THE ECONOMIC VALUE OF HIGH TEACHING QUALITY IN THE UK

28 SEPTEMBER 2023

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KEY FINDINGS

We study the value to the UK economy of increasing average teaching quality – as measured through value-added measures – by one standard deviation. This is considered to be roughly equivalent to 2 extra months of learning progress[1]. Our research suggests that the percentage increase in lifetime earnings for students exposed to five or more years of higher teaching quality ranges from 3% to 3.7%. This implies that over a 10-year period earnings for those in employment could be boosted by up to £2.6bn each year, generating additional income tax receipts of over £870m annually. If we extend the timeframe to 20 years the annual earnings boost for those in employment could nearly reach £10 billion, accompanied by an estimated increase in income tax revenue of £3.2 billion.

In addition to the findings mentioned above, our results also suggest that the present value of the cumulative expected increase in lifetime earnings over the entire lifetime of pupils going through the school system in the next decade could reach up to £90bn. The corresponding estimate accounting for all pupils going through the school system in the next two decades is almost £160bn.

Table 1   Annual benefits from higher teaching quality

Time frame	Annual increase in earnings	Annual tax benefits
5 years	£236m - £244m	£79.1m - £81.9m
10 years	£2.3bn - £2.6bn	£761.5m - £873.9m
20 years	£8.1bn - £9.7bn	£2.71bn - £3.23bn

Source: *Frontier Economics*
Note: *The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.*

Table 2   Lifetime benefits from higher teaching quality (in 2023 money)

Time frame	Present value increase in lifetime earnings	Present value of lifetime tax benefit
5 years	£35bn - £39bn	£12bn - £13bn

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[1] According to academic literature a one standard deviation increase in teaching quality is generally associated with an increase in pupil achievement ranging from 0.1 to 0.2 standard deviations. In our analysis, we took a conservative stance assuming a pupil achievement increase of 0.1 standard deviations. According to the Education Endowment Foundation (EEF), this corresponds to 2 extra months of learning progress.

Time frame	Present value increase in lifetime earnings	Present value of lifetime tax benefit
10 years	£76bn - £90bn	£26bn - £30bn
20 years	£133bn - £159bn	£45bn - £53bn

Source: *Frontier Economics*

Note: *The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.*

Our analysis also suggests that a one standard deviation increase in teaching quality can lead to an increase in annual GDP between 0.7% and 0.8% once the entire workforce has benefited from higher teaching quality.

Furthermore, our findings indicate that investing more in teachers' professional expertise would impact positively on inequality and social mobility, as research shows that disadvantaged children are more likely to be taught by less experienced teachers. Additionally, we find that beyond labour market returns, reductions in inequalities in other non-pecuniary outcomes, such as crime rates and university attendance can also be expected.

EXECUTIVE SUMMARY

Context

The role of education in shaping a nation's economic trajectory is widely recognized. Teachers play a vital role in this. Governments across the globe continually strive to enhance the quality of their education systems, with a central focus on improving classroom teachers' effectiveness. In the past two decades, the concept of "teaching quality" has gained significant global attention. Economic literature consistently underscores the link between teaching quality and student achievement, highlighting teaching as one of the most cost-effective levers for improving schools. Consequently, enhancing the quality of teaching has emerged as a pivotal goal in education reform efforts.

In England, this emphasis on improving teaching methods and standards gained momentum over the last two decades. The transition from the 2007 Professional Standards Framework to the Teachers' Standards[2] in 2012 set clear expectations on the professional behaviour and performance of educators. The introduction of the Early Career Framework (ECF) in September 2021 gave all early career teachers the entitlement to a funded, two-year package of structured, evidence-informed training and support. During the same period, revised National Professional Qualifications (NPQs) were introduced to help teachers develop their skills in specific areas, such as leadership, teaching literacy and numeracy, or creating cultures of good behaviour and high expectations. The NPQs were developed using an evidence base approved by the Education Endowment Foundation.

Academic research underscores that high-quality professional development is effective in improving teaching quality across a range of subjects and phases and is the most cost-effective means to improve teaching. It is therefore clear that pupil outcomes will be improved by staffing schools with teachers who have ongoing access to high quality professional development, and the time to dedicate to it. In reality, there are many barriers to achieving this in the UK, including an insufficient supply of teachers and funding constraints on schools. Understanding the economic value of high teaching quality is crucial to assessing the potential benefits of public investments in high quality professional development for teachers. This context sets the stage for our study, which explores the economic implications of improving teaching quality in the UK's education system.

Project aims and objectives

This report examines the potential economic value stemming from an improvement of the quality of teaching across the UK school system. The primary objective of this research is to determine the potential benefits that could arise from higher teaching quality, and to provide a quantitative assessment of the magnitude of such benefits. Non-pecuniary benefits are

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[2] The Teachers' Standards are a set of professional standards that define the minimum requirements for teachers' practice and conduct.

considered in a qualitative manner only – this should not be taken as a reflection of the lesser importance of these benefits, but merely as the result of methodological constraints. The specific study aims include:

- Identifying the potential short-term and long-term benefits that could result from higher teaching quality.
- Quantifying the expected increase in lifetime earnings for students exposed to higher teaching quality, as well as the associated expected rise in income tax revenue and GDP.
- Examining the potential effects of a focused policy intervention aimed at elevating the performance of the least effective 5% of teachers, and discussing its impact on inequality and social mobility.
- Discussing other potential non-pecuniary benefits and their relevance to society.

Approach

Our methodological approach comprises three main components:

- **Review of existing literature**: We conducted a review of the most relevant academic and grey literature linking teaching quality to improved education outcomes and economic performance.
- **Mapping of benefits**: Based on insights from the literature review, we constructed a logic model delineating the evidenced links between high quality teaching and a range of outcomes and impacts.
- **Quantitative modelling:** We formulated a valuation model estimating the economic benefits associated with higher teaching quality.

We estimated the value of high quality teaching in the UK primarily by studying the impact of improved teaching on increased lifetime earnings. High teaching quality yields a variety of non-pecuniary benefits – including improved health, higher university attendance, and reduced incarceration rates – but we have chosen to concentrate on earnings due to its prominence in the existing academic literature, which provides a wealth of high quality evidence in this domain. Several reasons contribute to the literature's focus on earnings. Firstly, earnings constitute a readily measurable metric, facilitating empirical analysis. Secondly, it is an aspect of education that garners the interest of policymakers across the political spectrum. In fact, the increase in lifetime earnings associated with higher teaching quality provides a strong motivation for implementing a policy to develop teacher effectiveness in the classrooms. Furthermore, studying the non-pecuniary benefits of teaching quality (and of education more generally) presents certain methodological challenges.

We evaluate the impact of increasing average teaching quality by one standard deviation. This is considered to be roughly equivalent to 2 extra months of learning progress[3]. We selected a one standard deviation because evidence from literature suggests this is an achievable target through investment in high-quality professional development. Research indicates that the top 10% of most effective professional development programmes achieve an average impact of 0.15 standard deviations increase on student achievement[4]. According to academic literature, this is approximately the same as the expected increase in test scores from a one standard deviation increase in teaching quality, and is equivalent to approximately 2 to 3 extra months of learning progress. This suggests that the increase in teaching quality we model is realistically achievable over a short time frame through a targeted policy intervention.

We estimated the economic returns that would result if every child benefited from high quality teaching during just five years of their schooling. Because the existing academic literature lacks sufficient evidence on the cumulative effect of high quality teaching over multiple years, we took the conservative assumption that the cumulative benefits of higher teaching quality extend up to five years, beyond which no further gain occurs. These intentionally conservative assumption, alongside other conservative assumptions described in the methodology section, help us address the uncertainty around the cumulative effect of higher teaching quality over multiple years and maintain confidence that our results represent the lower end of the potential earning benefits associated with higher teaching quality. It is important to note that by taking these assumptions we are not claiming that the benefits drop to zero after five years.

We extracted the modelling parameters from pertinent academic literature and combined these parameters with various modelling assumptions discussed in Section 3.

Findings

We model earnings benefits both in annual terms and present value terms across time horizons of 5, 10, and 20 years.

We present two types of benefits:

- **Annual benefit** - this is the overall expected annual increase in earnings for pupils who go through the school system, benefit from higher teaching quality for five years of their schooling, and enter the workforce. This benefit is calculated over a 5, 10, or 20 years' time horizon.

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[3] According to academic literature a one standard deviation increase in teaching quality is generally associated with an increase in pupil achievement ranging from 0.1 to 0.2 standard deviations. In our analysis, we took a conservative stance assuming a pupil achievement increase of 0.1 standard deviations. According to the Education Endowment Foundation (EEF), this corresponds to 2 extra months of learning progress.

[4] Sims, S. et al. (2021). *What are the characteristics of effective teacher professional development? A systematic review & meta-analysis.*

■ **Present value of lifetime benefit** – this is an estimate of the increase in earnings that a cohort of pupils benefitting from high teaching quality for five years could expect over their whole lifetime, added together and expressed in 2023 money.

The magnitude of benefits increases over time as more pupils go through the school system and join the labour market.

Table 1 shows the estimated annual benefits, while Table 2 shows the estimated present value benefits over pupils' lifetime. Both tables show benefits expressed as increased earnings, alongside the correspondent increase in estimated income tax receipts.

Our research suggests that the percentage increase in lifetime earnings for students exposed to five or more years of higher teaching quality ranges from 3% to 3.7%. This implies that over a 10-year period – at which point 11% of the workforce will have benefitted from higher quality teaching – earnings for those in employment could be boosted by up to £2.6bn each year, generating additional income tax receipts of over £870m annually. If we extend the timeframe to 20 years – once 34% of the workforce have benefitted – the annual earnings boost for those in employment could nearly reach £10 billion, accompanied by an estimated increase in income tax revenue of £3.2 billion.

Estimated gains increase more than linearly between the first and the second decade. This is because initial economic benefits are delayed as students benefiting from higher teaching quality need time to enter the workforce. However, in the second decade, a continuous influx of students who have benefited from these improvements will join the workforce each year.

In addition to the findings mentioned above, our results also suggest that the present value of the cumulative expected increase in lifetime earnings over the entire lifetime of pupils going through the school system in the next decade could reach up to £90bn. The corresponding estimate accounting for all pupils going through the school system in the next two decades is almost £160bn. These figures are much larger because the benefits would continue to be felt over the lifetime of the pupils who had benefitted from improved teaching.

Table 3   Annual benefits from higher teaching quality

Time frame	Annual increase in earnings	Annual tax benefits
5 years	£236m - £244m	£79.1m - £81.9m
10 years	£2.3bn - £2.6bn	£761.5m - £873.9m
20 years	£8.1bn - £9.7bn	£2.71bn - £3.23bn

Source: Frontier Economics

Note: The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.

Table 4   Lifetime benefits from higher teaching quality (in 2023 money)

Time frame	Present value increase in lifetime earnings	Present value of lifetime tax benefit
5 years	£35bn - £39bn	£12bn - £13bn
10 years	£76bn - £90bn	£26bn - £30bn
20 years	£133bn - £159bn	£45bn - £53bn

Source: Frontier Economics

Note: The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.

Our analysis also suggests that a one standard deviation increase in teaching quality can lead to an increase in annual GDP between 0.7% and 0.8% once the entire workforce has benefited from higher teaching quality. Between 2010 and 2019 (to ignore the effects of Covid-19), annual growth rates in the UK were between 1.1% and 3.2%[5]. The 0.7% illustrative baseline increase in GDP therefore would represent a substantial improvement in annual GDP growth.

Furthermore, our findings indicate that investing more in teachers' professional expertise would impact positively on inequality and social mobility, as research shows that disadvantaged children are more likely to be taught by less experienced teachers. Additionally, we find that beyond labour market returns, reductions in inequalities in other non-pecuniary outcomes, such as crime rates and university attendance can also be expected.

Policy implications and conclusion

The most important lesson of this study is that policies that raise teaching quality are likely to have substantial economic and social benefits. Evidence from literature suggests that when it comes to improving schools, investing in teaching is the most cost-effective approach compared to alternatives such as offering more school choices or reducing class sizes, which are often found not to yield substantial improvements despite significant investments.

This report also highlights the critical importance of increasing support for teachers to help them reach their full potential as professionals. A policy intervention raising teaching quality by one standard deviation – roughly equivalent to 2 extra months of learning progress – is expected to generate significant returns to the taxpayer and be able to pay for itself within a short time frame. In fact, while it takes time for the full effects of higher teaching quality to materialise in the economy, our results suggest that in ten years, improving teaching quality would yield additional tax revenue of £870m annually – more than three times what the

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[5] https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/ihyp/pn2

government has currently pledged to spend on teacher professional development (£242m per year) – and within twenty years this would rise to 13 times at £3.2bn.

1   Introduction

1.1   Definition of "teaching quality"

To provide clarity in this report, it is important to define what we mean by teaching quality. In this context, teaching quality refers to the effectiveness of teachers in the classroom, as reflected on pupils' test-scores. Our assessment of teaching quality primarily relies on value-added measures, which are statistical techniques used to assess the impact of teachers on the academic progress of pupils.

It is worth noting that while value-added measures provide valuable insights into a specific aspect of teaching quality related to test scores, we acknowledge that evidence suggests teachers can also significantly influence outcomes that go beyond what can be measured through test scores. These broader dimensions of quality, often referred to as 'non test-score' dimensions, are difficult to measure because of a lack of consensus among researchers regarding measurement methods. As a result, we were unable to quantitatively estimate the benefits associated with these 'non test-score' dimensions of quality in our model. Nevertheless, we thoroughly explore these theoretical benefits in qualitative terms within this report.

To avoid repetition, throughout this report the expressions "teaching quality" and "teacher effectiveness" will be used interchangeably to denote the dimension of quality captured by value-added measures.

1.2   Policy background

The role of education in shaping a nation's economic trajectory is widely acknowledged. Governments frequently aim to improve the quality of their education systems and institutions, and a central aspect of these policy endeavours revolves around improving the quality of classroom teaching.

Over the past two decades, the concept of teaching quality has gained mounting global attention. Academic literature has established a consistent link between teaching quality and pupil attainment and many studies have shown that teaching is the most cost-effective policy lever available for improving schools[6]. Focusing on the quality of teaching has become a significant goal in education reforms.

In England, over the same time period, there has been growing attention and effort on improving teaching methods and rules. The 1998 introduction of a statutory induction period for new teachers ensured that all new teachers would be able to spend a meaningful amount of time 'off-timetable' engaging in professional learning. The transition from the 2007

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[6] Allen et al. (2015). *Enhancing secondary school instruction and student achievement.*

Professional Standards Framework to the Teachers' Standards[7] in 2012 set clear expectations on the professional behaviour and performance of educators. The introduction of the Early Career Framework (ECF) in September 2021 gave all early career teachers the entitlement to a funded, two-year package of structured, evidence-informed training and support. During the same period, revised National Professional Qualifications (NPQs) were introduced to help teachers develop their skills in specific areas, such as leadership, teaching literacy and numeracy, or creating cultures of good behaviour and high expectations. The NPQs were developed using an evidence base approved by the Education Endowment Foundation.

Academic research underscores that high-quality professional development is effective in improving teaching quality across a range of subjects and phases and it is the best and most cost-effective means to improve teaching. While recruiting better teachers can undoubtedly enhance student achievement, it requires a sufficient supply of teachers, which currently remains problematic in the UK. Recruitment and retention of teachers is likely to remain a challenge going forward[8].

Gaining a comprehensive understanding of the economic value of higher teaching quality is essential to understand the benefits that can potentially be unlocked by public investment in high quality professional development of teachers.

1.3   Previous research

There is a substantial body of academic literature that explores the links between high-quality professional development and teaching quality, teaching quality and pupil outcomes, as well as broader economic performance indicators.

1.3.1   Link between continued professional development and teaching quality

Meta-analyses of causal studies have shown that high-quality professional development is effective in improving teaching quality across a range of subjects and phases[9]. Professional development improves teaching quality both by improving teachers' knowledge[10] and classroom practice[11]. The evidence base for the effectiveness of professional development

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[7] The Teachers' Standards are a set of professional standards that de fine the minimum requirements for teachers' practice and conduct.

[8] NFER (2022). *What teachers do next after leaving and the implications for pay-setting.*

[9] Basma and Savage (2018). *Teacher Professional Development and Student Literacy Growth: a Systematic Review and Meta-analysis.*

Basma and Savage (2023). *Teacher Professional Development and Student Reading in Middle and High School: A Systematic Review and Meta-Analysis.*

Lynch et al., (2019). *Strengthening the Research Base that Informs STEM Instructional Improvement Efforts: A Meta-Analysis*

Sims and Wood, (2020). *Identifying the characteristics of effective teacher professional development: a critical review*

[10] Gonzalez et al. (2022). *A Meta-Analysis of the Experimental Evidence Linking STEM Classroom Interventions to Teacher Knowledge, Classroom Instruction, and Student Achievement.*

[11] Kraft et al., (2018). *The Effect of Teacher Coaching on Instruction and Achievement: A Meta-Analysis of the Causal Evidence*

includes studies from replicated randomised controlled trials[12], meaning that the findings are highly trustworthy.

Relevant evidence from academic literature

- **Kraft et al (2018)** reviewed 60 experimental and quasi-experimental studies focused on one particular form of teacher professional development (instructional coaching) and found an average impact on student test scores of 0.18 standard deviations. This is equivalent to approximately two months of additional pupil progress.

- **Lynch et al (2019)** reviewed 95 experimental and quasi-experimental studies of science and maths professional development and found an average impact on student test scores of 0.21 standard deviations. This is equivalent to approximately three months of additional pupil progress.

- **Sims et al. (2021)** find an average impact of teacher professional development on pupil standardised test scores of 0.05 standard deviations. This is equivalent to approximately one month of additional pupil progress. However, they find that the impact of professional development varies widely across different professional development programmes, with the top 10% of most effective programmes having an average impact of 0.15 standard deviations.

- **Basma & Savage (2018) and Basma & Savage (2023)** reviewed experimental and quasi-experimental studies of reading-focused professional development and found an average impact on student test scores of 0.22 standard deviation, dropping 0.06 among middle and secondary school teachers. This is equivalent to between one and three months of additional pupil progress.

1.3.2   Link between teaching quality and pupil outcomes

Research consistently indicates that teaching quality is a significant factor influencing pupil performance. Effective teachers can have a positive impact on student learning outcomes, including standardised test scores, graduation rates, and long-term educational attainment.

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[12] Allen et al., (2011). *An Interaction-Based Approach to Enhancing Secondary School Instruction and Student Achievement.*

Allen et al., (2015). *Enhancing Secondary School Instruction and Student Achievement: Replication and Extension of the My Teaching Partner-Secondary Intervention.*

Relevant evidence from academic literature

- **Rockoff (2003)** finds large and statistically significant differences among teachers: an increase of one standard deviation in teaching quality leads to a rise of approximately 0.20 standard deviations in reading test scores and a 0.24 standard deviations in mathematics test scores on a nationally standardised scale. In addition, teaching experience has statistically significant positive effects on reading test scores, controlling for fixed teaching quality.

- **Nye et al. (2004)** finds positive teacher effects that are larger on mathematics achievement than on reading achievement. The estimated relation of teacher experience with student achievement gains is substantial, but is statistically significant only for 2nd grade reading and 3rd grade[13] mathematics achievement.

- **Hanushek et al. (2005)** finds that teachers have powerful effects on reading and mathematics achievement, and that the effects of a costly ten student reduction in class size are smaller than the benefit of moving one standard deviation up the teaching quality distribution, highlighting the importance of teacher effectiveness in the determination of school quality.

1.3.3 Link between teaching quality and economic performance

There is a well-established link in the literature between teaching quality and economic performance at both individual and national levels. The quality of teaching can impact not only students' earnings outcomes but also broader economic indicators.

Relevant evidence from academic literature

- **Hanushek (2011)** finds that in the US a teacher one standard deviation above the mean effectiveness can annually produce incremental gains of over $400,000[14] in present value of student future earnings with a class size of 20, and proportionately higher with larger class sizes. Alternatively, replacing the bottom 5-8 percent of teachers with average teachers could yield present value benefits of approximately $100 trillion[15].

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[13] The US school system is typically divided into three levels or schools: elementary (Grades K-5), middle (Grades 6-8) and high (Grades 9-12).

[14] In 2011 prices

[15] In 2011 prices

Relevant evidence from academic literature

- **Chetty et al. (2011)** finds that students assigned to high value-added teachers earn higher salaries. Using a dataset from North Carolina, they find that teachers have large impacts in all U.S grades[16] from 4 to 8. On average, a one standard deviation increase in teacher value-added in a single grade results in approximately a 1% increase in earnings at age 28. Upskilling a teacher whose value-added is in the bottom 5% up to the average teacher value-added would increase the present value of students' lifetime income by more than $250,000 for the average classroom in their sample[17].

- **Hanushek and Woessman (2012)** finds that the relationship between educational achievement and GDP growth is remarkably stable across extensive sensitivity analyses of specification, time period, and country samples. Specifically, their findings suggest that one standard deviation higher cognitive skills of a country's workforce is associated with approximately two percentage points higher annual growth in per capita GDP.

1.3.4 Non-pecuniary benefits of higher teaching quality

There is a growing body of academic literature that explores the non-pecuniary benefits of higher teaching quality. These benefits go beyond monetary considerations and encompass a wide range of positive outcomes for both students and society.

Relevant evidence from academic literature

- **Chetty et al. (2011)** finds that students assigned to high value-added teachers are more likely to attend college, attend higher-ranked colleges, live in higher socio-economic status neighbourhoods, and save more for retirement. They are also less likely to have children as teenagers.

- **Kirabo Jackson (2012)** finds that teachers have causal effects on skills not measured by testing, but reflected in absences, suspensions, grades, and progression to the next school year (in a context where pupils can be held back). Teacher effects on these non-test-score outcomes in 9th grade predict longer-run effects on high-school completion and proxies for college-going – above and beyond their effects on test scores.

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[16] The US school system is typically divided into three levels or schools: elementary (Grades K-5), middle (Grades 6-8) and high (Grades 9-12). Grades 4 to 8 roughly correspond to year 5 to 9 in the UK school system.

[17] In 2011 prices.

Relevant evidence from academic literature

- **Rose et al. (2022)** studies teachers' impacts on their students' future criminal justice contact using public schools and administrative data from North Carolina. They find that teachers' direct effects on future arrests, convictions and incarcerations are large – for example, they find a one standard deviation of teacher effects on future arrests of 2.7% and on incarceration of 2.1%. Estimated teachers' effects on criminal justice contact are independent to their effects on academic achievement, implying assignment to a high test score value-added teacher does not reduce future criminal justice contact. However, teachers who succeed in reducing suspensions and improve attendance, substantially decrease the likelihood of future arrests among their students. Their results suggest that the development of non-cognitive skills is central to the returns to education for crime and highlight an important dimension of teachers' social value missed by test score-based quality metrics.

1.3.5 Heterogeneity of teacher effects throughout different socio-economic groups

Academic literature suggests that teacher effects are not homogeneous across the entire student population. Instead, heterogeneity of teacher effects can be observed between different socio-economic groups.

Relevant evidence from academic literature

- **Allen and Sims (2018)** finds evidence that between schools, disadvantaged pupils are more likely to have unqualified, inexperienced or out-of-subject teachers. They also find evidence of an inequitable allocation of teaching quality to classes within schools.
- **Heckman et al. (2018)** investigates a range of non-market outcomes including incarceration, mental health, voter participation, trust, and participation in welfare. They find that the returns to education for many non-market outcomes appear to be larger for low-ability individuals – a feature of the returns to education that is missed if only market returns are analysed.

Relevant evidence from academic literature

- **Jackson et al. (2022)** studies the long-run effects of attending "effective high schools" (intended by the authors as high schools that improve a combination of test scores, survey measures of socio-emotional development, and behaviours in 9th grade) for students who are more versus less likely to attain more years of education (based on 8th grade characteristics). They find that students with the lowest likelihood of attaining more years of education experience larger improvements in high school graduation, college going, and school-based arrests, but not necessarily higher percentage increases in lifetime earnings. Their findings suggest that this category of students are relatively more responsive to non-test score dimensions of school quality.

1.4   Motivation for this study

The current challenging fiscal environment puts increased pressure on the government to achieve a more efficient allocation of funds within specific areas of public spending. This means that independent and evidence based appraisals of the economic value at stake in a specific policy area assume particular relevance. In this context, Frontier Economics has been commissioned by Ambition Institute to produce an independent piece of research to provide new evidence on the economic value of higher teaching quality in the UK.

The work is relevant as it provides policymakers with a more comprehensive understanding of the potential economic benefits stemming from an investment in teaching quality throughout the school system. This will help in identifying the scope of intervention and determining the optimal level of investment for policies aimed at improving the quality of teaching, like the roll-out of career-long high quality professional development for the teaching workforce.

1.5   Project aims and objectives

This report examines the potential economic value stemming from an increase in teaching quality across the UK school system. The primary objective of this research is to determine the theoretical benefits that could arise from higher teaching quality, and to provide a quantitative assessment of the magnitude of such benefits.

Unfortunately, for many of the theoretical outcomes and impacts of improving teaching quality, assessing or assigning a specific economic value to the benefits proves to be unattainable. In such cases, we have delineated the theoretical argument for these benefits but refrained from including them in the quantified assessment of the economic value at stake. This omission is likely to result in our final calculations understating the overall societal impact of higher teaching quality. It is important to note that the absence of quantification does not diminish the

significance of these benefits; rather, it signifies a lack of sufficient evidence to assign them a measurable value.

The specific aims of the study include:

- Identifying the potential short-term and long-term benefits that could result from higher teaching quality.
- Quantifying the expected increase in lifetime earnings for students exposed to higher teaching quality, as well as the associated expected rise in income tax revenue and GDP.
- Examining the potential effects of a focused policy intervention aimed at supporting the least effective 5% of teachers to develop as professionals, and discussing its impact on inequality and social mobility.
- Discussing other potential non-pecuniary benefits and their relevance to society.

1.6   Structure of the report

Section 2 presents a detailed description of the logic model and the methodology used to produce quantitative estimates of the economic value of higher teaching quality.

Section 3 presents findings of our modelling exercise, examines its impact on inequality and social mobility and discusses other potential non-pecuniary benefits and their relevance to society.

Section 4 discusses policy implications and final conclusions.

2   Methodology

2.1   Articulating the benefits of higher teaching quality

2.1.1   Approach to mapping the theoretical benefits

To explain how higher teaching quality contributes to particular results in the short-term and long-term, we developed a theory of change using a logic model framework. Logic models describe how the inputs and activities of improving teaching quality lead to outputs, outcomes, and impacts for the pupils and the wider economy. They are best-practice tools used widely by government economists and evaluators to show the pathway from inputs and activities to impacts by setting out the intermediate steps between activities and different types of impacts, including the causal links between these steps. Figure 1 sets out the structure of a logic model we use.

Our theory of change and logic model were based on a review of the available literature, to understand the potential benefits of higher teaching quality and provide evidence for each link in the steps.
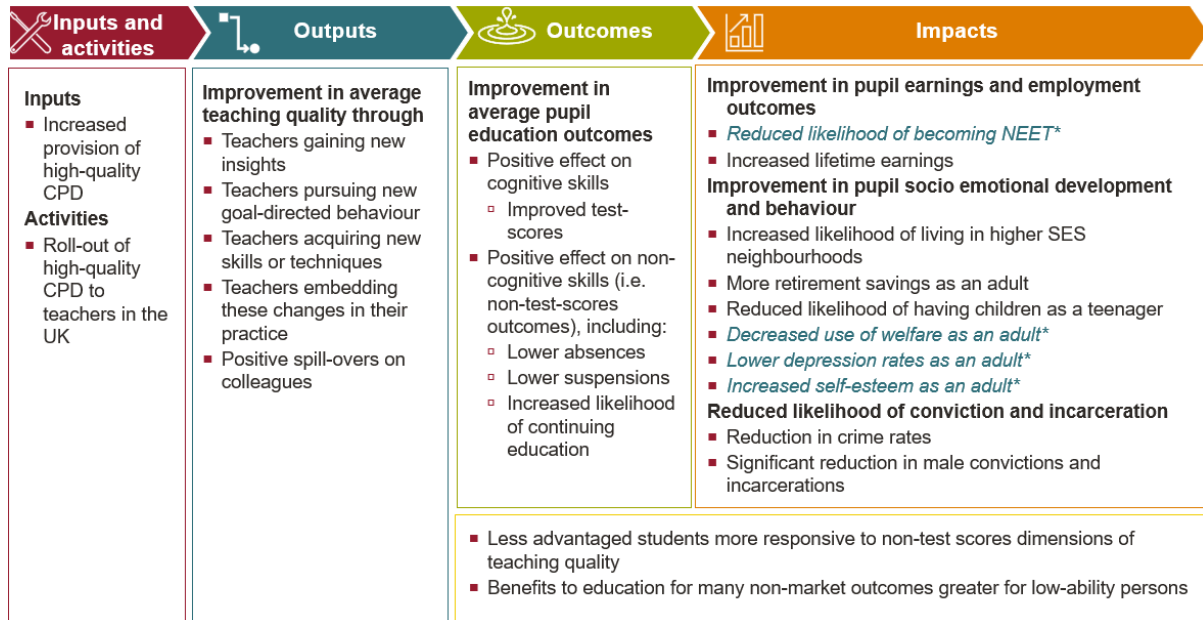
Figure 1   The structure of a logic model

Source: Frontier Economics

2.1.2   Theoretical benefits

Figure 2   The theoretical benefits of higher teaching quality

Inputs and activities	Outputs	Outcomes	Impacts

Inputs
▪ Increased provision of high-quality CPD
Activities
▪ Roll-out of high-quality CPD to teachers in the UK
	Improvement in average teaching quality through
	▪ Teachers gaining new insights
	▪ Teachers pursuing new goal-directed behaviour
	▪ Teachers acquiring new skills or techniques
	▪ Teachers embedding these changes in their practice
	▪ Positive spill-overs on colleagues
		Improvement in average pupil education outcomes
		▪ Positive effect on cognitive skills
		  ▫ Improved test-scores
		▪ Positive effect on non-cognitive skills (i.e. non-test-scores outcomes), including:
		  ▫ Lower absences
		  ▫ Lower suspensions
		  ▫ Increased likelihood of continuing education
			Improvement in pupil earnings and employment outcomes
			▪ *Reduced likelihood of becoming NEET**
			▪ Increased lifetime earnings
			Improvement in pupil socio emotional development and behaviour
			▪ Increased likelihood of living in higher SES neighbourhoods
			▪ More retirement savings as an adult
			▪ Reduced likelihood of having children as a teenager
			▪ *Decreased use of welfare as an adult**
			▪ *Lower depression rates as an adult**
			▪ *Increased self-esteem as an adult**
			Reduced likelihood of conviction and incarceration
			▪ Reduction in crime rates
			▪ Significant reduction in male convictions and incarcerations

▪ Less advantaged students more responsive to non-test scores dimensions of teaching quality
▪ Benefits to education for many non-market outcomes greater for low-ability persons

Source: Frontier Economics
Note: *Impacts not directly linked to teaching quality in the literature, but to education more generally

High-quality professional development is effective in improving teaching quality across a range of subjects and phases[18]. Professional development improves teaching quality both by improving teachers' knowledge[19] and classroom practice[20]. Teachers exposed to high-quality professional development would gain new insights into teaching and acquire new skills or techniques, such as pursuing goal-directed behaviour. These changes would be embedded in their practice, having positive spill-overs on colleagues.

In turn, this increase in teaching quality would improve average pupil education outcomes. Pupils would experience an increase in cognitive skills, evidenced by an improvement in their

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[18] Basma and Savage (2018). *Teacher Professional Development and Student Literacy Growth: a Systematic Review and Meta-analysis.*

Basma and Savage (2023). *Teacher Professional Development and Student Reading in Middle and High School: A Systematic Review and Meta-Analysis.*

Lynch et al., (2019). *Strengthening the Research Base that Informs STEM Instructional Improvement Efforts: A Meta-Analysis*

Sims and Wood, (2020). *Identifying the characteristics of effective teacher professional development: a critical review*

[19] Gonzalez et al. (2022). *A Meta-Analysis of the Experimental Evidence Linking STEM Classroom Interventions to Teacher Knowledge, Classroom Instruction, and Student Achievement.*

[20] Kraft et al., (2018). *The Effect of Teacher Coaching on Instruction and Achievement: A Meta-Analysis of the Causal Evidence*

test scores.[21] They would also see a positive effect on non-cognitive skills leading to lower absences and suspensions and increased likelihood of continuing education.[22]

In the longer-term, improved pupil outcomes would have beneficial impacts for pupils and the wider economy. Pupils would see improvements in their earnings and employment outcomes, including a reduced likelihood of becoming not employed, in education or training (NEET) and increased earnings over their lifetimes.[23] They would have a higher likelihood of living in higher socio-economic status neighbourhoods and more retirement savings as adults.[24] They would have a reduced likelihood of having children as a teenager[25] and decreased use of welfare as adults.[26] Moreover, they are likely to see lower depression rates[27] and increased self-esteem as adults.[28] Furthermore, they would see a reduced likelihood of conviction and incarceration.[29] Some of these benefits are not directly linked to teaching quality in the literature, but instead linked to education more generally (for example, increased years of education). However, there is evidence that higher teaching quality leads to an increase in the number of years spent in education and so we would expect teaching quality to have an indirect effect on these outcomes[30]

These pupil-focused benefits also benefit the wider economy. Higher GDP and tax revenues may result from increased lifetime earnings and reduced probability of becoming NEET. Reduced likelihoods of depression may reduce spending on healthcare, whilst reduced crime rates may reduce spending on the criminal justice system.

Additionally, there may be levelling up and inequality effects from higher teaching quality. Firstly, less advantaged students are more responsive to non-test score dimensions of teaching quality, for example they are more likely to benefit from reduced absences and in the long-term reduced crime rates. In addition, it is likely that those from lower socio-economic status backgrounds are disproportionately taught by the least experienced teachers: developing the expertise of these teachers will mean these benefits disproportionately go to those from lower socio-economic status backgrounds. We have not however attempted to estimate the financial contribution of these factors in our analysis.

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[21] For example, Kirabo Jackson (2012) and Rockoff (2003)

[22] Kirabo Jackson (2012) *Non-cognitive ability, test scores and teacher quality: evidence from 9th grade teachers in North Carolina*

[23] For example, Chetty et al. (2011) and Hanushek (2011). See section 3.2.1 for more details

[24] Chetty et al. (2011)

[25] Ibid

[26] Heckman et al. (2018) *The nonmarket benefits of education and ability*

[27] For example, Crespo et al. (2015) and Heckman et al. (2018)

[28] Heckman et al. (2018) *The nonmarket benefits of education and ability*

[29] For example, Rose et al. (2022). See more details in section 4.3.1

[30] For example, Chetty et al. (2011) finds that improved teacher quality increases the likelihood of attending colleges

2.2 Approach to valuing higher teaching quality

We estimate the value of higher teaching quality in the UK primarily by studying the impact of improved teaching on lifetime earnings.

While we acknowledge that higher teaching quality yields various non-pecuniary benefits, we have chosen to concentrate on earnings due to its prominence in the existing academic literature, which provides a wealth of high quality evidence in this domain. Several reasons contribute to the literature's focus on earnings. Firstly, earnings constitute a readily measurable metric, facilitating empirical analysis. Secondly, it is an aspect of education that garners the interest of policymakers across the political spectrum.

Furthermore, studying the non-pecuniary benefits of teaching quality (and of education more generally) presents certain methodological challenges. The first challenge, a recurring issue in education literature, arises from the potential correlation between higher teaching quality and a wide range of other factors, such as persistence, family background, and even genetic factors. To establish a convincing argument about causal effects, it becomes imperative to disentangle the sole impact of teaching quality. The second challenge, more specific to the examination of non-pecuniary effects, stems from the fact that higher teaching quality often leads to higher income, which, in turn, influences various aspects of individuals' lives. Therefore, when contemplating the non-financial effects of teaching quality, it is essential to distinguish the direct effects from those influenced by higher income[31].

In addition to our focus on earnings, we also study the potential impact of consistently higher teaching quality on UK GDP over the long term, and discuss wider potential non-pecuniary benefits such as improved health outcomes and reduced crime rates.

2.2.1 Lifetime earnings

The increase in lifetime earnings for pupils exposed to higher teaching quality is the impact that has received the most research attention and has the strongest evidence. The benefits for these pupils across their working lives provide a strong motivation for implementing a policy to develop teacher effectiveness in the classroom.

Evidence

A number of academic papers value the impact of teaching quality on pupils' lifetime earnings. We reviewed a number of sources and decided to extrapolate our modelling parameters from Chetty et al. (2011), since we believe this is the paper with the most robust methodology. This

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[31] Oreopoulos P., Salvanes K. (2011). *Priceless: The Nonpecuniary Benefits of Schooling.*

paper focuses on pupils in grades 4-8[32] from a US sample (aged 9-14), using a regression approach to regress income on teacher value-added plus controls.

Chetty et al. (2011) evaluates teachers based on their impacts on their students' test scores, commonly termed 'value-added'. Value-added measures are statistical techniques used to assess the impact of teachers on the academic progress of students. These measures attempt to isolate the contribution of a specific teacher, taking into account the student's prior performance and other relevant factors. Whether differences in test-score gains across teachers measured by value-added capture causal impacts of teachers or they are primarily driven by student sorting is still object of debate. However, a number of recent papers concluded that value-added is an unbiased measure of teaching quality

Relevant evidence from academic literature

- **Kane and Staiger (2008)** conducted an experiment involving 66 mathematics teachers in four school districts testing whether a teacher's performance measured through value-added under non-experimental settings predicts performance following random assignment of that teacher to a class of students. They found that test-based value-added measures are valid predictors of teacher impacts on student achievement.

- **Chetty, Friedman, and Rockoff (2014a)** predicts changes in student test scores using a naturally occurring variation in teacher assignments as teachers move from school to school and from grade to grade[33]. Using this method, they find that teachers' value-added scores are unbiased estimators of changes in student achievement when there are changes in the specific teachers working in a given subject.

- **Bacher-Hicks et al (2017)** conducted an experiment involving 66 mathematics teachers in four school districts to test the validity of value-added measures. Specifically, they tested whether a teacher's performance on each measure under naturally occurring (i.e. non-experimental) settings predicts performance following random assignment of that teacher to a class of pupils. Combining their results with those from previous experiments, they find that value-added measures are unbiased predictors of teaching quality.

One limitation of using value-added as the measure of teacher effectiveness is that evidence suggests that teachers can have an important impact on outcomes not captured by test-scores, for example supporting pupils to develop social skills or better emotional regulation. However, the lack of researcher consensus regarding how these skills might be measured means we were unable to estimate these benefits within our model.

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[32] The US school system is typically divided into three levels or schools: elementary (Grades K-5), middle (Grades 6-8) and high (Grades 9-12). Grades 4 to 8 roughly correspond to year 5 to 9 in the UK school system.

[33] The US school system is typically divided into three levels or schools: elementary (Grades K-5), middle (Grades 6-8) and high (Grades 9-12). Grades 4 to 8 roughly correspond to year 5 to 9 in the UK school system.

Chetty et al. (2011) finds that a one standard deviation increase in teacher value-added in a single year leads to an average 0.9% increase in earnings at age 28. This effect accounts for both the direct effect of improved teaching in the year under scrutiny and the indirect benefit of being more likely to receive better educational input in the following years.

Modelling assumptions

Cumulative teacher effect over multiple years

To assess the overall economic value of enhancing teaching quality across the entire UK education system, we consider the effect of a one standard deviation increase in teacher value-added over a student's entire school career. However, the existing academic literature lacks sufficient evidence on the cumulative effect of higher teaching quality over multiple years[34]. While it seems obvious that a pupil who is exposed to higher teaching quality for five years will have benefitted more than after one year, it also seems probable that they will not have benefitted five times as much.

Therefore, we adopt a conservative approach by assuming diminishing marginal returns of teaching quality, or in other words, that the impact on pupils' progress of higher teaching quality diminishes over time. Specifically, we assume that marginal returns diminish between 10% and 20% every year, to reflect the uncertainty around this modelling parameter. Additionally, we posit that the cumulative benefits of higher teaching quality extend up to five years, beyond which no further gain occurs. These intentionally conservative assumptions help us address the uncertainty around the cumulative effect of higher teaching quality over multiple years and maintain confidence that our results represent the lower end of the potential earning benefits associated with higher teaching quality. It is important to note by taking these assumptions we are not claiming that the benefits drop to zero after five years.

Under these assumptions, the effect of teaching quality in the second year falls within the range of 0.72% to 0.81% of lifetime earnings (80% to 90% of the initial year's benefit, which is 0.9%). Taking these considerations together, the total income increase for students exposed to five or more years of higher teaching quality ranges from 3% to 3.7%.

The increase in teaching quality

In our primary scenario we evaluate the impact of increasing average teaching quality by one standard deviation. Assuming teachers' value-added is normally distributed, this is equivalent to elevating the performance of a teacher at the mean of the value-add distribution up to the 84th percentile[35]. In real-life terms, this is considered equivalent to 2 extra months of learning

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[34] While Chetty et al. (2011) estimated impact accounts for the indirect benefit of being more likely to receive better educational input in the following years, this indirect effect is very small and we have chosen to disregard it. In fact, they report that the direct benefit is close to the 0.9% overall estimate.

[35] Although teaching quality is likely to be unevenly distributed, with a larger number of inexperienced teachers (as suggested by the OECD: https://www.oecd.org/education/education-at-a-glance/EAG2019_CN_GBR.pdf), we assume teachers' value-added follows a standard normal distribution. This is because the majority of academic studies we rely on for

progress per year for pupils. In this scenario, all pupils benefit from a one standard deviation increase in teaching quality[36].

Additionally, we analyse the value of enhancing the skills of teachers in the bottom 5 percent of the value-add distribution, or in simpler terms, in the bottom 5 percent of effectiveness as measured through test results, elevating their teaching performance to the median of the distribution. This approach aligns with the methodology employed by Chetty et al. (2011) and is equivalent to 5 percent of the student population experiencing an average 2.05 standard deviation increase in teaching quality.

Timescale of benefits

Estimating annual economic benefits over a short time horizon proves challenging due to the time required for the positive effects of investing in teaching quality to materialise. The immediate annual benefits are expected to be modest because only a small number of pupils will have left the school system and these individuals will only have seen improvements for a small proportion of their school careers. After ten years, pupils who have benefited from higher teaching quality will already represent 11% of the workforce. Looking further ahead, in twenty years, this figure is projected to rise significantly to 34% of the workforce[37]. We model earning benefits both in annual terms and present value terms over time horizons of 5, 10 and 20 years.

Annual increase in income

Chetty et al. (2011) finds that a one standard deviation increase in teacher value-added in a single year leads to an average 0.9% increase in earnings at age 28. The authors of this paper also recognise that the 0.9% mean earnings impact per standard deviation of teacher-value added at age 28 may understate the impact of higher teaching quality on lifetime earnings, particularly for high socio-economic status groups. This is because the annual percentage gain may increase as pupils progress through their careers, especially if they attend university. However, when they predict the potential earnings gains form selecting and retaining teachers on the basis of their value-added, they assume that the percentage impact of a one standard deviation increase in teacher value-added on earnings observed at age 28 would remain constant over the life-cycle.

We decided to be consistent with the approach used by Chetty et al. (2011) and assumed that the percentage increase in earnings remains constant over the entire career length of pupils for two reasons: firstly, the 0.9% increase observed at age 28 is a direct result of their rigorous econometric analysis and is grounded in empirical evidence; secondly, this assumption allows

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evidence standardise test scores within each school year to have a mean of zero and a standard deviation of one in the full student population.

[36] Informative figures presented in this section refer to our main scenario.

[37] These estimates rely on the assumption of a stable age distribution within the UK workforce over time. It is important to note that this assumption may not necessarily hold, so these statistics should be viewed as indicative rather than definitive.

us to maintain a conservative approach, and be confident that our results represent the lower end of the potential earning benefits associated with higher teaching quality.

Size of pupil population

We assume that students experience higher teaching quality from Reception to Year 11, with no consideration of sixth form or further education colleges. We also assume that the average individual enters the workforce at the age of 19, in accordance with data from the ONS [38]. For the calculation of annual benefits, we presume that once an individual joins the workforce, they remain employed every year throughout the designated time horizons (e.g., 5, 10, and 20 years). To estimate the present value of benefits, we calculate lifetime income for an average individual at age 16, drawing from ONS income data by age[39] and assuming zero income until age 19. We also assume an average career length of 37 years[40] and apply the standard green book discount rate of 3.5%[41]. Additionally, we utilize pupil projection data from the various nations of the UK to calculate the projected cohort size at age 15 until the year 2044[42].

Annual benefits

We calculate the benefit for each cohort in each year as:

$$Benefit\ for\ cohort\ X\ in\ year\ Y = \%\ increase\ in\ earnings\ for\ cohort\ X * \\ earnings\ for\ cohort\ X\ in\ year\ Y * projected\ cohort\ size$$

To illustrate, let's consider the cohort that completes their schooling in 2030, reaching the age of 21 in the year 2035. According to ONS income data[43], their expected earnings at age 21 amount to £12,451. We then apply the 3% to 3.7% estimated increase in lifetime income resulting from being exposed to higher teaching quality over five or more years of their school career to calculate the benefit for the average pupil. By multiplying this average pupil benefit by the cohort's size of approximately 750,000 students, we arrive at a total benefit of £280 million for that specific cohort in that particular year.

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[38]https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/milestonesjourneyingintoadulthood/2019-02-18

[39] https://commonslibrary.parliament.uk/research-briefings/cbp-8456/

[40] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Duration_of_working_life_-_statistics#:~:text=The%20expected%20duration%20of%20working%20life%20was%20on%20average%2036.5,women%20(see%20Figure%201)

[41] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020

[42] England: https://explore-education-statistics.service.gov.uk/data-tables/school-pupils-and-their-characteristics/2022-23?subjectId=25b9c86f-6235-4690-a62f-08db5b647393; Wales: https://statswales.gov.wales/Catalogue/Education-and-Skills/Schools-and-Teachers/Schools-Census/Pupil-Projections; Scotland: https://www.gov.scot/publications/pupil-projections/; Northern Ireland: https://www.education-ni.gov.uk/publications/school-enrolments-northern-ireland-summary-data

[43] https://commonslibrary.parliament.uk/research-briefings/cbp-8456/

The annual benefit for a given year is the cumulative sum of benefits in that year, encompassing all relevant cohorts. As an illustration, to determine the total annual benefit in 2035, we aggregate the benefits for cohorts ranging from those who completed their schooling in 2024 to those who did so in 2032, representing the current Year 6 through Year 11 pupils.

Present value of lifetime benefits

The present value of lifetime benefits is the cumulative value - discounted to the present day - of the future flows of increased earnings over the lifetime of pupils over 5, 10 or 20 cohorts of students. In simpler terms, this is an estimate of the increase in earnings that today's pupils could expect over their whole lifetime, added together and expressed in 2023 money.

We calculate the benefit for each cohort as:

$$PV\ benefit\ for\ cohort\ X\ at\ age\ 16\ = \%\ increase\ in\ earnings\ for\ cohort\ X * \\ lifetime\ earnings\ at\ age\ 16 * projected\ cohort\ size$$

For example, consider the average pupil currently in year 7; they will join the workforce in 2031. The lifetime earnings for all pupils at age 16 is estimated approximately at £500,000.[44] We multiply this by the 3%-3.7% increase in lifetime income that results from exposure to higher teaching quality over 5 or more years of their school career to calculate the benefit to the average pupil. Multiplying the average pupil benefit by the approximately 750,000 pupils[45], gives a benefit of £11.5bn - £14bn. This is the present value benefit for the pupils at age 16.

The present value benefit for a given number of cohorts (5, 10 and 20 cohorts) is the discounted sum of the present value benefit per cohort. The benefit for each cohort is discounted by the number of years before that cohort is age 16, since this is the age at which the present value benefit is calculated. As an example, the present value benefit for the next five cohorts is the sum of the present value benefit for the current year 7 to year 11 pupils.

Levelling up

In the absence of evidence on the differing effects of teaching quality across pupils from different socio-economic status groups, we consider how elevating the performance of the least effective 5% of teachers may disproportionately affect pupils from disadvantaged backgrounds. We discuss this qualitatively, based on evidence on the distribution of teaching quality.

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[44] Estimated based on ONS income data, https://commonslibrary.parliament.uk/research-briefings/cbp-8456/

[45] England: https://explore-education-statistics.service.gov.uk/data-tables/school-pupils-and-their-characteristics/2022-23?subjectId=25b9c86f-6235-4690-a62f-08db5b647393; Wales: https://statswales.gov.wales/Catalogue/Education-and-Skills/Schools-and-Teachers/Schools-Census/Pupil-Projections; Scotland: https://www.gov.scot/publications/pupil-projections/; Northern Ireland: https://www.education-ni.gov.uk/publications/school-enrolments-northern-ireland-summary-data

2.2.2   Increased GDP

Hanushek and Woessman (2012)[46] finds that a one standard deviation increase in cognitive skills of a country's workforce is associated with approximately a 2% increase in annual GDP growth rate over the long term. Their finding comes from a regression of PISA scores on annual GDP growth rates across 24 OECD countries in 1960-2000.

Chetty et al (2011) finds that a one standard deviation increase in teachers' value added in a single year increases pupils' test scores by 0.1 standard deviations. By assuming a 10% to 20% reduction rate in teacher effects, and that teacher effects are cumulative up to 5 years, we can estimate that a one standard deviation increase in teaching quality results in a test score increase between 0.34 and 0.41 standard deviations over five years.

Under the assumption that test scores are a reliable proxy of the cognitive skills of the students population, it is possible to combine evidence from these two sources to get an estimate of the long term increase in GDP unlocked by an increase in teaching quality across the school system. Results are discussed in section 4.2.

2.2.3   Other potential benefits

Whilst our literature review identifies other potential benefits, we do not model the economic impact of these effects. Instead, we discuss these qualitatively in the report based on findings from the literature. These potential benefits include improvement in health outcomes and reduction in crime rates.

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[46] Hanushek et al. (2011) *How much do education outcomes matter in OECD countries?* Economy Policy 26(67)

3   Findings

3.1   Increased lifetime earnings of pupils

We present two types of benefits:

■   **Annual benefit** - this is the overall expected annual increase in earnings for pupils who
    go through the school system, benefit from higher teaching quality for five years of their
    schooling, and enter the workforce. This benefit is calculated over a 5, 10, or 20 years'
    time horizon.

■   **Present value of lifetime benefit** – this is an estimate of the increase in earnings that a
    cohort of pupils benefitting from high teaching quality for five years could expect over
    their whole lifetime, added together and expressed in 2023 money.

The magnitude of benefits increases over time as more pupils go through the school system
and join the labour market. For example, in five years, pupils who have benefited from higher
teaching quality will represent up to 3% of the workforce; in ten years, this figure is projected
to rise to 11%, and in twenty years, 34%[47].

3.1.1   Value of increasing average teaching quality

Table 5 shows the estimated annual benefits, while Table 6 shows the estimated present value
benefits over pupils' lifetime. Both tables show benefits expressed as increased earnings,
alongside the correspondent increase in estimated income tax receipts. Figure 3 and 4
presents the earnings figures graphically.

Our research suggests that over a 10-year period – at which point 11% of the workforce will
have benefitted from higher quality teaching – earnings for those in employment could be
boosted by up to £2.6bn each year, generating additional income tax receipts of over £870m
annually[48]. If we extend the timeframe to 20 years – at which point 34% of the workforce will
have benefitted – the annual earnings boost for those in employment could nearly reach £10
billion, accompanied by an estimated increase in income tax revenue of £3.2bn.

Estimated gains increase more than linearly between the first and the second decade. This is
because initially economic benefits are delayed as students benefiting from higher teaching
input need time to enter the workforce. However, in the second decade, a continuous influx of
students who have benefited from these improvements will join the workforce each year.

In addition to the findings mentioned above, our results also suggest that the present value of
the cumulative expected increase in lifetime earnings over the entire lifetime of pupils going

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[47] These estimates rely on the assumption of a stable age distribution within the UK workforce over time. It is important to note
    that this assumption may not necessarily hold, so these statistics should be viewed as indicative rather than definitive.

[48] This is based on the assumption that every additional £1 in wages contributes 34p on average in tax and National insurance.

through the school system in the next decade could reach up to £90bn. The corresponding estimate accounting for all pupils going through the school system in the next two decades is almost £160bn. These figures are much larger because the benefits would continue to be felt over the lifetime of the pupils who had benefitted from higher teaching quality.

Table 5   Annual benefits from higher teaching quality

Number of years' time	Annual increase in earnings	Annual tax benefits
5 years	£236m - £244m	£79.1m - £81.9m
10 years	£2.3bn - £2.6bn	£761.5m - £873.9m
20 years	£8.1bn - £9.7bn	£2.71bn - £3.23bn

Source: Frontier Economics

Note: The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.

Table 6   Lifetime benefits from higher teaching quality (in 2023 money)

Number of cohorts receiving benefits	Present value increase in lifetime earnings	Present value of lifetime tax benefit
5 years	£35bn - £39bn	£12bn - £13bn
10 years	£76bn - £90bn	£26bn - £30bn
20 years	£133bn - £159bn	£45bn - £53bn

Source: Frontier Economics

Note: The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.
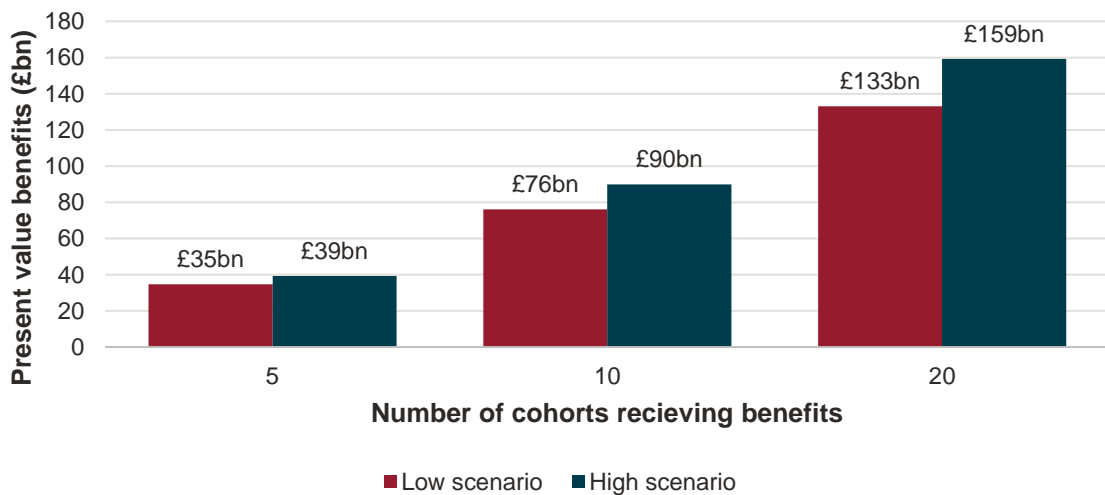
Figure 3 **The annual benefits from higher teaching quality**
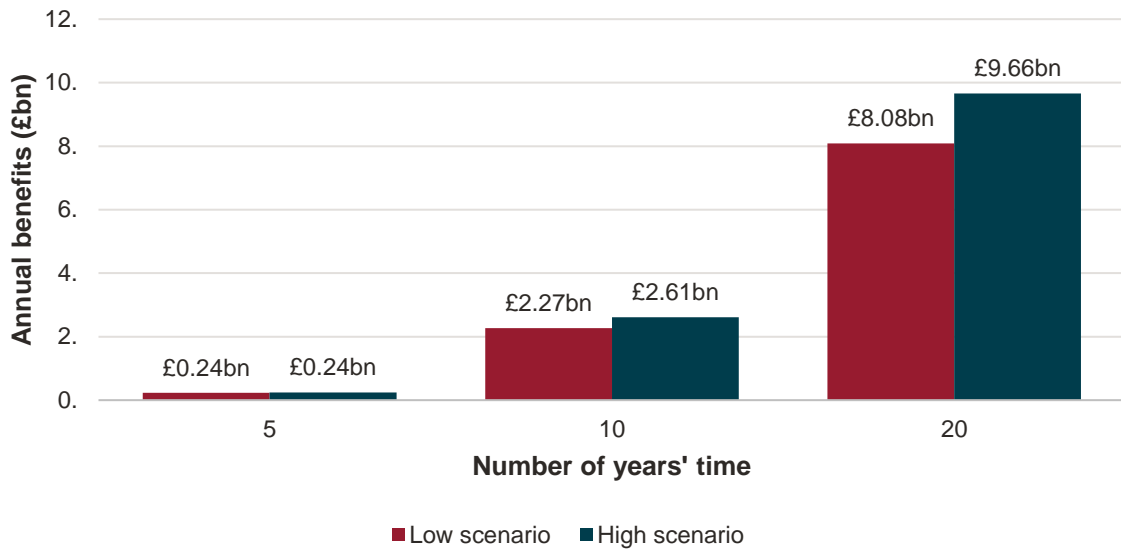
Source: *Frontier Economics*

Note: *The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.*

Figure 4 **The increase in present value lifetime earnings benefits overtime**

Source: *Frontier Economics*

Note: *The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.*

3.1.2 Value of upskilling teachers in the bottom 5% of the distribution up to the mean

Another option for improving teaching quality is to focus on upskilling teachers at the bottom 5% of the distribution of teaching quality. In simpler words, another potential approach is to elevate the performance of the least effective 5% of teachers so that they perform at the same level as an average teacher.

Table 7 shows the estimated annual benefits, while Table 8 shows the estimated present value benefits over pupils' lifetime. Both tables show benefits expressed as increased earnings.

The lifetime earning benefits are smaller in magnitude compared to improving the average quality teacher; this reflects the fact that a smaller proportion of pupils will be affected.

Nonetheless, the benefits are still significant. In 20 years' time, the annual benefits will be almost £1bn. Over a decade of increased investment, annual benefits will be £250m with cumulative benefits totalling nearly £10bn.

These benefits are likely to be concentrated in low socio-economic status groups and therefore help to reduce inequality – we discuss this in more detail below.

Table 7   Annual benefits from upskilling the bottom 5% of the distribution

Number of years' time	Annual increase in earnings
5 years	£24m-£25m
10 years	£232m-£266m
20 years	£825m-£984m

Source: *Frontier Economics*

Note: *The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.*

Table 8   Lifetime benefits (in 2023 money) from upskilling the bottom 5% of the distribution

Number of cohorts receiving benefits	Present value increase in lifetime earnings
5	£3.5bn-£4bn
10	£7.8bn-£9.2bn

Number of cohorts receiving benefits	Present value increase in lifetime earnings
20	£13.6bn-£16.2bn

Source: *Frontier Economics*

Note: *The results incorporate a low and a high scenario to account for variations in some assumptions, reflecting the uncertainty surrounding certain modelling parameters.*

Levelling up implications

Evidence suggests that pupils from lower socio-economic status backgrounds are more likely to be exposed to less effective teaching.

Allen and Sims (2018)[49] find that this inequality exists both within and across schools. The study uses School Workforce Census data to construct three measures of teaching quality: whether a teacher is qualified, their years of experience and whether a teacher has an academic degree in their subject. Using the proportion of pupils who qualify for free school meals as a measure of deprivation, they find pupils at more deprived schools are more likely to have unqualified, inexperienced or out-of-subject teachers.

Figure 5 shows the proportion of teachers with varying levels of experience across quintiles of deprivation – where Q5 is the most deprived school and Q1 is the least. For example, in the least deprived primary schools 12% of teachers have more than 10 years of experience whilst only 7% do in the most deprived schools. Similarly, Figure 6 shows the proportion of maths teachers with an academic maths degree across quintiles of deprivation. For example, in upper secondary schools (KS4), 10 percentage points fewer maths teachers have a maths degree in schools in the lowest quintile of deprivation compared to the highest quintile.

Within schools, they use the Teacher and Learning Internal Survey to compare the proportion of pupils who qualify for free school meals in a randomly chosen class with their measures of teaching quality. The evidence for inequality within schools is less consistent, but there is some evidence of unequal teaching quality within schools: each additional year of experience is associated with a 2% decrease in the probability of the class being part of the highest deprivation category.

The inequitable allocation of teaching quality between schools likely results from a combination of factors. In part, this likely reflects the preferences of teachers. For example, a recent survey found that the reason most frequently cited by early-career teachers for joining the profession was "making a difference to pupil lives", which was identified as a "very important" reason by 60% of respondents, with a further 45% citing the "opportunity to make

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[49] Allen, R. and Sims, S. (2018) *Do pupils from low-income families get low-quality school teachers? Indirect evidence from English schools?* Oxford Review of Education 44(4)

a difference to society" as being very important[50]. This may lead them to seek work in schools serving less advantaged communities. Second, these schools may have a higher number of vacant positions due to challenging working conditions, which in turn contributes to staff turnover. This cycle of teacher entry and exit keeps average experience levels low, increases turnover rates, and forces schools to hire teachers with qualifications that may not align with their students' needs.

On the other hand, within schools, the inequitable allocation of teachers likely stems in part from the fact that more experienced educators tend to have longer tenures in their current positions. In some instances, this longevity allows them to influence their placements, which may result in their choosing assignment to higher attaining classrooms[51].

As a result, improving the quality of the bottom five percent of teachers would have a disproportionate impact on students from lower socio-economic backgrounds. This strategy would yield benefits both within individual schools and across the education system, making it a more targeted approach to addressing inequality than school-level measures alone.

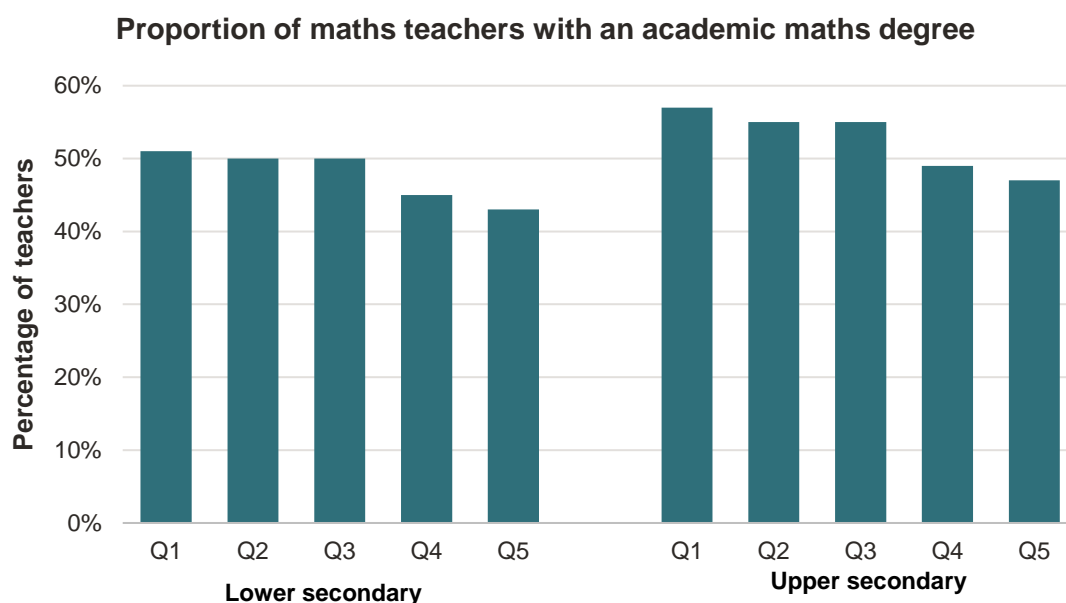## Figure 5   Teacher experience by school deprivation
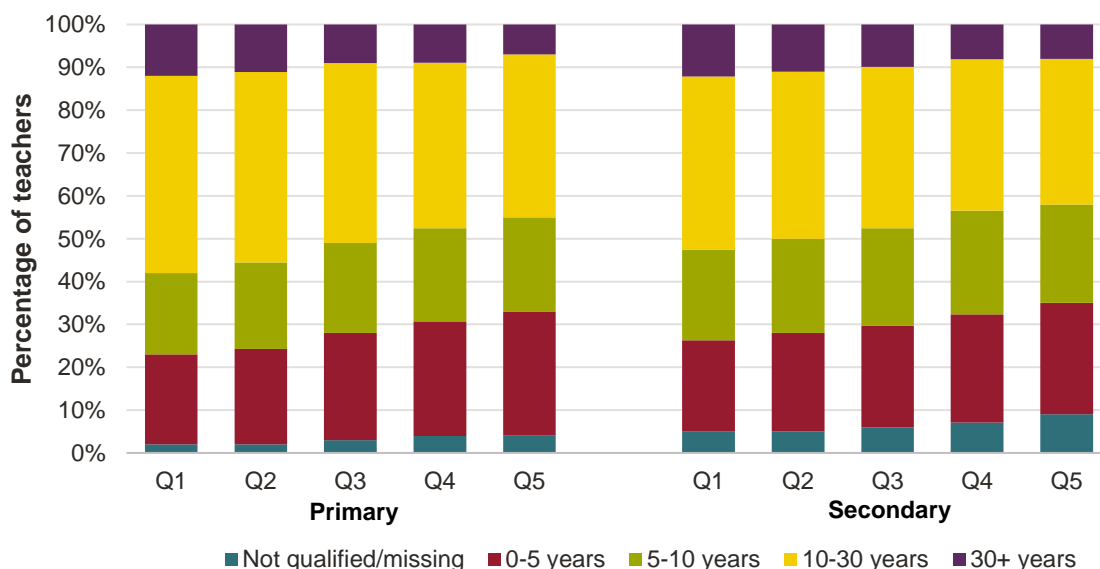
Source: Allen and Sims (2018)
Note: Q1 refers to the least deprived school, whilst Q5 refers to the most deprived school

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[50] Menzies et al. (2013). *School-wide Systems to Promote Positive Behaviours and Facilitate Instruction*

[51] McInerney (2019). *The Recruitment Gao: Attracting teachers to schools serving disadvantaged communities.*

Figure 6   Teacher qualifications by school deprivation

Proportion of maths teachers with an academic maths degree

Source: Allen and Sims (2018)

Note: Q1 refers to the least deprived school, whilst Q5 refers to the most deprived school. Lower secondary refers to Key Stage 3, upper secondary refers to Key Stage 4l

3.1.3   Caveats

Assumptions

Our methodology is founded on the assumption that the impact on pupil attainment of teaching quality accumulates over multiple years, with a reduction rate of 10% to 20% in teacher effects. To apply a conservative approach, we extract our modelling parameters from Chetty et al (2011) and assume that benefits to pupils accrue cumulatively over a span of no more than 5 years. While this approach is not based on evidence from the literature, it yields lifetime earnings benefits similar to those derived from Lee (2018) (see section 3.1.4 with sensitivity analysis).

Test-based value-added measures

As discussed, we study the impact of higher teaching quality as quantified by test-based value-added measures. It is important to recognise that the skills students acquire in the education setting extend beyond what is assessed by test scores. These encompass personal and socioemotional aptitudes, which are equally valuable outcomes of their education. Crucially, teachers who excel in imparting knowledge that leads to improved test scores may not necessarily excel in enhancing socioemotional skills. This implies that, regrettably, not all enhancements in teaching quality can be adequately captured through teachers' value-added.

Nevertheless, teachers' value-added represent the most frequently reported measure in the academic studies reviewed. While we employ teachers' value-added as a means to measure the impact of higher teaching quality, it is important to acknowledge that our results do not capture potential further societal benefits.

Returns to schooling

In our modelling exercise, we make the assumption that the returns to education remain consistent over time, even as individuals collectively enhance their skill levels[52]. This assumption is contingent on the presence of opportunities for higher-skilled employment. We have not accounted for general equilibrium effects that may reduce wages if all children are better educated.

However, it's worth noting that the actual benefits could be even greater, especially if the UK emerges as a global leader in skills, attracting foreign investments and consequently bolstering international trade. Such a scenario would likely result in the creation of higher-skilled, better-paying jobs, thereby leading to a more substantial increase in lifetime earnings.

Scenarios presented

The scenarios presented must be plausible for these benefits to be considered as realistic goals. An increase in average teaching quality by one standard deviation is equivalent to elevating the performance of a teacher at the mean of the value-added distribution up to the 84th percentile. Assuming that a one standard deviation increase in teaching quality leads to a 0.1 standard deviation increase in pupil achievement, such an improvement is equivalent to an additional 2 months of learning progress for pupils[53].

We selected a one standard deviation because evidence from literature suggests this is an achievable target through investment in high-quality professional development. Research indicates that the top 10% of most effective professional development programmes achieve an average impact of 0.15 standard deviations increase on student achievement[54]. According to academic literature, this is approximately the same as the expected increase in test scores from a one standard deviation increase in teaching quality.

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[52] In principle, an increased supply of high-skilled workers without a concurrent surge in demand for high-skill labour might cause a drop in the returns to education. This is because the salary of high-skilled workers can be seen as the equilibrium price for high-skilled work in the labour market. And prices tend to drop in response to a supply increase.

[53] According to academic literature a one standard deviation increase in teaching quality is generally associated with an increase in pupil achievement ranging from 0.1 to 0.2 standard deviations. In our analysis, we took a conservative stance assuming a pupil achievement increase of 0.1 standard deviations. According to the Education Endowment Foundation (EEF), this corresponds to 2 extra months of learning progress.

[54] Sims, S. et al. (2021). *What are the characteristics of effective teacher professional development? A systematic review & meta-analysis.*

Furthermore, a recent study from the Education Policy Institute[55], evaluating costs and benefits of entitling teachers to 35 hours of high quality continuing professional development, analysed 52 randomised controlled trials from 42 studies to identify an average effect size of professional development on pupil achievement, finding a 0.09 standard deviation mean effect size[56]. This is very close to the 0.1 standard deviation increase in test scores that we associate to a one standard deviation increase in teaching quality. This suggests that the increase in teaching quality we model is realistically achievable over a short time frame through a targeted policy intervention.

3.1.4   Sensitivity analysis

To test the robustness of our approach, we conducted a separate modelling exercise based on two other sources of evidence from the literature: Hanushek (2011) [57] and Lee (2018)[58]. Lee (2018) finds that a one standard deviation increase in cumulative teaching quality[59] results in a 0.3 standard deviation increase in test scores[60]. We applied this parameter to Hanushek's approach by multiplying it with the impact of test scores on earnings, resulting in a percentage increase between 2.8% and 4% (depending on the assumption made on diminishing marginal returns of teaching quality). This percentage increase in income is very similar to that obtained through Chetty et al. (2011) approach.

We also compared our estimates to the results of a recent study from the Education Policy Institute[61] evaluating costs and benefits of entitling teachers to 35 hours of high quality continuing professional development. They find that a policy entitling all teachers to 35 hours of high quality continuing professional development at a cost of around £4bn over 10 years could create net societal benefits (in present value terms) of £61bn over those years. This is based on the assumption (drawn from academic literature) that 35 hours of high quality CPD would increase pupil test scores by 0.06 standard deviations. This is roughly in line with our

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[55] Education Policy Institute, Jens Van den Brande, James Zuccollo, 2021. *The effects of high quality professional development on teachers and students.*

[56] This is the estimated mean effect size from all studies. However, this average effect size includes evaluations of all types of interventions. Some are interventions in the US, others are UK-based. Some are evaluated using specific examinations for the programme being tested, others are evaluated using external, national examinations. Modelling in the EPI study is based on the estimated mean effect size from external tests only (as these professional development interventions are mainly based in the UK and were evaluated with an examinations which is comparable to GSCSE points score) which is at a slightly lower level: 0.06 standard deviations.

[57] Hanushek (2011) *The economic value of higher teacher quality*. Economics of Education Review 30

[58] Lee (2019*). Pulling back the curtain: Revealing the Cumulative Importance of High-Performing Highly Qualified Teachers on Students' Educational Outcome*. Educational Evaluation and Policy Analysis 40(3)

[59] Cumulative teaching quality is a composite measure of teacher's years of experience, level of education, subject-matter expertise, and effectiveness.

[60] Despite Lee (2018) studies the cumulative impact of teaching quality over multiple years, we decided not to use this study as our primary source of evidence to set modelling parameters because, as stated by the author, "*given its nonexperimental design, the analysis in this study is not completely free of selection bias; thus, readers are encouraged to view the relationship between teacher quality and student academic achievement success **as relational rather than casual**".*

[61] Education Policy Institute, Jens Van den Brande, James Zuccollo, 2021. *The effects of high quality professional development on teachers and students.*

estimates of £76bn to £90bn of increased lifetime earnings over a 10 years' time horizon (unlike the EPI's study, we do not factor in the cost of a policy intervention), under the assumption of a 0.1 standard deviation increase in pupil attainment.

3.2 Increased GDP

Based on the methodology outlined in section 3.2.2, we find that a one standard deviation increase in teaching quality can lead to an increase in annual GDP between 0.7% and 0.8% once the entire workforce has benefited from higher teaching quality.

Between 2010 and 2019 (to ignore the effects of Covid-19), annual growth rates in the UK were between 1.1% and 3.2%.[62] The 0.7% illustrative baseline increase in GDP therefore would represent a substantial improvement in annual GDP growth. The effect is particularly important in light of the UK's productivity slowdown[63]: improving teaching quality is a crucial input for a higher-skilled workforce that can increase productivity and bring about long-term growth.

3.2.1 Caveats

The general criticism to empirical assessments of the impact of skills on growth based on cross-country models is that they provide little confidence that the models satisfactorily identify the causal impact of their included determinants of growth. For policy advice, distinguishing between a causal relationship and a mere association – which might reflect omitted variables, poor achievement measurement, or restricted models of growth – holds critical importance. However, this task is arduous because the sample of nations is limited and different nations possess diverse political, cultural, and economic institutions. Therefore, it becomes challenging to definitively rule out alternative explanations for the observed association between cognitive skills and economic growth.

We believe that the approach employed by Hanushek and Woessman (2012**)** is robust since they utilise distinct estimation techniques grounded in different identification strategies, getting estimates of the impact of cognitive skills on growth that are remarkably consistent. Moreover, even if the effect of cognitive skills on growth were to be half as substantial as currently estimated, or if it were to diminish in the future compared to the period from 1960 to 2000, it would still imply a noteworthy annual increase in GDP of approximately 0.4%, a figure of great economic significance.

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[62] https://www.ons.gov.uk/economy/grossdomesticproductgdp/timeseries/ihyp/pn2

[63] https://lordslibrary.parliament.uk/economic-growth-inflation-and-productivity/#:~:text=But%20productivity%20growth%2C%20a%20key,economy%20on%2029%20June%202023.

3.3 Other potential benefits

The academic literature discusses a number of non-pecuniary benefits of education. We present the evidence on incarceration and health and the extent to which benefits differ across pupils from different socio-economic levels and backgrounds.

Typically, these studies look at the impact of years of education or a more general measure of school quality, rather than studying teaching quality directly. However, we still expect the benefits to be realised when teaching quality improves:

- With respect to years of education, there is strong evidence in the literature that higher teaching quality leads to more years of schooling[64] and so the impact of teaching quality is likely to be indirect via the impact on time spent in education.

- With respect to school quality, we would expect teaching quality to be a key input into school quality.

We do not quantitatively model the size of these benefits due to the lack of robust literature linking these effects directly to higher teaching quality. Instead, we engage in a qualitative discussion of these potential benefits.

3.3.1 Incarceration

Evidence from academic literature suggests that higher teaching quality may lead to reduced incarceration rates.

Relevant evidence from academic literature

- **Deming (2011)[65]** finds that pupils attending higher quality schools in a school district in Charlotte, North Carolina (one of the largest school districts in the USA) are arrested for fewer crimes and spend less days incarcerated. This impact comes both from peer and teacher effects and so cannot be completely attributed to higher teaching quality.

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[64] For example, Chetty et al. (2011) find improved teaching quality increases likelihood of attending college

[65] Deming, D. (2011) *Better school, less crime*

Relevant evidence from academic literature

- **Rose et al (2022)**[66] studies teachers' impacts on their students future criminal justice contact using public schools and administrative data from North Carolina. They find that teachers' direct effects on future arrests, convictions and incarcerations are large – for example, they find a standard deviation of teacher effects on future arrests of 2.7% and on incarceration of 2.1%. Estimated teachers' effects on criminal justice contact are orthogonal to their effects on academic achievement, implying assignment to a high test score value-added teacher does not reduce future criminal justice contact. However, teachers who reduce suspensions and improve attendance substantially reduce future arrests. Their results suggest that the development of non-cognitive skills is central to the returns to education for crime and highlight an important dimension of teachers' social value missed by test score-based quality metrics.

- **Hjalmarsson et al (2023)**[67] studies a reform in Sweden, looking at the link between *years of schooling* and incarceration rates. For males, they find that one additional year of schooling decrease the likelihood of conviction by 6.7% and incarceration by 15.5%. They do not find a significant effect for women.

We have not modelled the economic benefits because the literature linking higher teaching quality directly to incarceration rates is limited. In particular, Rose et al (2022) is unlikely to be directly applicable to the UK because of the differences between the US and UK criminal justice systems.

Nonetheless, the economic benefits are likely to be large. The average cost of a prisoner is nearly £50,000 per year[68], alongside additional judicial and custodial costs, and so reduced incarcerations and arrests would lead to large cost savings for the government. There are likely to be additional economic benefits, as those not in prison would be more likely to be in work and earning money. And the benefits would span far beyond the economic benefits - with social improvements for those who avoid prison and who would otherwise have been victims of crime.

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[66] Rose, E et al. (2022) *The effects of teacher quality on adult criminal justice contact*

[67] Hjalmasson, R. et al (202) *The effect of education on criminal convictions and incarcerations: causal evidence from micro-data*

[68] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1140557/costs-per-place-and-costs-per-prisoner-2021-to-2022-summary.pdf

To provide an illustrative scenario, under the conservative assumption that a one standard deviation increase in teaching quality leads to a 1% fall in incarceration rates, 136 pupils would avoid incarceration every year.

3.3.2 Health effects

Some evidence in the literature suggests that improved education will lead to improved health outcomes. For example, Silles (2008)[69] finds that one extra year of education leads to a 4.5% increase in the probability of being in good health. Similarly, Crespo et al. (2015)[70] find a 6.5% reduced probability of suffering from depression. The economic benefit of any improvement in health outcomes will be large as the total economic cost of sickness in the UK is estimated to be £100 billion a year.[71] However, a recent meta-analysis[72] finds that, after controlling for publication bias, there is no compelling evidence that improved education leads to improved health outcomes. Consequently, there remains uncertainty in the literature regarding the extent to which more or better education might lead to improved health outcomes, and a consensus on this matter has yet to be reached.

3.3.3 How do effects differ across pupils?

There is evidence in academic literature that the non-pecuniary benefits of education may be larger for pupils from disadvantaged backgrounds and lower ability pupils.

Relevant evidence from academic literature

- **Deming (2011)** finds that the benefits on reduced incarceration rates are concentrated in 'high-risk youth'. The high-risk group commits 50% less crime across different measures and different scaling of crime by severity. Risk is based on the probability of an arrest as a function of test scores and behaviour measures, demographic characteristics, and neighbourhood of residence. It will capture the fact that those from lower socio-economic backgrounds are more likely to be arrested.[73]

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[69] Silles (2008), *The causal effect of education on health: Evidence from the United Kingdom*

[70] Crespo et al. (2015), *Compulsory schooling, education, depression and memory: new evidence from SHARELIFE*

[71] https://www.gov.uk/government/publications/health-and-work-infographics

[72] Xue et al (2020), *Does Education Really Improve Health? A Meta-Analysis*

[73] In the study, 90% of the high risk sample is free lunch-eligible African American males.

Relevant evidence from academic literature

- **Heckman et al. (2018)**[74] studies the impact of education on six non-market outcomes (depression, self-esteem, incarceration, voting, welfare receipt and trust) for pupils of different abilities. They find that the non-market benefits are greater for lower ability students. For example, low-skill individuals who graduate from high school are about 12 percentage points less likely to be incarcerated than they would be if they did not graduate high school.

- **Kirabo Jackson et al. (2022)**[75] finds that attending a more effective high school leads to larger improvements in high-school graduation, college going and school-based arrests for the least educationally advantaged pupils[76]. Educational advantage is linked to demographics, for example the top decile of educational advantage has fewer students who qualify for free lunch compared to the bottom decile (43% compared to 95%) and is also split by race (e.g. more white pupils and fewer black students in the top decile). As a result, the benefits for pupils from low income backgrounds are larger than those from higher income backgrounds

Therefore, improving the average teaching quality in the UK can contribute to reducing inequalities in non-pecuniary outcomes, such as incarceration rates and university attendance[77]. This is crucial since there is evidence of strong correlations between SES and these outcomes in the UK. As an example, the ten most deprived local authorities in England had imprisonment rates ten times higher than the ten least deprived ones.[78]

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[74] Heckman et al. (2018) *The nonmarket benefits of education and ability*

[75] Kirabo Jackson, C. (2022) *Who benefits from attending effective high schools?*

[76] 'Educational advantage' refers to the likelihood of attain more years of education based on 8th grade characteristics and is based on lagged test scores, behaviours such as absences, survey responses including interpersonal skills and academic effort, and demographics such as free lunches and race.

[77] This is not the case for lifetime earning benefits, where there is no evidence to suggest that those from lower socio-economic backgrounds see larger lifetime earning benefits from improved teacher quality than those from higher socio-economic backgrounds.

[78] https://www.cardiff.ac.uk/news/view/2684824-people-from-englands-most-deprived-areas-ten-times-more-likely-to-be-in-prison,-analysis-finds

4   Policy implications and conclusion

The most important lesson of this study is that finding policies to raise teaching quality – whether via the use of evaluations and feedback systems, changes in salary structure, or teacher training – is likely to have substantial economic and social benefits. Furthermore, evidence from literature suggests that improving teaching is the most-cost effective policy lever available to improve schools[79]. Policy levers such as providing greater school choice or reducing class sizes have been shown to produce negligible effects despite often substantial investment[80].

The literature supports the idea that effective professional development is the best and most cost-effective way to improve teaching quality. In fact, while hiring better teachers can undoubtedly enhance student achievement, it necessitates a robust supply of teachers, which currently remains inadequate in the UK[81]. Furthermore, recent research found that high quality professional learning is twice as effective as other school-level factors at raising pupil achievement[82], and has a similar effect on teaching quality as ten years' worth of (an average teachers') classroom experience[83].

However, professional learning needs to be of high quality in order to achieve cost-effective outcomes. Studies have shown that many forms of professional development fail to transform pupil outcomes, and some are even detrimental[84]. Research by the Education Endowment Fund (EEF) has identified the "active ingredients" that professional development must possess to have impact, which include managing cognitive load, modelling, context-specific repetition, and providing feedback, with the most effective interventions leading to two months' additional progress for pupils per year[85].

This report suggests that significantly expanding the support available to teachers to enable them to fulfil their potential as professionals is a policy intervention that would generate significant returns to the taxpayer and be able to pay for itself within a short time frame. In fact, while it takes time for the full effects of high quality teaching to materialise in our economy, our results suggest that in ten years, improving teaching quality would yield additional tax

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[79] Burgess (2019). *Understanding teacher effectiveness to raise pupil attainment.*

[80] Hattie (2015). *What doesn't work in education: the politics of distraction.*

[81] NFER (2022). *What teachers do next after leaving and the implications for pay-setting.*

[82] Allen et al. (2015). *Enhancing secondary school instruction and student achievement*; RAND (2019), *Teachers matter: Understanding teachers' impact on student achievement.*

[83] Fletcher-Wood & Zuccollo (2020). *Evidence review: The effects of high quality professional development on teachers and students*; Kraft & Papay (2014). *Can professional environments in schools promote teacher development? Explaining heterogeneity in returns to teaching experience.*

[84] Cordingley et al. (2015) *Developing great teaching: lessons from the international reviews into effective professional development* (2015); Fletcher-Wood & Zuccollo (2020), *The effects of high quality professional development on teachers and students: A rapid review and meta-analysis*; Humphrey et al (2020). *Achievement for All: Evaluation Report.*

[85] Sims, S. et al. (2021). *What are the characteristics of effective teacher professional development? A systematic review & meta-analysis.*

revenue of £870m annually – over three times what the current government has pledged to spend on teacher professional development (approximately £242m)[86] – and within twenty years this would rise to 13 times at £3.2bn.

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[86] This figure has been compiled from government announcements pertaining to spending on: teaching schools (£65m over 3 years); the early career framework and national professional qualifications (£376.5m over 4 years); and the expansion of the early career framework and national professional qualifications as part of the post-pandemic education recovery plan (£253m over 2 years). Sources:

- https://schoolsweek.co.uk/dfe-sneaks-in-25m-saving-with-teaching-school-hubs-switch/

- Early Career Framework and National Professional Qualification programmes: SRO appointment letter (publishing.service.gov.uk) - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1037286/Early_Career_Framework_and_National_Professional_Qualification_programmes_-_SRO_appointment_letter.pdf

- Written statements - Written questions, answers and statements - UK Parliament - https://questions-statements.parliament.uk/written-statements/detail/2021-06-07/hcws70

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