Department for Education

School Efficiency Metric

A technical note on the definition and calculation of school efficiency

May 2021

Contents

Summary 3

Calculating the School Efficiency Metric 3

- First step: calculating an ‘efficiency score’ 4
- Second step: identifying a group of ‘most similar schools’ 7
- Third step: calculating the efficiency deciles for similar schools 10

Summary of data used in the School Efficiency Metric 11

- Progress 11
- Spending per pupil 11
- School characteristics 12

Annex 13

- Dealing with expenditure in an all-through school 13
- Weighted mean and standard deviation formulas 13

Summary

About this document

This document has been produced so that users of the School Efficiency Metric can understand in more detail:

- How school efficiency is defined;
- What data is used to calculate school efficiency;
- How the School Efficiency Metric is calculated.

This is a **technical note** that is intended for people with a good general level of statistical knowledge.

Calculating the School Efficiency Metric

There are three steps to calculating the Efficiency Metric, summarised below.

In the first step, we **calculate an 'efficiency score' for each school** by dividing its progress by its spending per pupil. To control for regional variations in expenditure, we divide the school expenditure by the 'Area Cost Adjustment' (ACA) from the National Funding Formula (NFF), our main model for school funding allocations. The ACA uplift is allocated to schools in areas with higher labour market costs to allow schools to cover extra costs associated with running the school. We divide the school expenditure by the ACA to ensure that schools which receive more funding to cover these higher costs do not appear less efficient and vice versa.[1]As progress and spending per pupil are measured on different scales, they are not directly comparable. To allow as fair a comparison between the measures as possible, we standardise both before doing the calculation.

In the second step, **we identify a school's unique group of 'most similar schools'**. These are the 49 statistically most similar schools in terms of the proportion of pupils with a statement of SEN or an education, health and care (EHC) plan (% SEN) and the proportion of pupils who have been eligible for free school meals at any point in the last six years (% Ever6 FSM). In addition, they are of the same phase and organisational type. If a school has a sixth form, its most similar schools are all schools with a sixth form; conversely the 'most similar schools' of schools without a sixth form are all schools without a sixth form. We also compare small primary schools only to other small primary schools (with the 25% smallest schools in the Academy and LA Maintained school sector

[1] Please note that the School Benchmarking website displays the unadjusted per-pupil school expenditure.

being considered small for this purpose). This allows us to effectively control for large overhead costs in small primary schools compared to other primaries. Although there are several ways in which schools may differ from, or be similar to, other schools, the statistical similarity of the matched schools declines if we add more criteria.

In this version of the metric, all-through schools are only compared with other secondary schools. Please see the annex for more information on why we chose this method.

In the third step, **we identify a school's 'efficiency decile'**. We split schools into efficiency deciles to ensure the school efficiency scores are sufficiently large to allow for meaningful comparisons between the deciles. We compare the 'efficiency score' to those of its 'most similar schools'. Within each group of similar schools, we band schools into deciles (10 groups of five) based on their 'efficiency score'. A school's relative efficiency is reported in the form of a decile score from 1 to 10. A school in decile 1 has one of the highest five 'efficiency scores' (and is therefore one of the five most efficient schools) in its 'most similar schools' group; a school in decile 10 has one of the lowest five efficiency scores (and is therefore one of the five least efficient schools) in its 'most similar schools' group.

The three steps are now discussed in more detail.

First step: calculating an 'efficiency score'

Firstly, we apply the ACA to the per-pupil expenditure and then standardise the progress scores and school spending. The ACA is used in the NFF which is the model we use to allocate funding to schools. The ACA gives schools that are in areas with higher labour market costs more funding to help meet these higher costs. To control for these area-related variations in school funding, we divide the per-pupil expenditure by the ACA. If we did not control for these regional variations in spending, then schools in higher cost areas would appear less efficient than those in lower cost areas. The ACA is applied at the local authority level[2] and takes account of the regional pay band applied to teachers pay[3] in each LA and the general labour market conditions affecting the non-teaching workforce. Some LAs have more granular ACA calculations reflecting that not all of the LA is covered by the same teacher pay band. In these cases, we simply take the average ACA for the LA and apply it to the schools in the LA.

We then standardise progress and per pupil expenditure. Progress and per pupil spending are measured on different scales and, consequently, are not directly comparable. Without adjusting either progress or per pupil expenditure, an 'efficiency score' that divides progress by per pupil spending places a greater weight on spending

[2] ACA by LA in table on page 49 in Schools block national funding formula Technical Note

[3] There are four regional pay bands for teachers which are Inner London, Outer London, Fringe and Rest of England

than progress: this is due to the higher average of per pupil spending and the wider standard deviation. This would mean a one-unit change in per pupil spending would lead to a greater change in the 'efficiency score' than a one-unit change in progress.

Standardising is a statistical method of putting both measures on a more equal footing. In practice, it means roughly that having better progress than 75% of schools is just as important as having lower per-pupil spending than 75% of schools. We standardise progress and spending per pupil so that they have a mean value of 100 and standard deviation[4] of 15, which makes the distribution of efficiency scores easier to understand. This is to ensure the efficiency values are not negative and are centred around 1.

The formulas for standardising progress and spending per pupil are:

Formulas for standardised progress and standardised spending per pupil

$$\text{Standardised progress} = 100 + \left[\frac{\left(\text{Progress of school} - \mu_{\text{Progress}}\right) \text{ x } 15}{\sigma_{\text{Progress}}}\right]$$

$$\text{Standardised spending per pupil} = 100 + \left[\frac{\left(\text{Spending per pupil of school} - \mu_{\text{spending}}\right) \text{ x } 15}{\sigma_{\text{spending}}}\right]$$

Variable	Description
μ_{Progress}	The weighted mean progress for all schools of the same phase.
σ_{Progress}	The weighted standard deviation of progress for all schools of the same phase.
μ_{Spending}	The weighted mean spending per pupil for all schools of the same phase.
σ_{Spending}	The weighted standard deviation of spending per pupil for all schools of the same phase.

Next, we calculate the school's efficiency score. This is its 'standardised' progress divided by its 'standardised' spending per pupil.

[4] Standard deviation is a measure that reflects how spread out a set of values is from the mean of the set. The smaller the standard deviation is, the closer the set of values is to its mean.

Formula for the school efficiency score

$$\text{Efficiency score} = \left[\frac{\text{Standardised progress}}{\text{Standardised spending per pupil}}\right]$$

Worked example: Primary school

Consider a primary school with a progress score of 1.2 (averaged across reading, writing and maths) and spending per pupil of £4500. The (weighted) mean values and standard deviations of progress and income per pupil are:

(Weighted) mean progress = 0.09

(Weighted) mean spending per pupil = £4350

(Weighted) standard deviation of progress = 2.2

(Weighted) standard deviation of spending per pupil = 803

Therefore, this school's standardised progress and spending per pupil are:

$$\text{Standardised progress} = 100 + \left[\frac{(1.2 - 0.09)\ x\ 15}{2.2}\right] = 108$$

$$\text{Standardised spending per pupil} = 100 + \left[\frac{(4500 - 4350)\ x\ 15}{803}\right] = 103$$

Its 'efficiency score' is therefore:

$$'\text{Efficiency score}' = \left(\frac{108}{103}\right) = 1.05$$

Worked example: Secondary school

Consider a secondary school with a Progress 8 score of 0.25 and spending per pupil of £5200. The (weighted) mean values and standard deviations of progress 8 and spending per pupil are:

(Weighted) mean progress 8 = 0.025

(Weighted) mean spending per pupil = £5530

(Weighted) standard deviation of progress 8 = 0.34

(Weighted) standard deviation of spending per pupil =918

Therefore, this school's standardised progress and per pupil spending are:

$$'\text{Standardised}'\text{progress } 8 = 100 + \left[\frac{(0.25 - 0.025)\ x\ 15}{0.34}\right] = 110$$

$$'\text{Standardised}'\text{spending per pupil } = 100 + \left[\frac{(5200 - 5530)\ x\ 15}{918}\right] = 95$$

Its 'efficiency score' is therefore:

$$'\text{Efficiency score}' = \left(\frac{110}{95}\right) = 1.16$$

Second step: identifying a group of 'most similar schools'

Identifying a school's 'most similar schools' group requires two levels of grouping. Firstly, we group all schools with schools of the same broad phase and organisational type. For example, a secondary academy's most similar schools are all secondary academies. Furthermore, we group schools with/without sixth forms with other schools that have/do not have sixth forms. We also group the 25% smallest primary schools (for the LA maintained and for the academies sector) only with other small primary schools.

In the second level of grouping, we identify the 49 other schools that have the most similar proportions of % Ever6 FSM and % SEN. If the school's Ever6 FSM is not available, we replace it with the % of pupils receiving FSM in that year. The school's similarity to others is identified by using the Euclidean Distance Matching method. These 49 statistically similar schools, plus the case in focus, form the 'most similar schools' group of 50.

Technical explanation: Euclidean Distance Matching method

This is a statistical technique used to calculate the distance between two data points across, theoretically, many dimensions. In creating 'most similar schools' groups, we use it to calculate the distance between two schools in terms of % SEN and % Ever6 FSM. The smaller this distance, known as the 'Euclidean distance', the more similar the schools are in these characteristics.

The calculation of the 'Euclidean distance' involves a comparison of % SEN and % Ever6 FSM. As with progress and spending per pupil, these two characteristics are measured on different scales. % SEN = 20% is relatively large, whereas % Ever6 FSM = 20% is relatively small. To overcome the issues that this causes, these values are 'standardised'.

$$\text{Standardised value of \% SEN} = \frac{(\text{\% SEN of school} - \text{Mean value of \% SEN across phase})}{\text{Standard deviation of \% SEN across phase}}$$

$$\text{Standardised value of \% Ever6 FSM} = \frac{(\text{\% Ever6 FSM of school} - \text{Mean value of \% Ever6 FSM across phase})}{\text{Standard deviation of \% Ever6 FSM across phase}}$$

The Euclidean distance between two schools, school X and school Y, is calculated using the following formula.

$$\text{Euclidean Distance between schools X and Y} = \sqrt{(\text{SEN}_x - \text{SEN}_y)^2 + (\text{Ever6}_x - \text{Ever6}_y)^2}$$

Variable	Description
SEN_x	Standardised value of % SEN of school X
SEN_y	Standardised value of % SEN of school Y
Ever6_x	Standardised value of % Ever6 FSM of school X
Ever6_y	Standardised value of % Ever6 FSM of school Y

We repeat these steps to find the Euclidean distance between school X and all other schools. The schools corresponding to the 49 smallest Euclidean Distances are the 49 statistically most similar to School "X" in terms of % SEN and % Ever6 FSM and become its 'most similar schools'. Each school has a unique 'most similar schools' group of 50 including the school itself and its 49 'most similar schools'.

There are 50 schools in each ‘most similar schools’ group. This achieves a balance between having a manageable number of comparator schools for schools to benchmark against and ensuring that most schools have at least one ‘most similar school’ within 25 miles. Group sizes of 50 ensure that almost 90% of schools have a ‘most similar school’ within 25 miles.

Worked example of Euclidean Matching

Consider **school A**. It is a secondary academy, with a sixth form. Its % SEN = 10% and its % Ever6 FSM is 30%.

Consider four potential ‘most similar schools’ for school A. These are:

School B: A primary academy. Its % SEN is 12% and its % Ever6 FSM is 27%.
School C: A secondary maintained school without a sixth form. Its % SEN is 8% and its % Ever6 FSM is 35%.
School D: A secondary academy with a sixth form. Its % SEN is 12% and its Ever6 FSM is 36%.
School E: A secondary academy with a sixth form. Its % SEN is 23% and its Ever6 FSM is 15%.

The first level of grouping is to identify the schools of the same phase and organisational type as school A. Also, as school A is a school with a sixth form, we also identify the schools that have sixth forms.

School B is a primary academy. Although it is of the same organisational type, it is in a different phase to school A. Therefore, it cannot be a ‘most similar school’ to school A.

Similarly, school C cannot be an ‘most similar school’ to school A as it is of a different organisational type – it is a maintained school whereas school A is an academy – and does not have a sixth form, whereas school A does.

Schools D and E can be ‘most similar schools’ to school A, as, like school A, they are secondary academies with sixth forms.

In the second level of grouping, we calculate the Euclidean Distances between school A and the schools that pass the first level of grouping (schools D and E), in terms of % SEN and % Ever6 FSM. Their school level characteristics in standardised form are:

School A: Standardised SEN = 0.10. Standardised Ever6 FSM = -0.20
School D: Standardised SEN = 0.11. Standardised Ever6 FSM = -0.10
School E: Standardised SEN = 0.18. Standardised Ever6 FSM = -0.40

Worked example of Euclidean Matching

Therefore:

$$\text{Euclidean Distance between schools A and D} = \sqrt{(0.10 - 0.11)^2 + (-0.20 - 0.10)^2} = 0.10$$

$$\text{Euclidean Distance between schools A and E} = \sqrt{(0.10 - 0.18)^2 + (-0.20 - -0.40)^2} = 0.22$$

The "Euclidean distance" between schools A and D is smaller than between schools A and E. This means that school D is statistically more similar to school A than school E is, in terms of % SEN and % Ever6 FSM.

If these are amongst the 49 smallest "Euclidean distances" between school A and all potential 'most similar schools', school D and school E will be amongst school A's unique 'most similar schools' group.

Third step: calculating the efficiency deciles for similar schools

A school's relative efficiency is reported as an 'efficiency decile'. We use the efficiency deciles to ensure the efficiency scores between the groups of schools are sufficiently large to be meaningful. To calculate the decile, we use the 50 most similar schools in terms of pupil characteristics and split the schools into ten groups of five, based on the distribution of their efficiency scores. How a school's 'efficiency score' translates into its 'efficiency decile' is shown in the following table.

'Efficiency decile'	'Efficiency score' in 'most similar schools' group
1	Largest to 5th largest
2	6th largest to 10th largest
3	11th largest to 15th largest
4	16th largest to 20th largest
5	21st largest to 25th largest

‘Efficiency decile’	‘Efficiency score’ in ‘most similar schools’ group
6	26th largest to 30th largest
7	31st largest to 35th largest
8	36th largest to 40th largest
9	41st largest to 45th largest
10	46th largest to 50th largest

Summary of data used in the School Efficiency Metric

This section summarises the data used in calculating the School Efficiency Metric.

Progress

For the primary phase, we use an average of the key stage 2 reading, writing and maths progress for the 2018/19 cohort taking the tests. This measures the progress made between key stage 1 and key stage 2.

For the secondary phase, we use the Progress 8 measure for the 2018/19 exam-taking cohort. This measures the progress made by pupils between key stage 2 and key stage 4 in the subjects that make up their Attainment 8 GCSE (or equivalent), including English and Maths. Progress 8 compares each pupils’ achievement (based on Attainment 8) with the average attainment of all pupils nationally who had a similar starting point.

Spending per pupil

We use the published spending data to calculate per pupil expenditure. Consistent Financial Reporting (CFR) is the annual expenditure data published for maintained schools. It covers a financial year, and we use the 2018-19 data in the metric calculation. Academies Account Return (AAR) is the annual expenditure data for academies and covers an academic year, again we use the 2018/19 data for the metric calculation. We re-distribute Central Services expenditure back to individual academies weighted by the number of pupils in the school. In this analysis we make no adjustments for the differences in the accounting periods covered by the data.

The benefit of using spending data over income data (which we previously used for the metric) is that it allows schools to have more control over their efficiency score. When income was the main input variable, spending efficiently and making savings did not necessarily improve the efficiency measure as these had no effect on the income the schools received from central government and/or their local authority. As expenditure is now the main input, spending more efficiently should directly impact schools' efficiency score.

Further, spending data is published annually, and this allows users of the metric to link and compare to other publicly available data and sites such as 'School Financial Benchmarking' and 'Compare School Performance' which also draw on the same data.

School characteristics

The school names, phases and organisational type are correct as of August 2019 taken from the 'Get Information About Schools' (GIAS).

The data on SEN and FSM are taken directly from the school census for January 2019.

The Ever6 FSM school information is taken from the 'Pupil Premium: allocations and conditions of grant'. This publication uses the August 2017 census to allocate the Ever6 FSM funding for 2018-19 academic year.

Annex

Dealing with expenditure in an all-through school

In this edition of the efficiency metric, we compare all-through schools with other secondary schools. To ensure the results are comparable, we use the progress 8 reported in the all-through school to calculate their efficiency score.

After examining different methods to distribute expenditure across school phases in an all-through school, we decided to compare all-throughs to secondary schools only, as expenditure patterns between them, on a system level, are not significantly different. We performed an analysis of the variance (ANOVA) which is a statistical test to compare group means to verify if the difference between them is significant.[5] In this instance, we compare the average per-pupil expenditure in all-through schools to the average per-pupil expenditure in secondary schools across the LA and academy sector. The results from the test show that the average per-pupil expenditure is not significantly different across school phases and types. Therefore, we conclude that, on a system level, the per-pupil expenditure in all-through schools is not noticeably different than secondary schools and we can compare these schools against one another.

Weighted mean and standard deviation formulas

In calculating a school's 'efficiency score', we standardise its progress score and spending per pupil using their 'weighted' means and standard deviations. These are weighted by schools' full-time equivalent (FTE), as in the following formulas.

[5] A significant result from the ANOVA test would indicate that the observed difference in the expenditure data could not have occurred at random (due to chance)

Formulas for weighted mean and standard deviations

$$\textbf{Weighted mean of progress} = \frac{\sum_{i=1}^{n}(\mathrm{FTE_i\ x\ progress_i})}{\sum_{i=1}^{n}(\mathrm{FTE_i})}$$

$$= \frac{(\mathrm{FTE_1 x\ progress_1}) + (\mathrm{FTE_2 x\ progress_2}) + \cdots + (\mathrm{FTE_n x\ progress_n})}{\mathrm{FTE_1} + \mathrm{FTE_2} + \cdots + \mathrm{FTE_n}}$$

$$\textbf{Weighted mean of spending per pupil} = \frac{\sum_{i=1}^{n}(\mathrm{FTE_i\ x\ Spending_i})}{\sum_{i=1}^{n}(\mathrm{FTE_i})}$$

$$= \frac{(\mathrm{FTE_1 x\ Income_1}) + (\mathrm{FTE_2 x\ Income_2}) + \cdots + (\mathrm{FTE_n x\ Income_n})}{\mathrm{FTE_1} + \mathrm{FTE_2} + \cdots + \mathrm{FTE_n}}$$

$$\textbf{Weighted standard deviation of progress} = \sqrt{\frac{\sum_{i=1}^{n}\mathrm{FTE_i\ x\ (progress_i} - \overline{\mathrm{progress}})^2}{\frac{M-1}{M}\ \mathrm{x}\ \sum_{i=1}^{n}\mathrm{FTE_i}}}$$

$$\textbf{Weighted standard deviation of spending per pupil} = \sqrt{\frac{\sum_{i=1}^{n}\mathrm{FTE_i\ x\ (Spending_i} - \overline{\mathrm{Spending}})^2}{\frac{M-1}{M}\ \mathrm{x}\ \sum_{i=1}^{n}\mathrm{FTE_i}}}$$

$\mathrm{FTE_i}$ = Number of full time equivalent pupils in school i.

$\mathrm{Progress_i}$ = progress in school i.*

$\mathrm{Spending_i}$ = Spending per pupil in school i.

$\overline{\mathrm{Progress}}$ = weighted mean of progress

$\overline{\mathrm{Spending}}$ = weighted mean of spending per pupil

M = number of non zero values of $\mathrm{FTE_i}$

*Progress as measured by Progress 8 for secondary phase and the average across progress reading, writing and maths for primary phase.

Department for Education

About this publication:

enquiries www.education.gov.uk/contactus

download www.gov.uk/government/publications

Follow us on Twitter:
@educationgovuk

Like us on Facebook:
facebook.com/educationgovuk