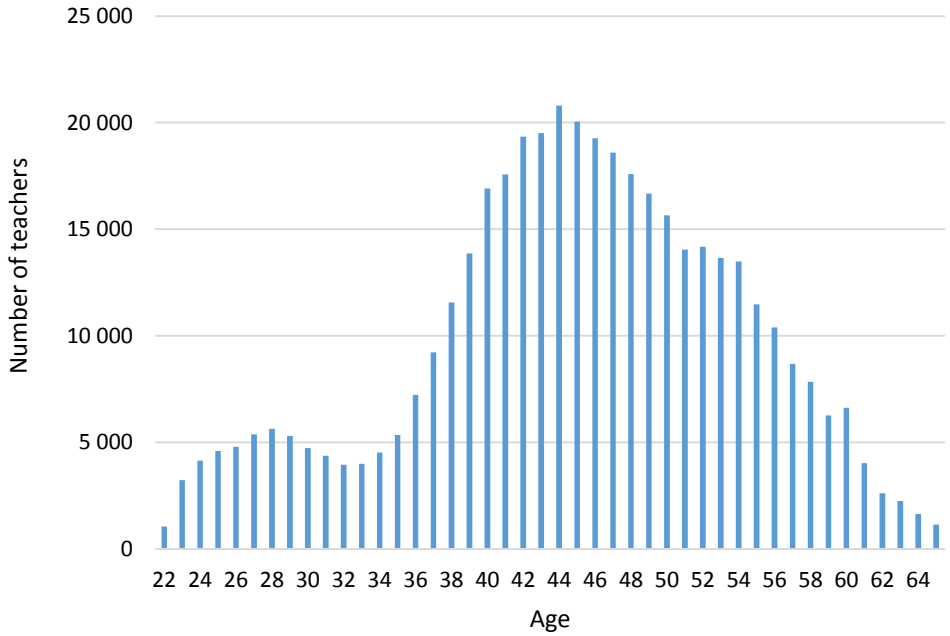
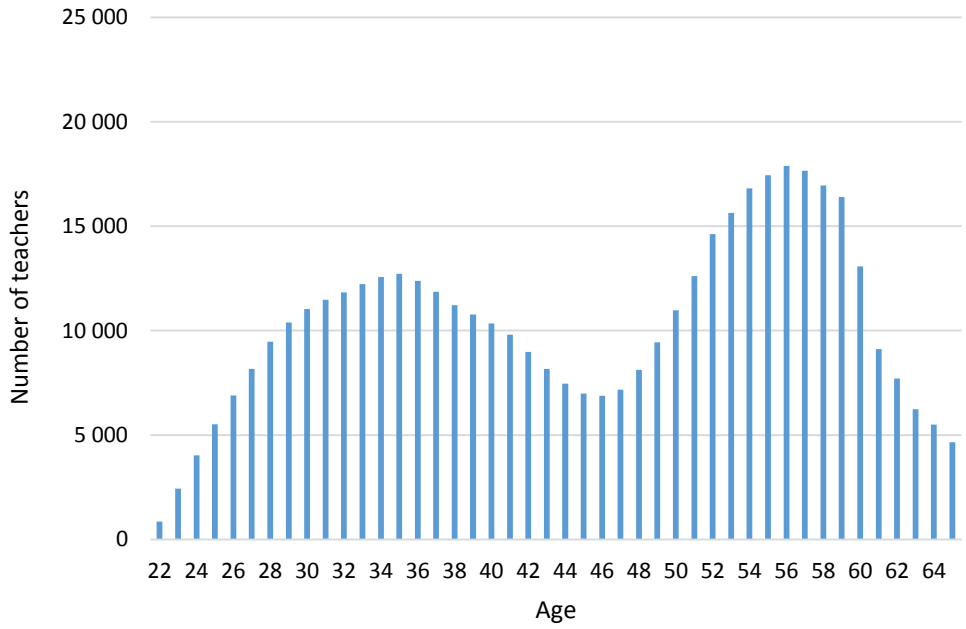


Figure 10: Age distribution of teachers in 2025



There was a dip in the number of young teachers employed about ten years ago. Table 16 sets out the number of teachers employed from 1999.

Table 16: Teachers employed, 1999-2014

Year	Educators employed	Actual	Per cent increase
			Three year moving average
1999	365447		
2000	363343	-0.58%	
2001	354201	-2.52%	-0.47%
2002	360155	1.68%	-0.05%
2003	362598	0.68%	0.74%
2004	362042	-0.15%	2.02%
2005	382113	5.54%	2.12%
2006	385860	0.98%	2.90%
2007	394225	2.17%	1.62%
2008	400953	1.71%	2.30%
2009	413067	3.02%	1.98%
2010	418019	1.20%	1.61%
2011	420608	0.62%	0.97%
2012	425167	1.08%	0.56%
2013	425023	-0.03%	0.36%
2014	425090	0.02%	

Source: Department of Basic Education, *Education Statistics* and *School Realities*

A stagnation in the number of teachers employed between 1999 and 2004 must have led to a decline in the number of young teachers entering the system. One possible reason could be the decline in enrolment of ITE students at contact colleges from 70 731 to 10 153 between 1994 and 2000.[9] When the colleges of education closed, there was very small flow of students into the higher education system.[10]

Figure 11: Stable age distribution

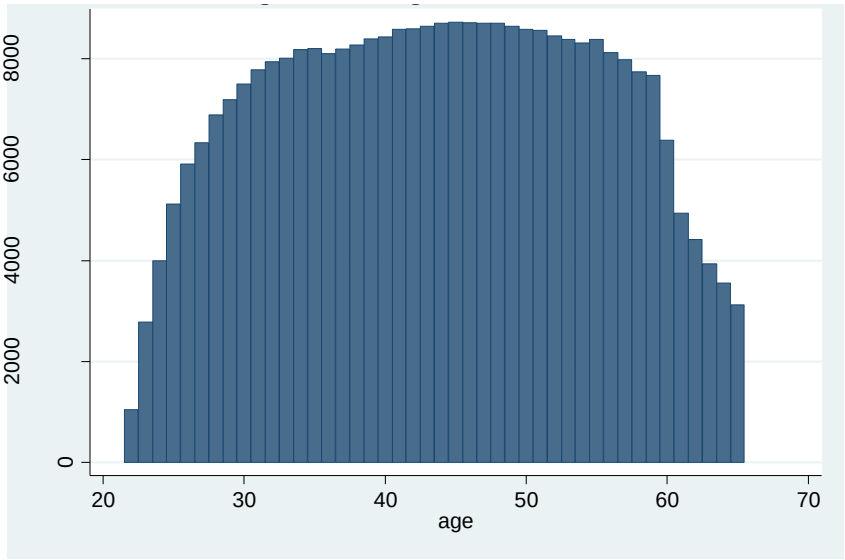


Figure 9 and Figure 10 show that there has been a boom and a bust in the hiring of young educators leading to an age distribution radically different from the stable distribution. They also show that the effects of a stop-start hiring policy last for decades. In 2025, there will be a relative shortage of teachers in their 40s. This will be great for the teachers involved, since promotion will necessarily be easy, but not so great for the learners because the promoted teachers will be younger and less experienced than in the past. Figure 11 shows the stable age distribution, which turns out to be close to ideal.

APPENDIX 4: COMPARISON OF SCHOOL REALITIES ESTIMATE OF LEARNERS BY GRADE WITH THE GENERAL HOUSEHOLD SURVEY ESTIMATE, 2013

Table 1: School enrolments, 2013

	School Realities	General Household Survey	Per cent difference
Grade R	779370	894426	14.8%
Grade 1	1222851	1253197	2.5%
Grade 2	1116427	1186161	6.2%
Grade 3	1025185	1041441	1.6%
Grade 4	964630	1083234	12.3%
Grade 5	923562	1083287	17.3%
Grade 6	909095	1118042	23.0%
Grade 7	902099	1103706	22.3%
Grade 8	942345	1112687	18.1%
Grade 9	1073060	1229710	14.6%
Grade 10	1146285	1319682	15.1%
Grade 11	834611	1033773	23.9%
Grade 12	597196	770469	29.0%
Total	**12436716**	**14229815**	**14.4%**

APPENDIX 5: GRADE R ISSUES

There is much debate about what is happening and what may happen to Grade R enrolments. Much of this is noise from the point of view of this study, but it needs to be discussed to put what is done here into perspective.

Grade R may be offered in more than one type of institution. It may be offered in ordinary schools and it may be offered in ECD centres. The DPME and DBE's report[11] on the effect of Grade R shows the "impact of Grade R is small and there is virtually no measurable impact for the poorest three school quintiles, while there are some impacts for the higher quintile schools". This suggests that the functional equivalent of Grade R may be offered in more informal contexts as well.

The Department of Basic Education's report states that 55 353 learners were enrolled in Grade R in ECD centres in 2011, citing a "Survey of ECD centres". Grade R enrolments in ECD centres were thus 6.9 per cent of total formal Grade R enrolments in 2011.

Government policy is to move towards providing universal access to Grade R, although there is no mention of a requirement that enrolment in Grade R will be required for enrolment in Grade 1 the next year and 'universal access' does not imply 'compulsory and universal enrolment'. Moreover, it may never be the case that all Grade R enrolments are in ordinary schools. Nonetheless, the implications of a higher Grade R enrolment on the number of educators required in 2025 can be summarized in Table 1.

Table 1: Projected additional Grade R teacher requirements

80% Grade R/Grade 1 ratio in 2025	4 556 additional teachers in 2025
90% Grade R/Grade 1 ratio in 2025	8 122 additional teachers in 2025
100% Grade R/Grade1 ratio in 2025	11 688 additional teachers in 2025

Some analysts prefer to use Grade R enrolments as measured by the General Household Survey (GHS). The GHS estimated the number of Grade R enrolments at 894 426 in 2013, considerably more than the 779 370 reported in *School Realities* 2013. However, tabulating the age distribution of learners in Grade R by age, one finds reported ages from 5 to 22. If one finds it implausible that any learner over the age of 6 is in fact in Grade R, the GHS estimate drops to 833 016. Moreover, some of these will be in ECD centres. In fact, the GHS puts the number of age appropriate Grade R learners in pre-school centres at 257 304 and in schools at 575 712, an implausible division.

The table in Appendix 3 comparing *School Realities* estimates with the GHS estimates shows that the latter are considerably higher than the former over most of the grade range and that in total, the GHS puts the number of learners in all grades at 14.2 million, 14 per cent more than the 12.4 million reported by *School Realities*. The discrepancy for Grade R is nearly the same as the discrepancy for learners in all grades. Some of the discrepancy can be explained by the fact that the GHS is a sample and so the estimates are subject to sampling error while *School Realities* reports a census. But the problem remains that the GHS estimates are consistently higher than estimates from *School Realities* for all grades. Why this is so is not known.

Some analysts use phrases like '80 per cent of five year olds are enrolled in Grade R'. These phrases should be approached with caution. If they are made on the basis of GHS results, they are unreliable, as indicated above. If they are made on the basis of estimates published in *Education Statistics*, it should be noted that enrolment estimates by age are not published in that source. What one can say is that the ratio of Grade R enrolments to children age 5 is such and such, but this is not the same as the claim at the beginning of this point.

We can find no reason to regard enrolments in Grade R in ordinary schools as any more unreliable than enrolments in any other grade. The method here is consistent. We have used published material from *Education Statistics* or *School Realities* throughout.

Endnotes

[1] The analysis of PERSAL data was based on two internal departmental reports by Martin Gustafsson, adviser to the Minister of Basic Education. At the time of this study the PERSAL database was not made available to Dr Simkins on the grounds of confidentiality. The reports are "Teacher supply patterns in the payroll data" (unpublished, 2009) and "Inflow of new teachers into the public system" (unpublished, 2014).
[2] The PERSAL estimate is used in the PERSAL projections and the ASS estimates (disaggregated by age) are used in the ASS projections.
[3] In Table 5 of Appendix 3, a finer classification of teachers by qualification is presented.
[4] The implicit assumption is that foreign teachers and South African teachers over the age of 65 will remain a constant proportion of all teachers employed.
[5] See table 6.
[6] It is sometimes suggested that the progression from graduation to employment as an educator is lower than this. But a lower figure is not consistent with the qualified new joiners and upgrades in relation to output in 2012-2013.
[7] The ASS data suggests that this assumption is too optimistic and that leaver rates are higher for qualified than unqualified educators.
[8] See Figures 5 and 6 below.
[9] Vinjevold & Associates, (2001), citing a Committee of College of Education Rectors of South Africa report of 2000.
[10] Patterson, A., & Arends, F. (2009). Teacher Graduate Production in South Africa *Teacher Education in South Africa Series*. Cape Town: HSRC
[11] ReSEP. (2013). The impact of the introduction of Grade R on learning outcomes. Pretoria: DPME & DBE.