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The analysis of SATS results as a measure of pupil progress across educational transitions

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Within any Educational System the transition of pupils from one stage to the next, and often the associated transition from one educational establishment to another, is an area of interest for educational establishments, educationalists and educational authorities due to the effects of this movement on pupil progress, their academic achievement and performance measures for schools. The National Curriculum Assessments (NCA) are used in England as a nationally administered examination to evaluate pupil progress and academic achievement at the transition from one Key Stage to another. Also within England different schools can have differently aged cohorts, for example Primary Schools cover ages 4 to 11 years whereas Infant Schools cover ages 4 to 7 years and Junior Schools 7 to 11 years. This investigation has examined the significance of type of primary school (i.e., all-age primary, 4 to 11 years, versus junior, 7 to 11 years) for achievement at age 11 years. Using national statistics, it was shown that junior and primary schools perform equivalently in terms of academic achievement at the end of the pupils' time in the schools but primary schools seem to outperform junior schools in terms of the improvement in the pupils' ability (value added) during their time in Key Stage 2. This work has shown that on average a junior school will have a lower value added score at Key Stage 2 to equivalently performing primary schools and that this difference, whilst small, is both statistically, and in terms of league table position, significant. Also, the data were compared to the much smaller group of schools which provide education from Key Stage 1 through to Key Stage 4 and beyond. These schools showed the same rate of progress (value added) through Key Stages 1 and 2 as the general population of schools but with lower points scores per student.

Keywords: assessment; primary/elementary years; secondary education; governance/management

1. Introduction

1.1 *The national assessment landscape*

The introduction of a National Curriculum (1989) in England and Wales, following the 1988 Education Reform Act, brought in a new series of assessments at the end of each Key Stage (KS)¹. As part of this new curriculum there was a desire to use a common method of analysing the academic performance of pupils and the Task Group on Assessment and Testing (TGAT) was challenged with producing these assessments. The National Curriculum Assessments (NCA) (commonly referred to as SATs [Standard Attainment Tests]) were developed, and are seen to enable pupil

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progress to be measured. The SATs deliver two numeric outputs per pupil; the Total Points Score, which reflects the overall academic achievement of the pupil, and the Value Added, which reflects how much progress the pupil has made since the previous assessment.

Before these assessments were in place there were no equivalent examinations for pupils at the end of Key Stages 2 and 3 (KS2 and KS3) and therefore pupil data were based on school assessment data (Millar 2011). Pupil attainment is described using National Curriculum level descriptors with the present scale of 1 to 8 levels. There is an expectation of the average pupil achieving level 2 at the end of KS1, level 4 at the end of KS2 and level 5/6 at the end of KS3 (Department for Education 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182413/DFE-RR096.pdf; Wyse and Torrance 2009). Each level represents that which a pupil might be able to achieve from two years of school (Nuttall and Stobart 1994). Over the intervening period these levels monitoring pupil progress have had revisions and the addition of sub-levels in Mathematics and English provided mark intervals (Brown 2011). These NCAs were in core subjects initially; English, Mathematics and Science, and depending on the age group were either internally or externally marked (KS1 assessments were internally marked in school, KS2 and KS3 externally). Revisions to these assessments have been part of the National Curriculum changing landscape with Science omitted at KS1 in 1996 (Whetton 2009) and all KS3 tests being abolished in 2008.

The reliability of these tests has been criticised (Whetton 2009) as the pupil assessments are based on teacher judgements at KS1. However, to ensure a national standard, a sample of schools are moderated by the relevant Local Authority (Stobart 2009) and this enabled cross comparison between schools.

One of the consequences of assessing pupils using the SATs is that the numeric output and common approach has allowed the results to be averaged at a school level and these averages are then used for the comparison of schools, often in a league table format. These school league tables are now a regular feature in educational debate, even for the general public.

Recently the use of pupil performance measures to evaluate schools' performance has been questioned (O'Neill 2013). O'Neill argued that the use of the pupil performance data as a measure of a school's performance was flawed as this became the primary driver with the pupil performance in examinations becoming more important than the delivery of a rounded education. Also one study has determined that the amount of lesson time spent on "cramming" for the tests must be reduced (Murphy and Beggs 2005).

There is also an on-going interest in the transition of pupils between one educational establishment and another, such as the transition from Key Stage 2 to Key Stage 3 (Braund and Hames 2005; Comber and Galton 2002). The pupils' NCA scores on exiting an educational establishment are often compared to the performance in the early months of a new establishment. Judgements could then be made around the quality of the transition (Mellor and Delamont 2011; Braund and Hames 2005). Whilst there is no doubt there has been some performance deficit (Ryan 2002) due to the break from education over the summer months (Sainsbury et al. 1998) and the upheaval of the transition (Galton 1987), there are criticisms of coaching to the test (Wyse and Torrance 2009) enhancing the SATs scores. The new establishment will take a snap shot of the pupils' ability and are unlikely to spend

extensive time preparing for these evaluations as the results are for the schools' use only and not outwardly reported.

Despite much interest in this area there has been little published analysis of the results of the SATs to obtain a numerate assessment of the pupils' performance across the KS boundaries and the effect of the associated preparation for the tests the pupils receive. In other words, does preparing for the test affect the pupil performance in the test in a measurable, numerate way, and thereby provide hard evidence of the issues raised by O'Neill (2013)? This paper investigates the effect of the quantity of preparation, and will allow the other factors identified in causing a drop in pupil performance across the Key Stage boundaries to be put into the context of the measured effect of examination preparation technique.

1.2 The focus on transition

In an attempt to investigate this possible issue, two transitions have been investigated; KS1 to KS2 and KS2 to KS3. The KS2 to KS3 transition has seen the majority of previous investigations (Braund and Hames 2005; Comber and Galton 2002; Mellor and Delamont 2011; Whetton 2009) but these investigations have focussed mainly on the wellbeing of the pupils during, and after, the transition rather than on the academic achievement of the pupils as determined by the tests themselves.

Whilst both these transitions were investigated here, the KS1 to KS2 transition has much more data available in differentiating groups to enable a robust analysis. A comparison can be made between the results for Infant Schools (KS1 pupils aged 5 to 7yrs) and Primary Schools (KS1 and KS2 pupils aged 5 to 11yrs). These two types of school have different requirements for the SATs at the end of KS1 and this leads to different approaches to the preparation for the tests. This transition is crucial for Infant Schools as the KS1 SATs give their performance measure, and as such pupils are well prepared for the SATs. However, this transition in a Primary School is a waypoint on the journey to the KS2 SATs, which give the vital output measure for these schools. As such there is much focus on the KS2 SATs, while the KS1 SATs are externally reported but not used as part of the league table assessment. There is no incentive to prepare for the examinations at KS1 and, in fact, the Value Added score for the Primary Schools reported in league tables is that calculated between KS1 and KS2 so there is a disincentive to prepare for the tests as a high result at KS1 will impact on the Value Added score at KS2. Junior Schools take pupils after KS1 and as such their KS2 Value Added score is influenced by the Average Points Score (APS) achieved by the "feeder" Infant Schools at KS1.

There have been anecdotal reports that the APS at KS1 is higher for Infant Schools when compared to Primary Schools at the same Key Stage (Tymms and Dean 2004) and this becomes an issue for Junior Schools when they are measured on Value Added at KS2. This difference in approach to the KS1 SATs between Infant and Primary Schools could be behind a difference in KS2 results for Junior and Primary Schools and would also give an insight into how the difference in approach to a set of tests impacts the outcome of the tests.

As around one tenth of schools at KS2 are Junior Schools the national results are dominated by the larger percentage of Primary Schools. The previously reported comments of Junior School Head Teachers (Tymms and Dean 2004) could be investigated to understand if there is any trend across a large data set. This will allow the comparison between school types to be made and to investigate whether a difference

in approach by the schools to the SATs examinations influences the outcome of the tests.

In this work the KS2 to KS3 transition has also been analysed for schools which use the KS2 SATs as output performance measures and compared to those which retain the pupils across the transition in the same way as Primary Schools at KS1. This has allowed a comparison of the data for the two different transitions to assess whether there are any common conclusions.

These data could be useful for policy makers at this time of revising the present National Curriculum for primary and secondary schools and for consideration when analysing league table and county performance.

2. Methods

The data used in this investigation were taken from the Department for Education website (Department for Education 2012, <http://www.education.gov.uk/schools/performance/>). Various databases, available to the public from the Department for Education, contained the results at KS2 for all schools in England for NCAs taken from 2007 to 2012. Data for Value Added at KS1 and KS2 were analysed for the years 2010 to 2012, for Total Average Points Score at KS2 for 2007 to 2010 and for Total Average Points Score at KS1 for years 2011 and 2012. The APS was for both English and Mathematics as there was no significant difference to the conclusions from the data if single subject averages were chosen. The date ranges were limited by the availability of historical data on the website. Data for the external examination results at KS4 were also obtained from the Department for Education website.

The data contained information for different types of school. One of the school attributes within the data was the age range of pupils on the roll. As the basis for this analysis Primary Schools were assumed to have the age ranges of 2 to 11, 3 to 11, 4 to 11 and 5 to 11, with Junior Schools having the ranges of 7 to 11 and 8 to 11. This allowed for Primary Schools to have a pre-school intake without altering the distribution of the data. Any schools with different age ranges were gathered into a category described within this paper as Other Schools. For a number of schools there were no data recorded so these schools were removed from the analysis. For most years this left over 13,500 schools in the data set with around 10% being Junior Schools and around 3% being classified as Other Schools. The data set in 2010 contained 9862 schools and this reduced number was due to the boycott of KS2 NCAs by a number of schools. There was no analysis of any regional or pupil type differential in this work as it was assumed that these would average out in such a large data set. The total number of schools and the split between groups can be seen in Table 1.

Table 1. Number of schools included in the data analysis.

	All Schools	Primary	Junior	Other
2007	13,528	11,791	1347	390
2008	13,769	12,025	1344	400
2009	13,888	12,147	1344	397
2010	9862	8512	1016	334
2011	14,556	12,806	1286	474
2012	14,702	12,892	1272	538

The data were analysed to obtain average results for each of the categories analysed and a two tailed Student’s T-Test was applied to assess the significance of the differences in results.

3. Results

3.1 Analysis of the KS1 to KS2 transition

Three different attributes were investigated for the school types chosen; the KS1 Average Points Score, the KS2 Total Average Points Score and the KS2 Value Added for English and Mathematics. These data should plot the journey of pupils through KS2 by looking at their academic achievement on entry (KS1 Total Average Points Score), the amount of progress made (KS2 Value Added) and their academic achievement on exit (KS2 APS). If the approach to the KS1 SATs is equivalent across all school types then these data should show no significant difference, due to the large numbers of pupils involved in the analysis, as the evaluations are calibrated nationally.

As a first point to note it can be seen that the group of schools in the “Other” category contain a high proportion of Special Schools and these have a strong influence over the tail of the distribution. In all the categories investigated they had averages significantly lower than the Junior and Primary School categories. This group lowered the “All Schools” data but not in a major way as they only made up 3% of the population.

The evaluation of the pupils’ journey will now be analysed but in reverse, starting with the KS2 APS as the exit measure before looking at the Value Added as part of the journey and the KS1 Total Average Points Score as the entrance level.

3.1.1 Analysis of the KS2 APS – the end of the journey

Looking first at the KS2 APS, Table 2, it can be seen that the type of school has little influence on the Total Average Points Score with the Junior and Primary Schools averages being closer than 0.1 in all years. From these data it is difficult to argue that the academic ability of the students on leaving KS2 is dependent on the type of

Table 2. KS2 APS for English + Mathematics (standard deviation in brackets).

	All Schools	Primary	Junior	Other
2007	27.37 (2.31)	27.49 (2.06)	27.57 (1.51)	23.27 (5.67)
2008	27.33 (2.26)	27.44 (1.99)	27.51 (1.45)	23.12 (5.65)
2009	27.37 (2.25)	27.49 (1.99)	27.57 (1.46)	23.26 (5.61)
2010	27.56 (2.28)	27.70 (1.95)	27.69 (1.47)	24.33 (5.11)
2011	27.39 (2.47)	27.58 (2.04)	27.59 (1.49)	21.70 (5.96)
2012	28.08 (2.63)	28.32 (2.03)	28.40 (1.41)	21.54 (6.40)

school (Primary or Junior) that they attended. By extrapolation it is likely that the academic ability of the pupils at KS1 was equivalent across all school types.

3.1.2 Analysis of the KS2 Value Added Score – the length of the journey

Now looking at the data for the Value Added by each type of school (Table 3) the results show an interesting trend. This looks at the quality measure for the academic journey through the school. There is now a gap between the average Value Added score for Primary Schools and Junior Schools with the Primary Schools outscoring the Junior Schools by 0.4 in 2010, 0.6 in 2011 and 0.6 in 2012. This implies that the students were making less progress in Junior Schools than their compatriots in Primary Schools but still achieving the same Total Average Points scores at the exit from KS2.

The data in tabular form show this difference in averages but give no real indication of whether there was any non-normal behaviour in the data causing these differences. Figure 1 shows the cumulative frequency plot for the four different groups of school for 2012.

It is clear from Figure 1 that the distribution curves for Primary and Junior Schools are similar, and this is confirmed by the populations having similar standard deviations of around 1. The difference between the groups is that the distribution curves are displaced by 0.6. A significance test on the two data sets has confirmed that they are different populations, whereas an equivalent test on the KS2 APS data shows no such difference. This trend is duplicated in the 2011 data.

This shows that the Primary Schools out-performed Junior Schools in terms of the quality of the journey through the school across the whole spectrum of school quality.

3.1.3 Analysis of the KS1 APS – the start of the journey

There are less data available for the KS1 APS (2011 and 2012 only) to investigate if this apparent discrepancy is due to the levels measured at KS1 or some other feature of the system. However the data which have been analysed show that the results at KS1 are more than 0.77 higher for Infant/Junior Schools than Primary Schools in 2011 and 0.83 for 2012 (Table 4). This difference in APS goes a great distance to explaining the lower Value Added for Junior Schools.

Once again, the distilled averages do not show the picture with the same clarity as the cumulative frequency plot of the data, see Figure 2. Once again the populations show similarities in behaviour except the data from Infant Schools have a

Table 3. Average KS2 Value Added by school type (standard deviation in brackets).

	All Schools	Primary	Junior	Other
2010	100.23 (1.95)	100.30 (1.00)	99.89 (0.95)	99.48 (0.84)
2011	99.86 (1.48)	100.03 (1.24)	99.41 (0.98)	96.46 (3.15)
2012	99.83 (1.53)	100.03 (1.22)	99.39 (0.95)	96.13 (3.24)

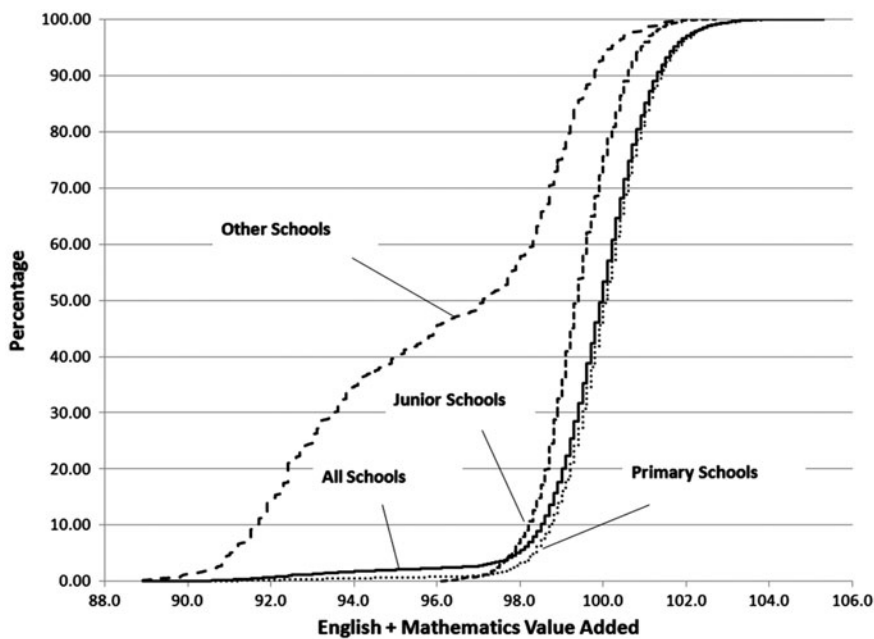


Figure 1. Cumulative frequency plot of KS2 VA for the school types in 2012.

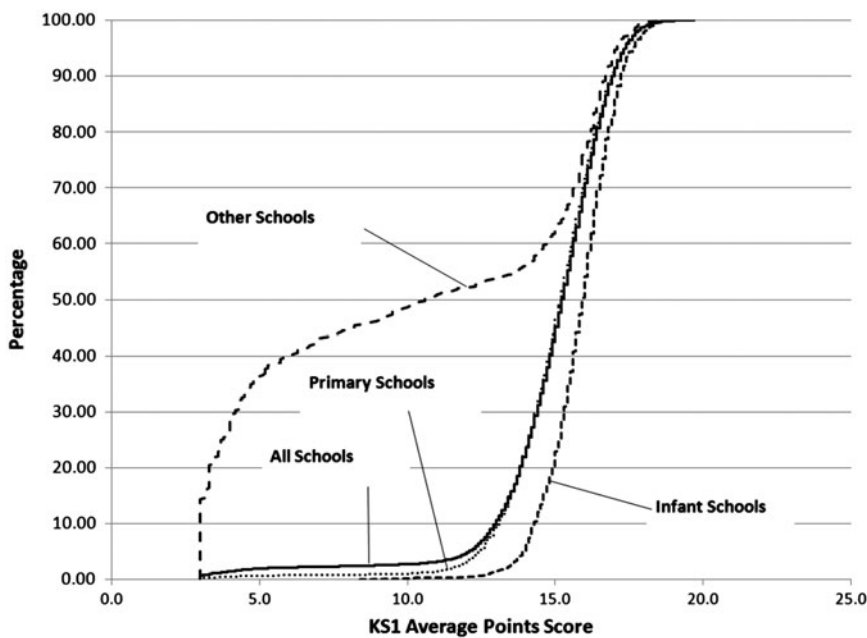


Figure 2. Cumulative frequency plot of KS1 APS for the school types in 2012.

smaller standard deviation (1.2) when compared to Primary Schools (1.8) and this can be seen in the larger separation in frequency plots at the lower APS scores. However, the plots do not cross with the Infant School population remaining higher than the Primary School population for all APS scores. Once again a very similar plot is obtained for 2011.

This shows that the Infant Schools out-performed Primary Schools in terms of the academic achievement across the whole spectrum of school quality.

This result is totally contrary to the results at KS2 which state that all school types have a similar level of academic achievement.

For whatever reason, pupils leave KS1 with a higher evaluation of their academic ability from Infant Schools than the equivalent cohort assessed towards the mid-point of their time in Primary Schools. This differential in academic ability is not shown at KS2 where the common, externally assessed, SATs papers should give an equal evaluation of academic achievement to all, regardless of school type. This places the Junior School at a disadvantage when Value Added becomes a measure, especially as only 10% of schools are Junior Schools, and the average is dominated by the results from Primary Schools. The anecdotal evidence of a differential between Junior and Primary Schools (Tymms and Dean 2004) has been borne out by the analysis of the data.

As these differences in KS1 APS and KS2 Value Added are mathematically significant but relatively small numerically it is worth noting the impact on the public perception of Junior Schools. This is important because parental choice and official comparisons are often undertaken as comparisons to the national mean data or other local schools. The distributions are dominated by the Primary Schools as can be seen in Figures 1 and 2 so the Junior Schools are at a disadvantage due to their small proportion of the total numbers. For example, a Junior School which is at the 50th percentile of Junior Schools in terms of Value Added is only at the 30th percentile of All Schools. The Junior School 25th percentile becomes the 15th percentile overall and the 75th percentile becomes the 52nd percentile. In fact a school in the top 10% of Junior Schools and, probably in reality, of all schools, could find itself in the third quartile of the population of all schools (i.e., lower than 75%). This will have a major impact on the public perception of the school.

To give some context to the magnitude of these results, the same analysis for value added scores for pupils receiving free school meals can also be analysed. The free school meal criteria are used to identify pupils who come from disadvantaged backgrounds and may not make the expected academic progress. For the results for 2012 the average Value Added scores, across all schools, for pupils not receiving free school meals is 100.0 whereas the cohort receiving free school meals has a Value Added of 99.6. This can be split down by school type and

Table 4. Average KS1 APS (standard deviation in brackets).

	All Schools	Primary	Infant	Other
2011	14.96 (2.19)	15.04 (1.80)	15.81 (1.24)	10.51 (5.82)
2012	14.91 (2.25)	15.01 (1.78)	15.84 (1.18)	10.12 (5.79)

shows that the difference for Primary Schools is 100.2 and 99.7, and for Junior Schools is 99.4 and 98.9. This shows that the drop in performance between those pupils receiving free school meals and those who do not is on average 0.5 and is not dependent on school type. This difference in pupil performance is less for having free school meals than the perceived performance drop for Junior Schools against Primary Schools at 0.6. It is interesting to note that an actual issue in pupil performance is of less numeric magnitude than the approach schools can take to the assessment process.

3.2 Analysis of the KS2 to KS3 transition

A much smaller group of schools allow an analysis of the transition between KS2 and KS3. Thirty seven schools offer education from KS1 to KS4 and in some cases beyond this but which are not identified as Special Schools. Their major performance measure will be the externally set examinations at KS4 and KS5 and good results here will be the key driver within the schools, with less emphasis on the interim assessments at KS1 and KS2. The data for these schools, compared to the national averages, are given in Table 5.

It can be seen that the schools which operate across the whole age range seem to perform worse in terms of APS than the general population. This is even more apparent when the results above are compared to the data in Tables 2 and 4 for Junior and Primary Schools. The Value Added at KS2 is in line with the general population so the general progress of pupils is commensurate with expectations; it is

Table 5. Analysis of the performance of schools which cover KS1 to KS4 and beyond (standard deviation in brackets).

	KS1 APS	KS2 Total Average Points Score	KS2 Value Added
All Schools	14.91 (2.25)	28.08 (2.62)	99.83 (1.53)
KS1–KS4+ Schools	14.54 (1.62)	27.35 (1.43)	99.67 (1.21)

Table 6. KS2 APS for English + Mathematics (standard deviation in brackets).

	All Schools	Primary	Junior	KS1–KS4+
2007	27.37 (2.31)	27.49 (2.06)	27.57 (1.51)	26.13 (1.43)
2008	27.33 (2.26)	27.44 (1.99)	27.51 (1.45)	25.88 (1.89)
2009	27.37 (2.25)	27.49 (1.99)	27.57 (1.46)	26.17 (1.71)
2010	27.56 (2.47)	27.70 (2.04)	27.69 (1.49)	26.35 (1.86)
2011	27.39 (2.47)	27.58 (2.04)	27.59 (1.49)	26.14 (2.30)
2012	28.08 (2.63)	28.32 (2.03)	28.40 (1.41)	27.35 (1.43)

just the actual points scores which are out of line. These schools average over 48% of pupils achieving five A to C grades at GCSE, including English and Maths, so the academic achievement of the pupils is not the determining factor here. These schools are scoring, on average, one whole point below Primary and Junior Schools at KS2 without seemingly impacting on the long term educational results of the students. This trend in Total Average Points Score has been consistent since 2007 and is shown in Table 6.

As the number of schools covering the continuum from KS1 to KS4 is small the results may not be as clear cut as those for Junior and Primary Schools. However, an evaluation of the significance of these differences using a T-test on these data sets shows that the likelihood of them coming from the same population is around 1 in 200 for all schools and 1 in 3000 for Primary Schools.

4. Conclusions

In terms of the approach different school types take to the SATs a number of conclusions can be drawn from the data:

- (1) When educational establishments are required to compare their students' academic achievement through nationally administered examinations AND these examination results also act as an output measure for the establishment then all establishment types are equivalent in terms of pupil achievement. This is borne out by the KS2 APSs for Primary and Junior Schools.
- (2) When there is no pressure for the educational establishment to use these examinations as publicly scrutinised quality measures (as they are intermediate stages) then student results are lower than those where the results are used for public scrutiny.
- (3) There is a significant difference in Value Added between pupils who have attended Primary Schools and those who attended Infant and Junior Schools. This is not caused by the examined capability of the pupils at KS2, as the APS at this stage (given by the SATs) is the same for both groups; it is a result of the APSs at KS1 being significantly different for the two groups. This is probably caused by the different approaches to the KS1 SATs between Infant and Primary Schools. The observed difference in Value Added is slightly larger than the difference associated with pupils having free school meals.
- (4) Schools which do not use the KS1 and KS2 SATs as an output measure show the same rate of progress (Value Added) to KS2 but not the same absolute level of performance.

The likely impact of school type on likely results is not highlighted in any commentary on "League Tables" but does impact on the perceived performance of Junior Schools in particular.

The pressures on Infant and Primary Schools are different at KS1. Infant Schools are measured on APS hence a high value is required. However, Primary Schools will face more scrutiny over their KS2 APS and Value Added so there is little external pressure to heavily prepare for the examinations and in some way keeping the KS1 data lower helps the KS2 Value Added data. Also, the impact on the pupils within Primary Schools of the KS1 results is minimal as the school will only need to know

where the student lies academically within his or her local peer group, not the entire national cohort. These national pressures will probably only influence a small number of pupils in each school, those near grade boundaries, but will lead to the mathematically small but statistically significant differences when rolled up across all educational establishments. Any benefit to the intensive exam preparation will be quickly lost after the pupil transitions to the next stage of their education.

For the educational establishments which teach across the whole age range and therefore can have a little more of a relaxed attitude to the SATs exams, the data show that they have a deficit of one point in the APS at KS2. This may be the difference between educational establishments which need to place a high level of emphasis on the SATs and hence undertake extra lessons, among other things, and those which take it with less preparation. Short term “cramming” for examinations may have the desired impact on the examination grade but is more likely to be forgotten soon and may account for the perceived drop in pupil performance early in KS3.

The key conclusion of this work is that educational establishments will prepare their pupils for whatever assessment the establishments are monitored on. This is the case in all walks of life and should come as no surprise here. The twin method of comparing schools (Total Average Points Score and Value Added) needs to be interpreted in the light of whether the educational establishment covers a single Key Stage or a number of Key Stages as different types of educational establishment will have different levels of control over their data and different requirements for the examination results.

Note

1. Key Stage 1 pupils aged 5 to 7yrs; Key Stage 2 pupils aged 7 to 11yrs; Key Stage 3 pupils aged 11 to 14yrs; Key Stage 4 pupils aged 14 to 16yrs.

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