Specialisation-specific teacher supply and employment in the 2019 to 2022 period

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Summary

The current report presents statistics on teacher graduates completing their studies in 2018, broken down by specialisation, as well as new analysis of the patterns whereby these teachers move into public schools. While the graduates data are now six years old, they were the most recent readily available data lending themselves to this type of analysis. While teacher graduate production has increased marginally since 2018, it is unlikely that the breakdown by specialisation has changed substantially.

At the aggregate level, in 2019 the supply of new graduates from universities roughly matched estimated demand. However, at the primary school level, supply was only 60% of the projected demand. In contrast, at the secondary level supply was twice what was demanded. Despite an under-supply problem at the primary level, only 64% of the 2018 Foundation Phase graduates found work in the public schooling system in any year from 2019 and 2022, and only 55% were employed in this system in 2022. The latter figure for upper primary was a lower 47%. Two things explain this co-existence of an under-supply with low levels of absorption into the primary level of the public schooling system.

Firstly, budget constraints meant that the public teacher workforce was not able to grow as it should, in line with enrolment increases.

Secondly, many primary schools resorted to hiring secondary-level teachers, who were relatively easily available, given the *over*-supply of these teachers. Data covering three provinces, which jointly account for around half of the country's enrolments, point to 22% of newly appointed graduates in the Foundation Phase having been trained for a higher school level, mostly for upper primary, and as many as 47% of grades 4 to 7 teachers having been trained for the secondary level. Statistics on what teachers actually teach are in large part made possible by recent efforts to extract teacher data from SA-SAMS, a system covering most schools in the country. Perhaps the most concerning thing is that newly qualified teachers not trained for the Foundation Phase should not be teaching at this level, given the complexities of, for instance, teaching early grade reading. Fortunately, this problem is fairly limited, with 78% of newly hired Foundation Phase teachers being trained to teach at this level.

After an introduction in section 1 and a discussion of aggregate statistics in section 2, section 3 of the report describes the language of learning and teaching (LOLT) specialisation among Foundation Phase graduates. Two-thirds of teachers trained for the Foundation Phase should ideally be able to teach using an African language as the LOLT, but universities point to only half being in a position to do this. This under-states the problem insofar as graduates tend to be inadequately prepared during their university studies to teach the entire curriculum,

[1] This report would not have been possible without the valuable assistance and inputs from a variety of individuals, including (but not limited to): Naledi Mbude-Mehana, Leticia Munday, Mfela Mahlangu, Veronica McKay and Aaron Nkosi from the Department of Basic Education (DBE); Michelle Mathey, Bongekile Mathebula and Nthabeleng Lepota from Department of Higher Education and Training (DHET); Nwabisa Makaluza and Servaas van der Berg from Stellenbosch University. Ultimate responsibility for the statistics and their interpretation obviously still rests with the author.

particularly mathematics, in an African language. This underlines the fact that increases in the production of Foundation Phase teacher graduates should concentrate on the output of more teachers with competencies in the use of African languages. A significant supply boost is needed especially in the case of isiXhosa and Sepedi – here the 2018 graduate output was only around a fifth of the estimated demand.

The predominance of UNISA is especially striking with respect to the training of Foundation Phase teachers. Of all graduates focussing on this level, 53% graduated at UNISA. It is important to note that despite UNISA's predominant distance education mode, much of UNISA's teacher training occurs using face-to-face modalities, especially when it comes to Foundation Phase teachers.

Section 4 focusses on grades 4 to 7, specifically the languages of graduates. The language-specific supply and demand issues at this level are fairly similar to those seen in the Foundation Phase.

Section 5 focusses on the secondary level. The over-supply of graduates is concentrated among non-language subjects, and especially the humanities. With regard to the eleven official languages there is a slight *under*-supply of graduates. The number of mathematics and mathematical literacy graduates should ideally increase a bit, though here what is perhaps more critical is improving the competencies of mathematics teachers. Linking to SA-SAMS data allowed for new insights into the degree to which the university-based subject specialisation of graduates matches their teaching responsibilities in schools. The level of matching is relatively high insofar as 84% of teachers trained for the secondary level, and who teach at that level, teach at least one of the two specialisation subjects they had to focus on.

Finally, section 6 provides insights into the mathematics competencies of the 2018 teacher graduates analysed in the rest of the report. This is done by linking graduates to their earlier Grade 12 examination results in mathematics. This approach is useful as it assists in determining the scope for improving teacher quality through better selection into the profession. The scope for this is in fact limited, as new teachers are already relatively good performers among Grade 12 candidates. Instead, improving mathematics competencies among school learners, the pool from which teachers are drawn, and a stronger focus on raising subject content skills during initial teacher education, emerge as optimal solutions.

1 Introduction

In recent years analysis of teacher supply and demand, both at the aggregate level and in terms of LOLT[2] and subject specialisation, has improved. On the demand side, Excel files behind a 2020 Department of Higher Education and Training (DHET)[3] report provide estimates of the specialisation-specific demand per year for 2018 to 2058 for the public ordinary schooling sector[4]. Those estimates are based on enrolment projections. Currently, the Teacher Demographic Dividend project, a collaborative initiative involving, among others, the Department of Basic Education (DBE) and Stellenbosch University, is exploring specialisation-specific demand using, among other sources, teacher details in the SA-SAMS dataset. Teacher data, as opposed to enrolment data, have the potential to provide a more reliable demand picture, for instance because learner-educator ratios can differ across subjects and subject teachers often teach more than one subject. It appears, however, that estimates

[2] Language of learning and teaching, or language of instruction.
[3] Department of Higher Education and Training, 2020.
[4] This demand covers both publicly and privately educators in these schools.

emerging from the teacher data differ very little from what was obtained previously from enrolment data[5].

This report deals mostly with the supply side of the equation. An unpublished 2021 report by DHET[6] breaks down teacher graduates at the end of the 2019 academic year by level in the schooling system at which they are qualified to teach. That report includes supply from private universities, which account for 2% of all teacher graduates produced in the country. The DHET report does not include breakdowns by LOLT and subject. The current report aims to address this gap. In doing this, it makes use of data on individual graduates from the end of 2018, data which appeared particularly fit for purpose, and which are a part of the data which have been shared between DBE and DHET on a routine basis, up to now mainly to gauge the movement of educators into the public schooling system at the aggregate level.

Following an overview of the overall supply and demand situation in section 2, section 3 below examines LOLT-specific supply at the Foundation Phase, section 4 does something similar for grades 4 to 7, while section 5 examines subject-specific demand at the secondary level. The presence of the 2018 graduates in the Persal payroll is also examined across all three sections.

Limitations of the current analysis include the omission of the private sector, both with respect to the supply from private universities and, on the demand side, subsequent presence in some private employment. Moreover, there are some quality problems with the graduates data, which are noted below. These problems should be addressed in future, but they do not appear to compromise the findings seriously. It is possible they have already been addressed in post-2018 data, which were not available or not suitable for the current report.

2 Supply and demand by school level

There is a relatively clear picture of supply and demand by school level, and this points to an over-supply of secondary-level teachers. As seen in Table 1, for both grades 1 to 3 and grades 4 to 7, supply has been around 60% of the estimated demand in recent years. For the secondary level, however, supply has been more than double the estimated demand[7].

Table 1: Supply and demand by level

	2019 estimated *demand* for new joiners in the 2020 DHET report	2019 graduate *supply* according to 2021 DHET report (includes private universities)	2018 graduate *supply* according to data used for the current report
Grades 1 to 3	7,709	4,799	4,174
Grades 4 to 7	10,868	6,621	6,470
Grades 8 to 12	7,458	17,028	14,962
Total	26,035	28,447	25,606

Note: In this table and others in the report totals and sub-totals may misalign by one or two graduates. This is because half graduates in some instances apply.

From Figure 1 it is clear that there are no great differences by school level in the age distribution of graduates. However, graduates from UNISA tend to be a bit older than other

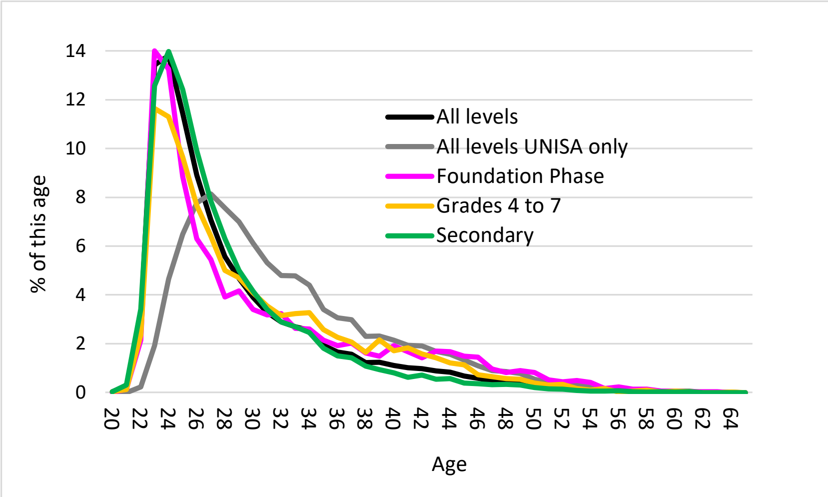
[5] Van der Berg *et al*, 2023.

[6] Department of Higher Education and Training, 2021.

[7] Importantly, the teacher training policy (Government Notice 111 of 2015, commonly referred to as 'MRTEQ') breaks level specialisation down by the three levels seen in Table 1, and not by the four phases or bands of the national curriculum – those four would be grades 1 to 3, 4 to 6, 7 to 9 and 10 to 12.

graduates. Among all graduates, 15% were above age 35, the figure being 28% for UNISA graduates.

Figure 1: Ages of graduates



The 25,606 total in the last column of Table 1 is 95% of the 27,085 records available in the Excel files provided by DHET. The difference of 1,479 is accounted for by records where the level of the graduate was not indicated in the data. Of the 1,479, 1,249 were from two universities: Cape Peninsula (CPUT – here 849 graduates could not be classified) and Fort Hare (UFH – 400 graduates not classified). The graduate counts for these two universities can be considered particularly incomplete in the current report. Judging from statistics for a later year published by DHET[8] it appears that most unclassified CPUT graduates are primary teachers, while most unclassified UFH graduates are secondary teachers.

If the supply of new graduates is compared to the annual intake of new teachers into the public schooling system, which accounts for around 95% of the entire schooling system, what emerges for 2019 is the abovementioned approximately 27,000 teacher graduates from universities and an intake of around 20,000 teachers. This intake is suppressed by budget constraints in the basic education sector, which has kept the overall size of the public teacher workforce roughly static, even though enrolments have increased considerably. This gap between the supply and intake has widened since 2019, as universities increased supply in line with DHET targets[9].

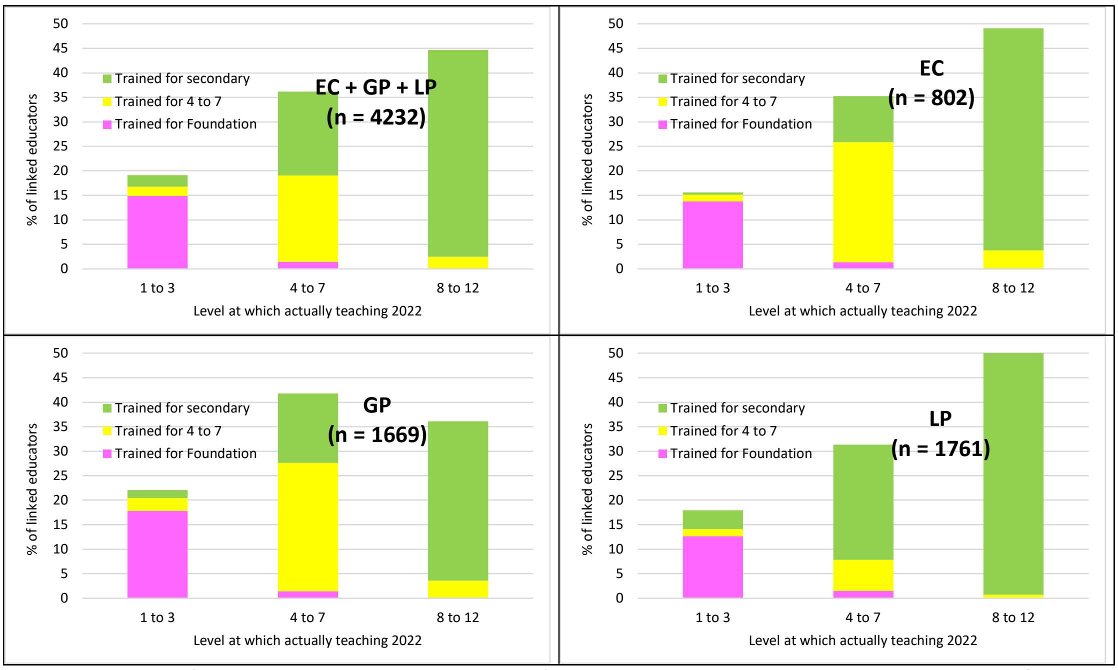
It should not be surprising, given what Table 1 shows, to find many recently graduated teachers with a secondary level specialisation teaching at the primary level. Even if in general it would not be considered desirable, there is no policy prohibiting this. Recent extraction and processing of data on what grades and subjects teachers teach in three provinces provides a unique opportunity to compare the level focussed on by graduates in their studies to the level actually taught when the graduates become employed. The new data are extracts from SA-SAMS[10] for Eastern Cape, Gauteng and Limpopo[11]. It was possible to merge 4,299 2018 graduates in the DHET data, out of a total of 27,085, to the SA-SAMS data of 2022. After removing 67 linked educators whose studies did not fit neatly into one of the three school levels represented by the row headings in Table 1, the result was 4,232 educators available for the analysis. Figures presented in subsequent sections of this report indicate these 4,232 educators are 42% of all educators who graduated in 2018 and were then in employment as

[8] Department of Higher Education and Training, 2021.
[9] Gustafsson, 2023: 41.
[10] South African School Administration and Management System.
[11] See Van der Berg *et al* (2023).

educators in 2022. This is a high degree of linking given that the three provinces account for around half of the country's schooling system[12]. There is no reason to believe that patterns would be substantively different in the other six provinces. Yet their exclusion from the analysis must of course be taken into account when interpreting the statistics.

Figure 2 below provides the results of this linking analysis. When the three provinces are combined, a picture emerges of a relatively 'neat' Foundation Phase: if teachers were trained to teach at this phase, this is what they actually end up doing. The numbers of educators teaching at the Foundation Phase despite not being trained for this constitute 22% of newly appointed Foundation Phase teachers. This is to some extent reassuring given, for instance, how specialised early grade reading is. The large anomaly consists of large numbers of teachers trained for the secondary level but teaching in grades 4 to 7. Among newly appointed graduates teaching grades 4 to 7, 47% were trained for the secondary level. In Limpopo this is particularly visible, where the statistic is as high as 75%. In Limpopo, moreover, as many as 30% of graduates entering the Foundation Phase were actually trained to teach in grades 4 to 7 or 8 to 12. Across the three provinces, 32% of graduates trained for the secondary level and who moved into the public system ended up teaching learners in grades 7 and below.

Figure 2: Level alignment between training and actual responsibilities



Note: Fractions of teachers would be used where, for instance, a teacher teaches, according to SA-SAMS, grades 3, 4 and 5. In such a case one-third of the teacher would be counted as teaching in the Foundation Phase, and two-thirds in upper primary. See Van der Berg et al *(2023) for further details on this method.*

How problematic is it that large numbers of educators trained to teach grades 8 to 12 end up teaching grades 4 to 7? This is clearly less serious than the reverse, or teachers trained for grades 8 to 12 teaching in the complex environment of the Foundation Phase. As pointed out in section 5 below, teachers with a grade 8 to 12 specialisation do not appear to be unduly spread across too many subjects if they end up teaching in grades 4 to 7. Arguably the

[12] Specifically, the three provinces account for 46% of grades 1 to 12 enrolments in the country. The SA-SAMS data did not have the full 13-digit identity number, but it did have the school's EMIS number and each educator's date of birth. This allowed for the use of the Persal data to find, to a satisfactory degree, each SA-SAMS educator's 13-digit ID number, which then allowed for linking to the graduates data. Because of this linking procedure, all 4,232 linked educators would have to be publicly employed, even if the SA-SAMS data do include privately paid educators.

misalignments illustrated by Figure 2 are not among the more pressing concerns that should preoccupy education planners. The costs to the state across all categories of educators are similar, as all require a four-year qualification. One key reason why university students would prefer the training for grades 8 to 12 teaching is that this route generally involves obtaining a three-year general Bachelors degree outside of the education field, which widens career options. A further reason is that universities may restrict entry into the four-year Bachelors of Education degree, in line with DHET targets.

It is important to bear in mind that the anomalies illustrated in the above graphs relate to new graduates entering the schooling system in recent years. The anomaly of many teachers trained for the secondary level teaching at the primary level may not exist for most of the teacher force, which does not consist primarily of recent graduates. Further analysis of the SA-SAMS data on its own could reveal what the situation is in this regard.

3 LOLT-specific supply and demand in the Foundation Phase

The DHET dataset that is the key source for the current report contained 27,085 records, each representing a graduate after final-year attendance in 2018. Columns were labelled A to R in the received data, giving 18 columns, with the meaning of each clear in the original Excel files per institution. These columns would also be familiar to faculties of education across the country, who are responsible for compiling the data in this format. There were 23 public universities providing the data, the three missing universities being Vaal, Sefako Makgatho, and Mangosuthu. According to Department of Higher Education and Training (2021), Vaal had students, but no graduates yet, and the other two universities do not train teachers. The following processing of the data preceded the calculation of the university-specific statistics of Table 2 below.

- First teachers qualifying to teach in the Foundation Phase (FP) had to be extracted. For this, column C was used. In the case of 1,604 graduates with no data in column C, it was possible to identify 466 as Foundation Phase teachers using column E, where home language for just Foundation Phase teachers had to be entered. The extraction produced 4,713 Foundation Phase graduates, from 17 universities. This seems complete. Department of Higher Education and Training (2021) pointed to 16 universities producing Foundation Phase teachers. Of the 4,713, 531 had level descriptions such as 'FP/IP', suggesting teachers were trained not just for the Foundation Phase, but also for some other level. The 531 were from three institutions: Tshwane, Free State, and KwaZulu-Natal.

- The heading for column F indicates it should specify what *African* language teachers were qualified to use as a LOLT. Not only was this column often blank, some values reflected the non-African (strictly speaking Germanic) languages English and Afrikaans. Column F suggested that only 994 Foundation Phase graduates were qualified to teach using an African language. These 994 were from just 9 of the 17 universities, with all Foundation Phase graduates in the 9 covering just 33% of the total across all universities. This obvious problem was alleviated by the fact that for 98% of Foundation Phase graduates, column E on home language contained one of the eleven official languages. An analysis of patterns within the 9 universities revealed that 62% of graduates in these universities had an African language as a LOLT (using the appropriate column F), that there were virtually no graduates with an African language as a home language who chose English or Afrikaans as their LOLT (there we just three such graduates), and that 112 graduates reported having English or Afrikaans as a home language, but an African language as their LOLT. These 112 graduates are likely to be from a multilingual background with considerable fluency in at least one African language[13]. Where column F had no value, and where home language appeared in column E, column E was considered the LOLT, the understanding being that the graduate *may* have formally specialised in this LOLT, and would almost certainly have some capability in using this African language as the LOLT. Drawing from columns E and F in this manner produced 4,663 graduates with one of the 11 South African LOLTs. In Table 2, values in grey indicate that while there was no clear indication from column F that this language was formally considered the LOLT (there was not a single entry to confirm this), column E indicated that at the very least, there were this many graduates using the language as a home language. In producing Table 2, graduates qualified not just as Foundation Phase teachers, but also teachers of grades 4 to 7, were counted as half a Foundation Phase teacher. This reduced the 4,663 to the 4,174 seen in Table 2.

- The column on the far right of Table 2 and the row at the bottom reflect numbers of graduates who were found in the 2022 Persal data.

Apart from aforementioned data issues, a more fundamental issue is that where universities report having prepared a teacher to use an African language as a LOLT, this preparation tends to be inadequate[14]. Above all, the training of Foundation Phase teachers to teach mathematics is mostly conducted in English, with little focus on how mathematical terms and concepts will be conveyed in an African language.

What striking patterns emerge from Table 2? The 2,289 public education employees in 2022 represent 55% of the 4,174 graduates in 2018. The percentage rises to 64% if employee data for *all* the years 2019 to 2022 are considered. Even 64% is a low percentage if one considers that this figure, at least for all teachers of all levels, has been as high as 80% some ten years ago[15]. The details behind the Department of Higher Education and Training (2020) estimates point to a demand for 7,709 Foundation Phase teachers in 2019. The supply of 4,174 is just 54% of this. The gap between the estimated demand of 7,709 and actual intake of 2,289 is striking and is likely to reflect some over-estimation in the former and the fact that budget constraints in the schooling sector have suppressed hiring. Against this background, whether the universities over- or under-produced graduates at the aggregate level is debatable. However, at the level of the 11 LOLTs firmer conclusions can be drawn. For all African languages except Setswana, close to 80% of graduates were employed in the public system by 2022, which seems desirable. In the case of Setswana, only 42% of graduates were employed, with the figures suggesting this was more about exceptional under-absorption in public schools using Setswana, presumably to a large extent in North West Province, than about an over-supply. Had budgetary constraints in the schooling sector been less severe, it is possible that there would have been a clear under-supply of African language teachers, especially as far as isiXhosa and Sepedi are concerned. Supply for these two languages was just a fifth of the projected demand.

Importantly, half of the 2018 Foundation Phase graduates are likely not to be fluent in an African language – graduates focussing on English and Afrikaans as a LOLT come to 33% and 15% of graduates respectively. The demand within the public ordinary schooling sector is for some 32% of Foundation Phase teachers to use English or Afrikaans (23% and 9%

[13] It is also noteworthy that 60% of graduates with *both* an African home language and such a language as an official LOLT (column F) have *different* African languages across the two columns. There is moreover considerable movement across language families. For instance, 82 of the 351 across-language movements were from isiZulu home language to Setswana LOLT (these are from the Nguni and Sotho families respectively). However, this may not be representative of all graduates in the 9 universities, where 20% of Foundation Phase graduates had no value in column F. In fact, it is possible that column F was more likely to be filled in specifically if the LOLT differed from the home language.

[14] Ramadiro, 2022.

[15] Gustafsson, 2023: 42.

respectively). The various statistics in Table 2 suggest this should be corrected through an *increase* in the number of African language graduates, as opposed to a *reduction* in English and Afrikaans.

What is also striking about Table 2 is that 53% of the graduates are from UNISA. This is even higher than the secondary-level figure of 39% (see section 5). The question is often raised whether distance education is a sufficient training modality for teachers. What should be kept in mind in this regard is that in training teachers UNISA makes use fairly extensively of face-to-face support and work-based individualised coaching, for instance in recent years in its Gauteng-focussed programme to upgrade the qualifications of Grade R teachers to allow them to also teach in grades 1 to 3.

Importantly, of the 4,174 graduates seen in Table 2, 530 were already employed in the public schooling system in 2018, the last year of study. Of the 530, 418 were from UNISA, 75 from Mpumalanga (UMP) and 15 from North West (NWU). These were then individuals who were finalising their studies, presumably part-time, while already employed.

Table 2: LOLT-specific statistics for Foundation Phase using 2018 graduates

	Eng	Zul	Afr	Sot	Xho	Tsw	Ven	Ped	Swa	Tso	Nde	Total	Lang. count	Inflow to Persal 2022
UNISA	905	448	494	41	75	61	17	99	17	42	15	2,214	11	1,063
NWU	193	2		35		63						292	4	99
UNIVEN		1		34			121		28	58		242	5	220
UP	38	103	17			2		32			3	195	6	90
UNIZULU		194										194	1	147
WITS	84	30	5	14	12	7	6	8	2		1	167	10	78
TUT				78		86						164	2	88
UFS	7	32	34	29	3	1		2				106	7	78
UFH[16]	13	17	10		63							102	4	92
UMP									73		27	100	2	95
SUN	31		56		6							93	3	32
NMU	53		23		16							92	3	53
UJ	8	35		10	5	11			12	4	4	89	8	75
RU	14		3		52	1						70	4	44
UKZN	9	14										23	2	15
UCT	19											19	1	12
CPUT[17]	12		1									13	2	10
Total	1,384	875	642	241	232	231	144	140	132	104	50	4,174	11	2,289
Univ. count	13	10	9	7	8	8	3	4	5	3	5	17		
2019 demand	1,777	1,585	692	439	1,277	646	162	716	131	239	46	7,709	Supply <60%	
Persal 2022	415	652	266	188	190	96	123	115	114	97	35	2,289	Inflow <80%	

Note: Vertical sorting is from university with most graduates to least, horizontal sorting from language with most graduates to least. As explained in the above narrative, values in grey indicate values entirely derived from the home language of the graduate.

[16] UFH figures are clear under-counts given classification problems in the data – see section 2.

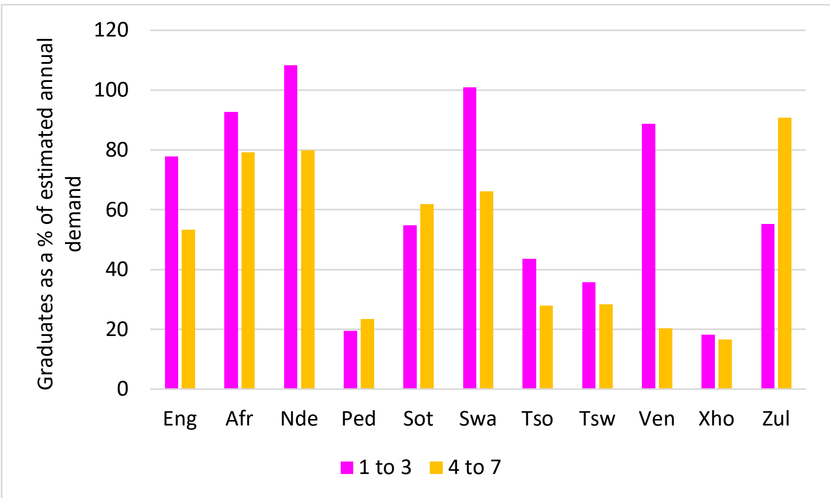
[17] CPUT figures are clear under-counts given classification problems in the data – see section 2.

4 LOLT-specific supply and demand in upper primary

Table 3 below breaks graduates specialising in grades 4 to 7 down by language. The same procedure of prioritising column F, then column E, used for the Foundation Phase is employed here. The data were worse for this level of the schooling system than for the Foundation Phase, presumably because language is less of a concern in grades 4 to 7, compared to the Foundation Phase, as the LOLT has been English across around 80% of the country in these grades[18]. Overall, there were 6,470 graduates trained for grades 4 to 7 teaching, after treating each of the abovementioned 531 'FP/IP' individuals as half an educator. The 5,627 educators covered in Table 3 reflect the fact that 13% of the educators did not have language data. Why is the language of grades 4 to 7 teachers important if officially the LOLT is mostly English? This is important as in these grades learners still need concepts to be explained in their mother tongue, and there is an interest in extending mother tongue instruction to grades 4 to 7 – see Mbude (2019) for an account of work in Eastern Cape in this regard.

The inflow of graduates into Persal according to Table 3 is even lower than for the Foundation Phase: 47% against 55%. This would be line with Figure 2, which pointed to many grades 4 to 7 posts being filled by graduates actually qualifying to teach grades 8 to 12. With regard to language-specific supply and demand, the patterns for grades 4 to 7 are similar to those for the Foundation Phase. The values in Figure 3, which are calculated from output over estimated demand in Table 2 and Table 3, display a fairly high correlation of 0.61 if one compares the two levels. Exceptions include Tshivenda, where graduates for the Foundation Phase almost match estimated demand, while graduates for grades 4 to 7 is only 20% of the demand. However, this can be assumed to be a reflection of the data gaps, as opposed to a real problem. The University of Venda (UNIVEN) is one of the universities excluded from Table 3 due to missing language values. According to Table 3, 37% of grades 4 to 7 graduates appear not to be fluent in an African language, a better statistic than the 49% seen in the Foundation Phase. Here again, however, this could be a reflection of the data problems at the grades 4 to 7 level.

Figure 3: Percentage of language demand met at the primary level



[18] Department of Basic Education, 2010: 16.

Table 3: Language-specific statistics for grades 4 to 7 teachers using 2018 graduates

	Zul	Eng	Afr	Sot	Xho	Tsw	Ped	Swa	Tso	Nde	Ven	Total	Lang. count	Inflow to Persal 2022
UNISA	1,793	889	518	116	189	126	221	101	90	46	40	4,129	11	1,766
NWU		190		48		17						254	3	111
UFS	25	4	105	97	1	1	2					233	7	177
WITS	53	71	9	27	14	10	5	4		1	6	198	10	96
TUT				78		86						164	2	88
UKZN	84	63										147	2	90
SUN		45	89		7							141	3	70
UP	14	36	25	1	8	6	9	10		3	1	113	10	48
UFH[19]	17	13	10		63							102	4	92
UJ	42	9	2	16	8	4		7	4	2		94	9	82
SPU		4	14		5	9						32	4	29
CPUT[20]		12	1									13	2	10
RU	1	2	2		3							8	4	3
Total	2,028	1,336	774	383	298	258	236	122	94	52	47	5,627	11	2,660
Univ. count	8	12	10	7	9	8	4	4	2	4	3	13		
2019 demand	2,234	2,505	976	618	1,800	911	1,009	184	336	65	228	10,868	Supply <60%	
Persal 2022	899	440	378	276	196	127	178	41	63	34	30	2,660	Inflow <80%	

Note: Vertical sorting is from university with most graduates to least, horizontal sorting from language with most graduates to least. As explained in the above narrative, values in grey indicate values entirely derived from the home language of the graduate.

[19] UFH figures are clear under-counts given classification problems in the data – see section 2.

[20] CPUT figures are clear under-counts given classification problems in the data – see section 2.

5 Subject-specific supply and demand at the secondary level

The DHET dataset contains 14,962 graduates qualifying as secondary-level teachers. The dataset uses columns O, P, and Q for entry of grades 10 to 12 subjects from a dropdown menu. Column R permits the entry of a subject not seen in the dropdown menu. Columns K to N permit the entry of grades 8 to 9 subjects, with each of these four columns restricted by another dropdown menu focussing on grades 8 to 9. Analysing the supply of secondary-level subjects using the dataset is made somewhat difficult by two key problems. Firstly, in many cases values are entered which are not from the relevant dropdown menu, and it is possible for one value to refer to two subjects, as in ‘Business Management, Geography’. A value may moreover refer to some teacher training area which is not a school subject, as in ‘RESEARCH METHODOLOGY’. Secondly, it is possible for more than two of the aforementioned eight columns to contain a school subject, yet secondary teachers are expected to focus especially on *two* subjects. If there are more than two subjects mentioned for a graduate, the question is what subjects to consider the two subjects policy requires the students to pay special attention to.

The next table illustrates the extent of the first problem. The fact that the 14,962 graduates come with 46,233 subject values illustrates that many graduates have more than two values. Of the 46,233 values, only 43% are from dropdown menus. Many universities have relatively clean data – Tshwane’s 200 values are all from the menu – but above all large problems with the UNISA and North West (NWU) data pull the aggregate down. Cape Peninsula (CPUT) and Fort Hare (UFH) do not appear in Table 4 at all given level classification problems in the data (see section 2). It should be kept in mind that the data are for 2018 graduates, and that the quality of the data are said to have improved since then, at least for certain universities.

Table 4: University usage of the dropdown for subjects

University	Total non-missing values in columns K to Q	% of these values drawing from the dropdown menu
CUT	1,478	85
DUT	602	85
NMU	372	90
NWU	5,215	0
RU	137	83
SPU	149	74
SUN	508	80
TUT	200	100
UCT	139	89
UFS	2,165	89
UJ	1,288	82
UKZN	3,661	77
UL	2,437	87
UNISA	19,841	14
UNIVEN	1,147	48
UNIZULU	2,379	59
UP	1,344	88
UWC	816	94
WITS	1,175	90
WSU	1,180	90
Total	46,233	43

Regarding the second problem, three-quarters of the 14,962 graduates have the expected two subjects in columns K to R, though even here there is a problem insofar as some graduates have two grades 8 to 9 subjects, when at least one subject should be a grades 10 to 12 subject[21]. For 5% of the graduates there is just one completed column[22], for virtually none is there no subject data, and for around one-fifth of the graduates there are 3, 4, or 5 values. No-one has more than five values.

The following processes were followed to take the analysis forward:

- The first task was to produce a 'translation table' linking non-standard entries in columns K to R to the standard values. There were 224 unique non-standard values across the eight columns, while the count of unique standard values across all columns is 43. The translation table linked each originally found value, which could be standard or non-standard, to up to two standard values spread across three newly created variables: (1) a first grades 10 to 12 subject; (2) a second grades 10 to 12 subject; (3) a grades 8 to 9 subject. Of the 267 rows in the translation table, 192 translated to just one standard value, 44 translated to two subjects (the 'Business Management, Geography' example), and 31 translated to no subject (the 'RESEARCH METHODOLOGY' example). In this process, two standard subjects were added to the 43 in the lookup tables, these being 'Sport and Exercise Sciences' and 'South African sign language', which are reflected in the values entered by universities, and are considered a part of the curriculum.

- The next task was to programmatically identify just two subjects per graduate. This was done by going through the columns O, P, Q, R, K, L, M and N, in this order. For each column, the translation table was used to obtain standard versions of subjects. Once two different subjects had been found for a graduate, no more subjects were identified. The sequence of the columns meant grades 10 to 12 subjects were prioritised[23].

Subjects were grouped into fields. How this grouping occurred should be clear from Table 5 to Table 8 below. Statistics by field are provided in Table 5. In this table it can be seen that of 14,949 secondary-level graduates[24], 7,449, or 50% of them, were absorbed into the public system by 2022, which is high considering that the demand for one year, specifically 2019, was estimated to be 7,456. To compare, according to Table 2 less than a third of the projected annual demand at the Foundation Phase was satisfied by an inflow of teachers, and according to Table 3 actual supply into public schools was only 25% of estimated demand for grades 4 to 7. This contrast can be understood as follows. Universities and university students clearly prioritised secondary-level graduates, relative to the projected demand. This relative over-supply of secondary-level teachers, plus the fact that it is more feasible and acceptable for a secondary-level teacher to teach in a primary school than the reverse, meant a significant number of secondary-level teachers found their way not just into secondary schools, but also primary schools, especially grades 4 to 7. Section 3 above provided figures in this regard. The 7,449 statistic in Table 5 would include employment in a primary school. It should be remembered that just because there are non-employed primary teachers somewhere in the country does not mean they are always prioritised over secondary teachers when posts at the primary level are filled. Often prospective teachers are for various reasons geographically confined to certain areas.

It is clear from Table 5 that there is a particularly strong over-supply of humanities teachers, and that this is driven largely by UNISA, which accounts for 39% of all secondary-level graduates (lower than the 53% seen at the Foundation Phase). Yet it was relatively easy for these humanities teachers to be absorbed into the public system. The projected demand for

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[21] See the relevant policy in Government Notice 111 of 2015.
[22] A quarter of the 5% is accounted for Tshwane (TUT), where all graduates have just one subject.
[23] There 44 subjects among the two per educator. One subject, South African sign language, did not feature in the final normalised dataset.
[24] This is lower than the aforementioned 14,962 because a few graduates had no relevant school subject data at all. The 14,949 includes what are probably 12 duplicated graduates records, judging from the 13-digit identity numbers.

these teachers was just half of the actual inflow – 943 compared to 1,948. This would in part be explained by the phenomenon of teachers teaching at a lower level relative to their training.

Table 5: 2018 secondary-level graduates (aggregated by field)

	Mathematics	Sciences	Humanities	Commercial	Technical	Arts	LO	Languages	Total	Field count	Inflow to Persal 2022
CUT	32	81	86	169	98		15	171	650	7	352
DUT	46	37	6	100	36				223	5	171
NMU	26	34	26	45	8	12	12	25	186	8	113
NWU	65	152	177	446	136	17	87	105	1,183	8	349
RU	3	15	15	7	1	2	9	16	66	8	22
SPU	13	10	13		1			15	50	5	38
SUN	30	33	44	16	2	10	37	59	228	8	66
TUT	37	28		31	104				200	4	155
UCT	9	9	13	2	1	11	5	19	67	8	22
UFS	30	62	99	92	46	2	41	170	540	8	350
UJ	38	134	101	132	14	6	41	59	523	8	313
UKZN	123	226	357	409	81	78	62	285	1,618	8	892
UL	109	137	163	95	18		47	201	769	7	674
UNISA	457	673	2,306	942	564		518	298	5,756	7	2,292
UNIVEN	31	71	193	96	73		3	109	574	7	411
UNIZULU	12	15	231	100	3	1	27	197	584	8	311
UP	39	35	140	175	11	23	86	142	649	8	333
UWC	3	31	42	5			60	66	205	6	157
WITS	30	74	71	30	14	8	5	59	288	8	182
WSU	44		132	104	69	36	36	170	590	7	246
Total	1,171	1,851	4,209	2,991	1,277	203	1,087	2,162	14,949	8	7,449
Univ. count	20	19	19	19	19	12	17	18	20		
2019 demand	1,118	978	943	782	511	215	518	2,392	7,456	Supply <100%	
Persal 2022	755	1,208	1,948	1,157	623	96	445	1,218	7,449	Inflow <50%	

Table 6: 2018 secondary-level graduates (mathematics, sciences, humanities, commercial)

	Math	Math lit	Phys	Life	Sport	Natural*	Hist	Geog	Econ	Religion	Social*	Account	Business	Consum	Hosp	Tourism	Econ*	Total	Subj. count	Inflow to Persal 2022
CUT	32		46	36				1	85			59	105		3	4		367	9	179
DUT	45	1	15	22					6			54	46					187	7	140
NMU	7	19	8	21		5	6	5	15			11	14			9	11	130	12	84
NWU	65		20	21	3	108	18	44	49	1	65	49	163	4		19	212	839	15	253
RU	1	2	1	6		8	3	5	7		1	2	4				2	39	12	15
SPU	13			10			5	6			2							35	5	27
SUN	5	25	3	19	11		23	14	5	3		8	8					122	11	39
TUT	37		28											31				96	3	82
UCT	9		5	1		3	6	4	3			2						32	8	9
UFS	30		22	28		13	22	19	54	1	4	7	59	1			26	282	13	191
UJ	38		39	61	15	20	36	23	39		4	33	54		1	13	31	404	14	246
UKZN	123		47	111	10	58	128	162	37		31	89	202			91	28	1,114	13	643
UL	109		67	66		5	30	58	75		1	39	56					503	10	432
UNISA	457					673					2,306						942	4,377	4	1,779
UNIVEN	31		16	55			31	51	112			42	54					390	8	258
UNIZULU	12		8	6		1	124	57	49		2	12	45			44		357	11	194
UP	11	28	8	24		3	44	78	9	9	1	21	80			75		388	13	202
UWC	3		15	16			21	18	3			3	2					80	8	61
WITS	30		33	42			15	35	15	7		17	13				1	204	10	137
WSU	18	26					26	69	37			29	59	7		10		280	9	103
Total	1,072	100	377	540	38	896	534	645	597	19	2,415	473	959	42	4	263	1,251	10,221	17	5,068
Univ. count	20	6	17	17	4	11	16	17	17	5	10	17	16	4	2	8	8	20		
2019 demand	702	415	271	454	1	252	178	343	161	9	252	129	246	69	16	153	329	3,981	Supply <100%	
Persal 2022	716	40	301	388	18	503	305	445	285	11	904	224	386	26	2	127	393	5,068	Inflow <50%	

Table 7: 2018 secondary-level graduates (technical, arts, life orientation)

	Agric sci	Agric tec	CAT	IT	EGD	Design	Civil	Elec	Mech	Tech*	Visual	Music	Drama	Dance	Arts*	LO	Total	Subj. count	Inflow to Persal 2022
CUT	14		31	12	10		9	8	15	1						15	113	9	50
DUT			3		11		14	4	5								36	5	31
NMU			5	4							11	1				12	32	5	15
NWU			38	2	57		2	1	8	30	7	2			8	87	240	11	73
RU				1		1					1		2			9	12	5	2
SPU										1							1	1	1
SUN	2										3		7			37	48	4	10
TUT			25		19		19	20	21								104	5	73
UCT						1					1	8		2		5	17	5	7
UFS	6		1		5					35			2			41	88	6	55
UJ					1	2	1	3	2	6	6					41	61	8	31
UKZN	18	1	2	2						59	29	9	40			62	220	9	115
UL	18															47	65	2	55
UNISA										564						518	1,082	2	396
UNIVEN	70			3												3	75	3	64
UNIZULU			2		1							1	1			27	31	5	17
UP	2		4	1	5						10	4	10			86	120	8	50
UWC																60	60	1	45
WITS				5	5				4	1	5	2	1			5	26	8	15
WSU			12		22		11	13	11			36				36	141	7	62
Total	129	1	121	28	134	3	55	48	66	694	72	62	60	2	8	1,087	2,566	16	1,164
Univ. count	7	1	10	8	10	3	6	6	7	8	9	8	7	1	1	17	20		
2019 demand	124	10	58	6	83	2	26	13	21	168	22	13	10	2	168	518	1,244	Supply <100%	
Persal 2022	97	1	41	12	70	1	40	33	45	286	30	33	31	1	2	445	1,164	Inflow <50%	

Table 8: 2018 secondary-level graduates (official languages)

	Eng	Afr	Zul	Swa	Xho	Nde	Tsw	Sot	Ped	Tso	Ven	Total	Subj. count	Inflow to Persal 2022
CUT	88	18			5		7	53				171	5	124
NMU	17	3			5							25	3	15
NWU	60	14					29	4				105	4	24
RU	7	1			9							16	3	6
SPU	10	1					5					15	3	11
SUN	41	12			6							59	3	17
UCT	16	1			2							19	3	7
UFS	105	19	23					24				170	4	105
UJ	44		12						3			59	3	36
UKZN	112		173						1			285	3	135
UL	89								68	38	7	201	4	188
UNISA	298											298	1	118
UNIVEN	33			24		1			6	23	24	109	6	90
UNIZULU	41		157									197	2	101
UP	42	25	42			13			21			142	5	82
UWC	34	23			10							66	3	52
WITS	47		12									59	2	31
WSU	39	1			127			4				170	4	82
Total	1,117	116	418	24	162	14	40	85	97	61	31	2,162	11	1,218
Univ. count	18	11	6	1	7	2	3	4	5	2	2	18		
2019 demand	1,178	267	335	34	177	11	91	61	152	51	37	2,392	Supply <100%	
Persal 2022	593	67	208	19	76	14	8	66	91	56	24	1,218	Inflow <50%	

Table 6 to Table 8 above provide statistics at the level of individual secondary subjects. Grades 8 to 9 subjects are indicated with an asterisk. The shortened subject names should be easily understood by anyone familiar with the school curriculum. One would expect few subjects to experience an under-supply of graduates relative to estimated demand, given how at the aggregate level secondary teachers are over-supplied. But a few exceptions stand out: in particular mathematical literacy and the grades 8 to 9 subject arts and culture, both non-language subjects with high levels of enrolment, appear to be under-supplied. However, a mathematics *over*-supply compensates for the mathematical literacy *under*-supply using the very simplistic assumption that all graduates go to public schools. If the output of secondary-level graduates were to be reduced, reduction should occur largely with respect to *non*-language subjects, in particular in the humanities. As can be seen from Table 8, at the aggregate level language supply does not meet demand, with the under-supply concentrated in Afrikaans, Setswana and Sepedi.

Table 9 provides important background information, namely the most common subject combinations for secondary-level graduates[25]. The combination 'Economic & Manag Sciences + Social Sciences' stands out as this consists of *two* grades 8 to 9 subjects. Closer analysis of the data confirms that the 1,634 UNISA graduates in question had no grades 10 to 12 subject in any column.

Table 9: Most common subject combinations

Combinations (or single subject)	Graduates	Largest if over 50% of total
Economic & Manag Sciences + Social Sciences	1,635	1,634 in UNISA
Life Orientation + Social Sciences	615	596 in UNISA
Business studies + Economics	580	
Social Sciences	569	563 in UNISA
English language + Social Sciences	485	477 in UNISA
Mathematics + Physical Sciences	400	
Social Sciences + Technology	381	372 in UNISA
Mathematics + Natural Sciences	378	290 in UNISA
Natural Sciences	344	344 in UNISA
Accounting + Business studies	344	
English language + Life Orientation	326	
Accounting + Economics	324	
Natural Sciences + Social Sciences	318	264 in UNISA
Business studies + Economic & Manag Sciences	290	232 in NWU
Life Sciences + Mathematics	286	
History + isiZulu language	250	173 in UNIZULU
Geography + History	206	
Mathematics	201	146 in UNISA

The opportunity to link SA-SAMS educators to the 2018 graduates (see section 3) meant that it was possible, arguably for the first time ever, to explore a persistent concern: is secondary-level schooling being compromised by the fact that teachers teach subjects they were not trained to teach? While this is considered not to be ideal, no policy prohibits this. There are many reasons why this situation would arise: teachers accept an 'out of field' post because it is geographically convenient, or because they want to teach in the same school as a spouse, and so on.

It was possible to link 1,582 educators who were, on the one hand, graduates from 2018 specialised in secondary-level teaching and, on the other hand, teachers teaching at least one grade in the range 8 to 12 in 2022. In this linking a few graduates who had just one subject specialisation were excluded. There were 45 subjects considered for the analysis. Results are

[25] Where a row in the table refers just to one subject, this is because the graduate only had one school subject in the data.

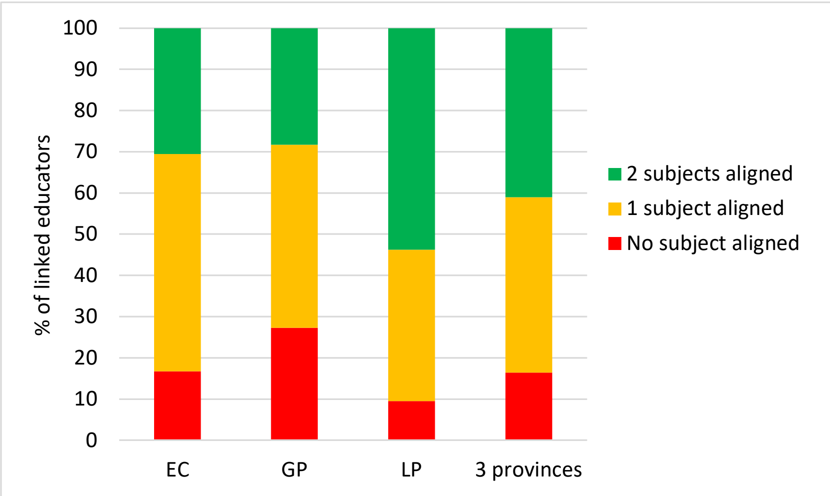
reflected in Figure 4 below. To illustrate, of the 1,582 linked educators 260, or 16%, were not teaching either of the two subjects they specialised in. In making this assessment, exact matches across the 45 subjects were considered, but also an additional 12 matches across grades 8 to 9 versus grades 10 to 12 subjects. Thus, for instance, if a teacher specialised in geography, a grades 10 to 12 subject, but was teaching the subject social sciences in grades 8 to 9, there was considered to be a match between the university specialisation and actual teaching. The reverse was not treated as a match: if someone specialised in the teaching of grades 8 to 9 social sciences and taught geography in grades 10 to 12, this was not considered a match. The 12 additional matches are described in Table 10. There were less common matches which should arguably have been included in the list, yet their exclusion would not affect the overall statistics presented below to a significant degree.

Table 10: Subjects considered sufficiently compatible

Subject in the 2018 graduates data	Subject in the 2022 SA-SAMS data	Number of occurrences among sample of 1,582 teachers
Geography	Social Sciences	110
Mathematics	Mathematical Literacy	94
Life Sciences	Natural Sciences	85
Physical Sciences	Natural Sciences	57
History	Social Sciences	55
Business Studies	Economic Management Sciences	50
Economics	Economic Management Sciences	45
Accounting	Economic Management Sciences	45
Life Sciences	Agriculture	39
Agriculture	Life Sciences	31
Physical Sciences	Technology	30
Agriculture	Natural Sciences	27

As seen in Figure 4, a further 43% of educators across the three provinces taught one of their two specialisation subjects, while 41% taught both their subjects. Matching is better in Limpopo than the other two provinces.

Figure 4: Subject alignment between training and actual responsibilities



Note: Total educators analysed for the three provinces are 347 in EC, 476 in GP and 759 in LP.

The mismatch problem, extending to some 16% of the graduates examined, and reflected in the right-hand column in Figure 4, is probably smaller than many would expect, given widespread concerns that teachers are not teaching the subjects they are meant to teach. What are the specialisation subjects of the 260 educators not teaching either of these subjects?

Certain subject specialisations stand out as being less likely to be matched in the classroom: economic and management sciences; isiZulu; religion studies; social sciences; and technology. Except for isiZulu and religion studies, these are subjects offered only in grades 8 to 9. A social sciences specialisation is especially unlikely to be matched: 21% of specialisation subject records in the data which are unmatched are social sciences, against just 5% among matched subjects[26].

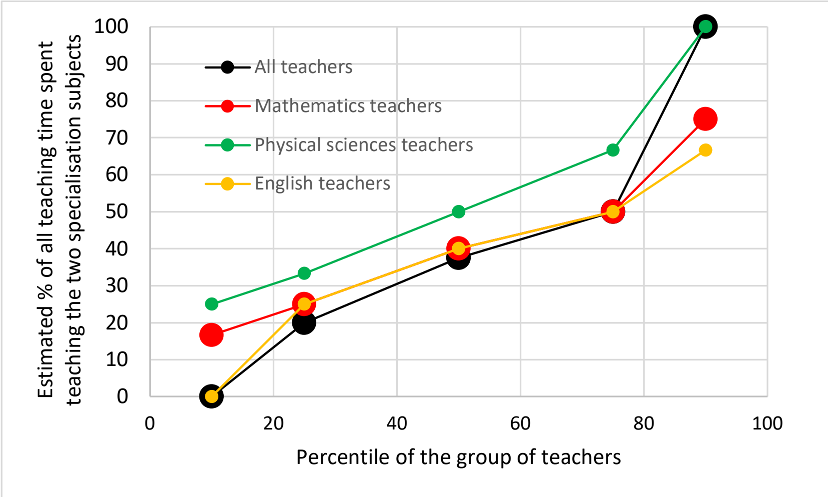
How effectively are mathematics skills provided by university training matched to actual mathematics teaching? Of the 378 graduates with a mathematics (not must mathematical literacy) specialisation, from among the set of 1,582 linked educators, 72% were teaching mathematics in 2022, a figure which rises to 81% if the teaching of mathematical literacy is included. While this degree of matching may seem lower than the ideal, what should be kept in mind is that teachers with a mathematics specialisation commonly have a second critical subject, physical sciences, as their second specialisation subject (see Table 9 above). Of the 70 teachers in the data with a mathematics specialisation who are not teaching pure mathematics, 35 are teaching physical science, a figure which rises to 42 if the grades 8 and 9 subject natural sciences is also counted. The conclusion seems to be that supplied mathematics teachers are relatively well utilised in the schooling system, at least as far as young graduates are concerned.

A further question is how unfamiliar subjects actually being taught would be for the 260 unmatched educators. The data suggest that there would not be problematically high levels of unfamiliarity. Unmatched graduates with a social sciences specialisation tend to teach English, or life orientation, for instance. But there are some clear anomalies, such as those with a social sciences specialisation teaching agriculture.

Another way of approaching the data is to ask roughly what proportion of the time secondary-level teachers spend teaching the subjects they were trained for. While teaching hours are not included in the SA-SAMS data, a rough estimate of this can be obtained by weighting equally every teaching record. For instance, teaching mathematics and physical sciences in Grade 11 and physical sciences in Grade 12 can be assumed to be a third of a teacher's time being spent on each, and hence two-thirds on physical sciences in total. Figure 5 illustrates the result of the analysis. For instance, at the 50th percentile, or for the median teacher, roughly 38% of the teacher's time is spent teaching either of the specialisation subjects. This rises to 100% at the 90th percentile. Physical sciences graduates appear to be especially likely to be assigned to the subjects they specialised in. Importantly, the figures for, say, physical sciences teachers take into account the second subject. Thus, the median teacher with a physical sciences specialisation spends 50% of his or her time teaching one or two of the two specialisation subjects. This is arguably a more relevant way of examining the data than considering the proportion of time spent only on physical sciences and not, say, mathematics, if mathematics is the second subject. The central policy concern here is whether, say, the skills of physical sciences teachers are 'wasted'. If they are teaching their second subject, that is not considered a waste.

[26] The reference here is not to educators, but to subjects, as each educator has two specialisation subjects.

Figure 5: Subject alignment between training and actual responsibilities



The picture provided in Figure 5 could appear concerning. For instance, if the median teacher with a mathematics specialisation spends only around 40% of his or her time on either of the two specialisation subjects, the question is why 60% of this teacher's time is spent on subjects for which the teacher did not specialise. Further analysis of the data reveals that the 60% comprises teaching subjects closely related to mathematics. Even if the second specialisation subject is not physical sciences, the chances are high that this subject will be taught. Moreover, mathematical literacy and life sciences are common within the 60%. To illustrate, among teachers with mathematics but not physical sciences as a specialisation, around 85% of teaching time is spent on some science-, mathematics- or technology-related subject. This serves as a reminder of the complexity of teacher time allocation. For practical reasons, exact matches between specialisation subjects are not always achievable.

It is worth noting that while teachers trained for grades 8 to 12 who teach those grades teach on average 2.1 subjects, while those trained for grades 8 to 12 who teach in grades 4 to 7 teach on average 2.6 subjects. This would under-state the difference somewhat as several single subjects existing up to Grade 9 split into two subjects in Grade 10. The policy question is whether teachers trained for grades 8 to 12 who work in grades 4 to 7 are unduly spread across too many subjects. This is a legitimate concern as teachers trained for grades 4 to 7 are trained to teach all subjects, while this is not the case for teachers trained for grades 8 to 12. The abovementioned difference between 2.1 subjects and 2.6 subjects does not suggest that the problem is a large one. It is also worth noting that teachers trained for grades 4 to 7 who also teach those grades teach 2.4 subjects on average. The allocation of teaching responsibilities in grades 4 to 7 thus appears to be fairly independent of the level one was trained for. Schools are not recognising the more specialised nature of teachers who focussed on grades 8 to 12 by having them teach fewer subjects. These issues could clearly be further interrogated using the available data.

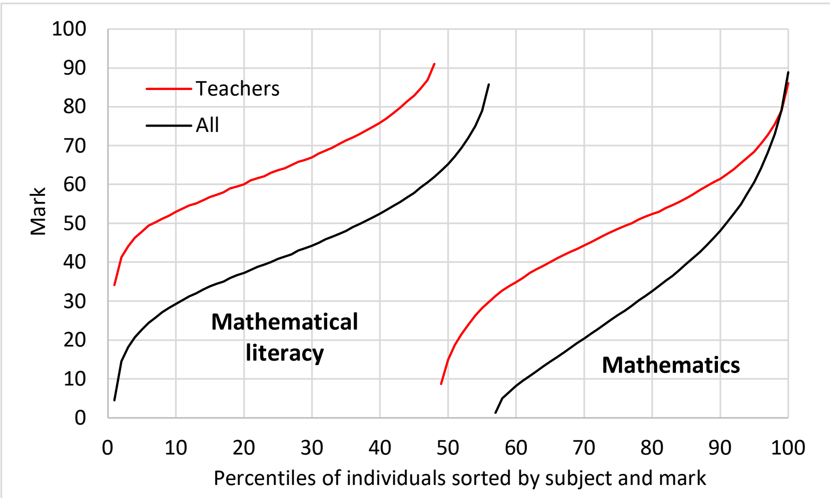
6 The Grade 12 mathematics competencies of teacher graduates

Alarming accounts exist of low mathematics competencies among teachers. Specifically, Venkat and Spaull (2014, 2015) used SACMEQ 2007 teacher test results to conclude that four-fifths of Grade 6 mathematics teachers could not master 60% of test items which learners in Grade 6 are expected to master. This finding has been repeated in several places, including in a report by the Oppenheimer Memorial Trust (2023). A more recent analysis is that of Roberts (2022), who uses mathematics test score data drawn from students across 14 universities studying to be primary-level teachers. That analysis concluded that for only 56% of prospective teachers, at the fourth year of teacher training, could it be said that 'standards are achieved' with respect to mathematics. Moreover, it was found that gains in each student's mathematics competencies between the first and last year of university studies were small.

Below, a different approach to gauging the mathematics competencies of teachers is pursued: the Grade 12 mathematics scores of different sub-groups of the 2018 graduates analysed above are compared to the scores of all Grade 12 candidates. This analysis assists in determining whether selecting better candidates for teacher training is the optimal solution for enhancing the mathematics competencies of teachers, as opposed to improving mathematics already at the school level. As will be seen, the latter emerges as the more compelling solution.

Figure 6 below was produced by merging the teacher graduates data received from DHET with Grade 12 National Senior Certificate (NSC) results for the years 2010 to 2015. This merging was possible for 52% of the teacher graduates analysed in previous sections of this report. Over 90% of graduates born in the years 1993 to 1998 could be linked to their NSC results. Where linking was not possible, this was mainly because graduates were relatively old, and would have been in Grade 12 before 2010, though participation in Grade 12 examinations outside the public South African system is also a likely explanation. Figure 6 illustrates the distribution of mathematical literacy and mathematics marks, with the latter being placed on the right of the graph. Participation in mathematics, as opposed to mathematical literacy, was slightly more common among teacher graduates than among Grade 12 examination candidates in general. Moreover, teacher graduates score around 20 points better than candidates in general – see the vertical differences between the black and red curves. Precise statistics are provided in Table 11 below.

Figure 6: Subject-specific Grade 12 mathematics results for teacher graduates



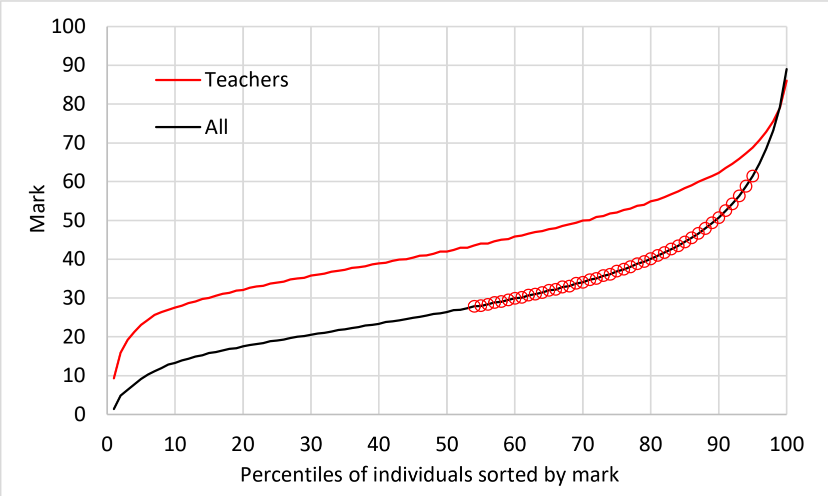
Note: For each series, for instance 'All', mathematics score distributions begin on the horizontal immediately after the mathematical literacy score distribution, even though it is possible for high-scoring mathematical literacy achievers to display better mathematics competencies than low-scoring mathematics achievers.

Figure 7 below was produced by converting mathematical literacy scores to a mathematics score, using a series of regressions on English results to obtain a conversion algorithm[27]. Candidates taking mathematics retained their original scores. Red bubbles on the black 'All' curve indicate where on this curve teacher graduates are found, specifically where graduates between their 10th and 90th percentiles were found. Put differently, the red bubbles indicate where on the black curve the middle 80% of the red curve would sit. Clearly, on the whole

[27] This general approach to re-scaling mathematical literacy scores has been used by several analysts, for instance Simkins (2010).

teacher graduates are from the better half of Grade 12 mathematics performers. However, near the bottom of the distribution, teacher graduates displayed mathematics marks in Grade 12 which were around 30% (in terms of the subject mathematics, not mathematical literacy), meaning a low mathematics pass.

Figure 7: Grade 12 normalised mathematics results for teacher graduates



The following two graphs show the situation for just those teachers specialising in mathematics teaching for the secondary level. Here a very different Grade 12 history is seen. Figure 8, which is like earlier Figure 6 but focussing just on secondary mathematics teachers, shows that only 5% of graduates took mathematical literacy, and that those who took mathematics were among the top achievers in school. The context is that around 10% of South Africans get to obtain a university degree[28]. Given this, the fact that recently graduated secondary-level mathematics teachers should be from roughly the top 10% of Grade 12 candidates is close to optimal. The only way of improving the quality of mathematics teachers further, would be to improve the overall level of mathematics emerging from schools. There appears to be little room to recruit even more capable youths from the schooling system to become secondary mathematics teachers. This is especially so if one considers that youths with top mathematics marks are easily absorbed into competing and attractive professions in areas such as engineering, finance and medicine.

[28] Van der Berg, Gustafsson and Malindi, 2020: 48.

Figure 8: Subject-specific Grade 12 mathematics results for mathematics teachers

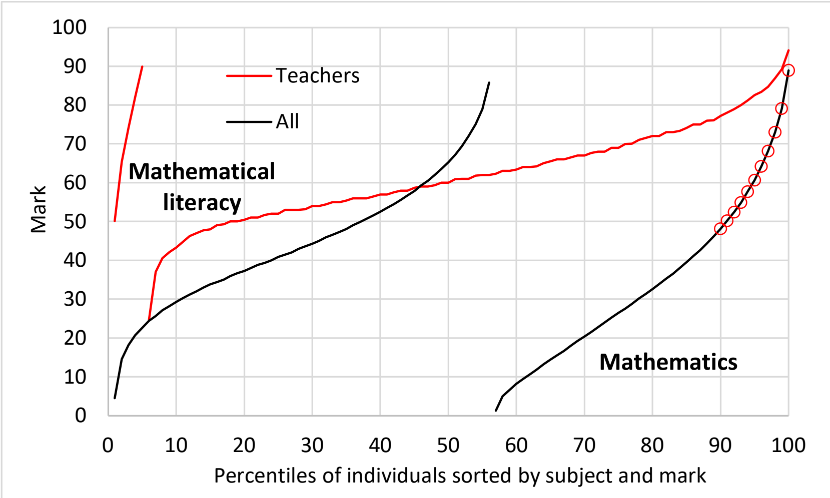


Figure 9: Grade 12 normalised mathematics results for mathematics teachers

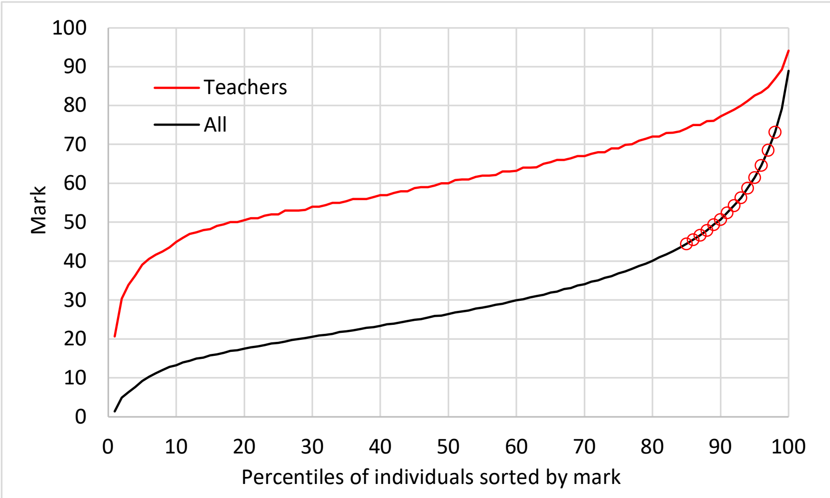


Table 11 provides details relating to all graduates, secondary mathematics teachers (dealt with in the previous two graphs) and five additional sub-sets of all graduates. The final column indicates that the only exceptional sub-group is secondary mathematics teachers. Other groups display similar levels of mathematics competency, considerably below that of the secondary mathematics teachers. UNISA graduates display somewhat lower levels of competency, compared to graduates in general. Perhaps surprisingly, Foundation Phase teachers display slightly better mathematics competencies than secondary teachers in general. At the low end of the spectrum, there are many teacher graduates at the 10th percentile displaying results just below a 30% pass. For instance, the 10th percentile of grades 4 to 7 teachers obtained only 26% in mathematics, using a normalised score. Yet these teachers would still be roughly average Grade 12 candidates in terms of their mathematics results – see Figure 7 above. Again, the evidence suggests that if the mathematics competencies of teachers are to be raised, much of the work involves improving results in the schooling system, as opposed to improving the selection of who becomes a teacher.

Is the analysis presented here compatible with, say, the findings of Venkat and Spaull (2015) that four-fifths of Grade 6 mathematics teachers in 2007 struggled with Grade 6 mathematics questions? Both analyses point to the concerning fact that many primary teachers display low levels of mathematics skills. However, the studies focus on rather different things. While

Venkat and Spaull focussed on the situation in 2007 for all Grade 6 mathematics teachers, the analysis presented above has focussed on later years, and only on newly graduated teachers. A key factor that would mitigate the problem is that, as past evidence has shown, the norm in grades 4 to 7 is for teachers to be assigned to specific subjects, not specific grades. Thus, even though these teachers are expected to be in a position to teach all school subjects, current timetabling practices suggest teachers are assigned to classes where their subject-specific competencies are best applied. An additional mitigating factor is that over time teachers' mathematics competencies have improved, in large part because younger teachers trained in the post-2000 teacher training environment come with better mathematics subject knowledge than their older colleagues. This emerges if the 2007 SACMEQ data are compared to the less dated 2013 SACMEQ data[29].

[29] Department of Basic Education, 2020: 111.

Table 11: Grade 12 mathematics results of candidates in general and teacher graduates

	n	% taking mathe-matics	Mathematics				Mathematical literacy				Normalised mathematics			
			p10	p50	p90	Mean	p10	p50	p90	Mean	p10	p50	p90	Mean
All candidates	3,045,598	44	9	31	64	34	24	43	67	44	13	26	51	30
All graduates	14,756	52	26	48	69	48	48	63	81	64	28	42	62	44
All graduates not UNISA	11,585	50	27	49	69	48	49	63	80	64	29	42	63	44
All graduates UNISA	3,171	57	23	45	69	46	46	64	83	64	26	42	64	43
Grades 1 to 3 graduates	1,638	39	29	49	68	48	51	67	84	67	31	44	61	45
Grades 4 to 7 graduates	2,888	50	22	45	66	45	47	65	83	64	26	42	61	43
Secondary graduates	8,536	56	26	49	70	49	48	62	79	63	28	42	64	44
Secondary mathematics teachers	1,199	95	48	61	78	62	51	74	88	72	45	60	77	61

Note: p10 refers to the 10th percentile, p90 to the 90th percentile and p50 to the median.

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