WHAT WORKS IN ATTRACTING AND KEEPING TEACHERS IN SCHOOLS?

WORKING PAPER 2

Beng Huat See, Rebecca Morris, Stephen Gorard, Nada El-Soufi, Sophia Abdi and Binwei Lu

Durham Evidence Centre for Education
Leazes Road
DH1 1TA
Email: b.h.see@durham.ac.uk

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EXECUTIVE SUMMARY

This report is a summary of the best current evidence on interventions to improve the supply and retention of school teachers.

Attracting and retaining qualified teachers is a persistent problem that has plagued many countries for decades. The trends in recruitment to initial teacher training are often associated with the national labour market condition and the relative attractiveness of other occupations. For example, teacher shortages in England are particularly pronounced in some secondary subjects like maths, physics, chemistry and modern foreign languages, perhaps because graduates in these subjects are in high demand in the job market. Compounding this is the growing pupil population. Teacher demand has consistently outstripped supply for the last 7 years (DfE, School Workforce Census 2019). Reportedly, more people are leaving teaching than ever before. Only 60% of teachers remained in state schools after five years. For 'high-priority' subjects like physics and maths, this five-year retention drops to just 50% (Sibieta 2018). Average salaries of maths graduates are £4,000 above those of teachers. There is stiff competition out there.

A range of policy initiatives have been introduced to increase supply. The government has made it easier for people to gain qualified teacher status through a number of training routes, such as School Direct, School Centred Initial Teacher Training (where teachers receive training while teaching), Troops to Teachers, Teach First, and Apprenticeship scheme for teaching assistants. In addition, financial incentives such as bursaries and scholarships are offered to teachers in hard-to-staff subjects. Other initiatives include the Early Careers Framework for newly qualified teachers providing professional development and mentoring to support them in the early days of teaching, workload reduction strategy to make teaching more attractive.

This new review provides evidence on the effectiveness of these programmes for attracting and retaining teachers. It is based on a systematic search, and then data extraction of 116 relevant studies providing causal evidence on what works.

What works in attracting teachers to the teaching profession?

- There is no robust evidence that alternative routes into teaching increase the number of teachers, largely because those who chose the alternative teaching programmes are self-selected.
- Not all alternative pathways to teaching are similarly effective. Only one higher quality study found that an immersion programme was successful in attracting highly qualified teachers to teach in some of the most challenging schools compared to the traditional higher education route and other alternative routes (e.g. Teach for America and Teaching Fellowships).
- A good school experience, career prospects and making teaching attractive may help attract those who have considered teaching but have decided not to pursue it.
- **Substantial increases in salary are needed, if used to attract teachers.**
- However, financial incentives (e.g. bursaries, scholarships and bonuses) are effective only in attracting those

who are already interested in teaching, but not those who do not consider teaching.

- **Monetary incentives also work in increasing the number of teachers in challenging schools,** but the effect is greater for high performing schools and schools with lower proportions of disadvantaged children.
- **The impact of incentives is temporary**, and generally lasts only while the incentive is still active – there is no residual benefit.
- For shortage subjects or high demand subjects such as maths and science, **salary increases may have to be higher to compensate for the wage differential compared to other occupations.**
- Financial incentives are more effective in attracting young female teachers than older male teachers.
- Where incentives are used to try and attract teachers to specific local areas or schools this could be at the expense of other schools, thus calling in to question the benefit for the system as a whole.

There is no good evidence that other approaches, such as Grow Your Own where teachers are trained and recruited form local community, are effective in increasing the number teachers in challenging schools. This is largely because almost all of these studies are based on stakeholders' anecdotal reports of successful practice in their own school or district. None of these could establish causation. However, this does not mean that they do not work. What is needed now is for more robust evaluations of these approaches using research designs appropriate to establishing a causal link between the approach and teacher recruitment and retention. Case studies using ethnographic accounts and survey data based on respondents' perceptions would not be able to provide causal answers.

What works in retaining teachers in the teaching profession?

- **Money works in retaining teachers in challenging in schools and areas, but the effect is short-term,** and ceases when the money stops.
- There is no evidence that alternative routes into teaching work in retaining teachers largely because there is so much variation in the different routes in terms of who they are targeted at, and the extent to which they are actually different from the 'traditional' route on offer.
- Mentoring and professional support for teachers show promise in retaining teachers but the results are complex.
- Mentoring is more effective if mentors are in the same subject area. However, it is effective only in retaining mentees but not mentors.

And so, what are the 'best bets' for schools and policymakers to improve the recruitment and retention of school teachers?

In conclusion, the best evidence is that **money works, while it lasts.** However, the picture is distorted by the fact that so much work has been done on financial incentives (and so little on anything else). The is no good evidence that alternative routes into teachers are effective for either recruitment or retention. This does not mean that this approach does not work, merely that we do not know yet. Improving conditions, and induction/mentoring both have promise but the evidence base is not yet clear enough.

Ensuring an adequate supply of qualified teachers is important for the provision of an effective education system. It is widely acknowledged that teachers can make a difference to children's academic and lifelong outcomes, and that a shortage of teachers can have a detrimental effect on the life chances of children (Gerritsen, Plug and Webbink 2016, Goe 2007, Sanders and Horn 1998, Sorenson and Ladd 2018, Sutton Trust 2011).

Many countries in Europe have reported a widespread shortage of teachers (European Commission, 2018). Teacher supply continues to be a challenge in Australia and New Zealand and, in England and the US, a teacher shortage is predicted to get worse as the pupil population rises and more teachers leave before retirement. Across each of these contexts, the extent of the shortages can vary depending on geographical region, subject area, age of student and school types.

Why do these shortages exist, and why does the number of new teachers needed (the demand) outstrip the number of suitable people available to fill these positions (the supply)? Simply put, it is because either or both of the dual goals of recruitment and retention are not being sufficiently met. Education systems need a constant stream of prospective teachers willing to train and enter the profession, but they also need to ensure that once in the profession, most teachers choose to remain for a reasonable period.

There are a number of factors which may influence a shortage of people being recruited into the teaching profession. These predominantly relate to people recognising and opting for what they perceive to be more favourable alternative career options. From an individual's perspective, these decisions may be influenced by the financial rewards available (e.g. salary, prospect of bonuses) or by their understanding of what the role entails (e.g. required tasks, working conditions, level of autonomy). Economic and employment cycles can have an impact on the numbers of people choosing teaching as a career, with more people seeing it as an attractive option during times of economic uncertainty (Dee and Goldhaber 2017, Aldeman 2015, Ingersoll 2011, Hutchings 2011, Dolton et al. 2003). It is also the case that government policies could influence teacher recruitment too e.g. through funding and allocation of training places, the development of training routes, or marketing strategies (See and Gorard 2020).

The shortage of teachers is reportedly also partly the result of people leaving the profession prematurely. Teaching has often been characterised as an occupation with a high level of turnover especially among new teachers (Lortie 1975, Ingersoll and Smith 2003, Ward, 2019). While all occupations experience some degree of turnover and career change, which is normal, turnover in teaching is considered high particularly in the first few years compared to many other professions, such as lawyers, engineers, architects and professors (Ingersoll 2003, Ingersoll and Perda 2010b). In the US, it has been reported that around 40 to 50 percent of new teachers leave within the first five years of entry into teaching (Murnane et al. 1991).

In England the attrition rates are similar, particularly in maths, science and

languages subjects (Worth and De Lazzari 2017). Among the secondary teachers who qualified in 2010, 2011 and 2012 around 66% stayed on in state-funded schools in the fifth year (DfE 2018, Table 7.8). Government data show that the odds of leaving are higher for newly qualified teachers (NQTs) and those with stronger academic backgrounds (Bowsher 2016).

In countries experiencing teacher shortages, numerous policy initiatives have been introduced in an attempt to address recruitment and retention issues and the factors which contribute to them. Many strategies involve financial incentives such as increased pay for teachers (e.g. for those teaching certain subjects or in particular areas) as well as bursaries or scholarships designed to attract more people into the profession, or to keep them there once they have qualified. In England, for example, there is a long history of providing tax-free bursaries and maintenance grants/loans for those entering training, and additional 'early career' payments for those continuing in the role after completing their NQT year. The amount available is, in theory, associated with the level of shortage. At present, for example, those wishing to train in chemistry, languages, maths or physics are eligible for a £26,000 bursary plus £6000 in early career payments; for those training in English a £15,000 bursary is available; and for those hoping to become primary teachers or Physical Education teachers, there is currently no bursary support for the coming academic year (DfE, 2020). Similar approaches can be found in other countries experiencing teacher shortages. In the US there have also been more widespread interest in variable salaries for those working in certain geographical areas, or in schools with higher proportions of disadvantaged pupils, as well as some initiatives which seek to reward teachers financially based upon their performance (Glazerman and Seifullah 2012, Fryer et al. 2012, Springer et al. 2011).

In more recent years some policymakers have moved beyond financial incentives to for retaining teachers (although these still remain a prominent feature in many campaigns to reduce teacher shortage). A growing awareness of the often challenging working conditions associated with teaching (Ingersoll and May 2011, CooperGibson Research 2018) has led to the development of strategies to try and improve these, and in turn make teaching a more attractive profession to enter and remain in. Factors linked to teachers' working conditions and environment include induction programmes, leadership in schools, available support, feelings of job satisfaction, pupil behaviour, flexible working, and access to professional development. In England, the Early Career Framework (ECF) (DfE 2019a), introduced in 2020, is part of the wider Teacher Recruitment and Retention Strategies (DfE 2019b). This includes plans for increased support during the NQT/induction years via high-quality mentoring and professional development, and a reduced teaching timetable.

Workload has become an increasingly important issue when considering the school environment and teacher attrition. Correlational studies indicate that teachers' perception of workload are strong predictors of their decision to leave teaching (e.g. Torres 2014, Higton 2017, Lynch et al. 2016). In England, a report published by the DfE (CooperGibson Research 2018), based on interviews with 101 former teachers, suggested workload as the most important factor influencing

teachers' decision to leave the profession. Workload, policy changes and accountability pressure were among the top reasons cited for teacher attrition in a survey of over 1,000 teachers in England (DfE 2017). In 2014, the DfE launched the Workload Strategy to understand and address 'unnecessary' tasks that teachers undertake in the course of their duty. The aim was to support teachers' wellbeing and the development of more positive working environments. The outcomes of the strategy were a set of 'action plans', resources and reports for school leaders. There is no evidence available on the extent to which schools are engaged with these. The Teacher Workload Survey carried out in 2019 in England by the Department for Education (DfE) showed a reduction in teachers' reported working hours since 2016. However, the majority of teachers (73% of primary and 87% of secondary) still stated that their workload was either a 'very' or 'fairly' serious problem, indicating that there is still some way to go.

The following sections of this report examine in more detail some of the strategies used to tackle teacher recruitment and retention, including evidence from existing reviews on these issues. Following this, we present the methodological approach taken for the current systematic review, and then synthesise our findings on the impacts of the various policies and strategies used.

COMMON APPROACHES USED TO IMPROVE TEACHER RECRUITMENT AND RETENTION

Financial incentives (including scholarships, bursaries, higher wages)

Financial incentives are commonly used to try and improve recruitment and retention. These are premised on the assumption that if sufficiently well compensated, people can be encouraged to go into teaching or be persuaded to stay on in the profession. In theory, financial rewards could persuade people to consider the profession favourably when comparing it with alternative career options that that they may have available. Moreover, monetary compensation is sometimes used to offset potentially challenging or unattractive job characteristics associated with teaching. These may relate to working in certain types of schools/areas or high workload.

Identifying what a well-designed pay incentive should be is difficult because of the numerous challenges and parameters that need to be considered (Figlio and Kenny 2007). Some commentators have suggested that effective incentive plans must offer relatively large awards to induce behavioural changes (Milanowski et al. 2009, Prince 2003). A number of American studies have pointed to the level of financial incentives needed in different contexts. Goodnough and Kelly (2000) suggested that teacher salaries in New York be increased by up to 25% in the lowest-performing schools as the 15% increase that was offered in 39 of those schools appeared to have little impact in terms of attracting qualified teachers. Boyd et al. (2003) and Hanushek et al. (2004) estimated that considerable pay rises (up to 50%) may be needed to induce more teachers to work in schools with high

proportions of ethnic minority or socioeconomically disadvantaged students. However, if working conditions and the relative attractiveness of the schools can be improved, then the size of the pay increase may need not be as large.

Others have argued that a single pay scale does not provide incentives for teachers with skills that are in high demand in non-teaching fields, such as in mathematics and science. Successive governments in England have offered more to trainees in certain subjects. However, once qualified, teachers then tend to enter the profession at a similar pay level irrespective of subject area. Recent reports have recommended that teachers in shortage subjects (e.g. maths and physics) be paid a 'salary supplement' to encourage their retention, particularly in the early years of their careers (Sibieta 2018, Sims 2017). Increased flexibility of pay was also introduced in England in 2013-2014 meaning that schools no longer had to use the seniority-based national pay scale but instead could determine annual pay awards by 'performance'. Studies have suggested limited impact on teacher mobility or retention in the same schools thus far (Anders et al. 2019, Burgess et al. 2017, Karbownik 2014). There is very little evidence to indicate whether performance-related pay works either in improving teachers' performance or retaining them within the profession (Duffrin 2011).

Even if financial incentives attract or support the retention of some teachers, it is not clear that they work to attract or retain the *best* teachers. Some studies (above) raise concerns that those attracted predominantly by financial gains may not be the people most suited to or motivated to join the profession. Incentives linked to certain subject areas may create feelings of unfairness or resentment amongst colleagues who ostensibly do a similar job in the same school context (DeLaat and Vegas 2005). Pay related to 'performance' may encourage teachers to be competitive or could lead to 'gaming' of the system (e.g. discouraging weaker students from sitting exams).

Alternative routes in to teaching

Another approach often used to address the critical shortage of teachers is alternative certification or alternative pathways into teaching. These offer options different to the 'standard' or 'traditional' routes within a particular region or country and often provide ways into teaching for those wishing to train 'on the job' or who are working in other careers or roles (e.g. Troops to Teachers in England, or routes permitting teaching assistants to qualify as teachers). Traditional teacher-preparation programmes tend to emphasise pre-service training on the assumption that the learning and practical experiences that trainees engage with will give them the requisite skills and knowledge needed for success in the classroom. Alternative programmes may try to reduce barriers to entry and/or aim to enable teachers to enter the classroom more quickly. In both the US, and UK, there have been numerous alternative routes offered in recent years. In England, the School Direct and School Centred Initial Teacher Training (SCITT) routes have developed, and the Teach First programme operates in both England and Wales at present. Alternative certification programmes in the US include Teach for America, the Teacher Residency Programs and Peace Corps Program. Many states run their own alternative certification programmes too, sometimes encouraging

those with non-traditional qualifications to train or preparing their teachers to work in specific contexts or with specific groups of young people (e.g. ethnically diverse schools, in areas of high deprivation, or with children with special needs) (Hess et al. 2004)

Many studies have been conducted to evaluate the effectiveness of different teacher preparation routes, but most focus on outcomes relating to teacher performance (Greenwald et al. 1996, Rivkin 2007). Typically, these studies assess the relationship between certain attributes and qualifications of teachers and teacher performance (usually measured using students' performance as a proxy). The results have been mixed. There has been less research on the effects of teacher preparation for teacher retention.

Induction programmes and mentoring

There is growing policy interest in induction and mentoring programmes strategies to support with teacher retention (Kearney 2014, Martin et al. 2016). While there is a large body of research on mentoring/induction programmes that has purportedly examined the "impact" of induction and mentoring on teacher retention, many studies are limited to single-group causal comparative analysis, correlating teachers' participation in these programmes with their self-reported intention to stay in teaching (e.g. Jenkins 2012). Some older studies (Heyns 1988, Murnane et al. 1991) found that mentoring and induction impacted on secondary teachers and primary teachers differently. Other studies have reported few differences in turnover between elementary and secondary teachers (Ingersoll, 2001; Kelley, 2004). A systematic review on the role of mentors on retention of newly qualified teachers could not find conclusive evidence of a positive impact (Totterdell et al. 2008). Only three studies within the review reported positive effects, but all were correlational studies (not based on experimental designs). The report called for closer scrutiny of the relationship between induction and retention and highlighted the need for more robust and reliable research in this area. Moreover, given the often complex or multi-faceted nature of induction/mentoring programmes, it can sometimes be difficult to understand which of the mechanisms or 'ingredients' within them are likely to drive any impact on retention. This is also an area where further high-quality work would be beneficial for the development of new policies and initiatives in this area.

Professional development

Investing in high-quality professional development is widely believed to be an effective way of improving both teachers' and, in turn, students' performance (Darling Hammond et al., 2017). More recently, however, professional development is also being considered as a method for improving teachers' satisfaction with their job and potentially reducing their workload. This, it is hoped, may lead to increased retention (Coldwell 2017).

There are numerous professional development opportunities available to schools and teachers at present. However, there is considerable variation in the aims of such programmes and teachers' access and engagement with them. Further, there is very little robust evidence which points towards an impact on retention (Humphrey et al., 2018; Glazerman et al., 2010). A study by Allen and Sims (2017) in

England indicated that high-quality subject-specific professional development may be beneficial for retaining teachers. The study examined teachers' engagement with the National STEM (Science, Technology, Engineering and Mathematics) Learning Network development scheme, finding that while participants were no more likely to stay at their current school, they were more likely to stay in the profession for the first and second year after taking the courses. Recent analyses by Worth and van den Brande (2020) found an association between teachers' reported autonomy over their professional development and their intention to stay in teaching. While not established as a causal relationship, this finding does suggest that some experimental work on this issue would be helpful for understanding whether increasing teachers' autonomy in relation to professional development might be a potential strategy for improving retention.

Leadership support

There is a body of research suggesting that leadership support is an important factor in keeping teachers in school and in the profession. A series of observational studies point to teachers' perceptions of administrative support and leadership as being strong predictors of teachers' intention to leave (Allensworth et al. 2009, Boyd et al. 2011; Johnson, Kraft and Papay 2012; Marinell and Coca 2013). A study by Johnson et al., (2012) argues that while working conditions generally appear to be important to teachers and their future career plans, it is the social conditions which form part of these – such as the principal's leadership, school culture and relationships with colleagues – which are most influential. Analysis in England, based upon the international TALIS dataset, also highlights the importance of good leadership. Sims (2017) finds that better school leadership is associated with higher job satisfaction for teachers and a reduction in the odds that they would want to leave their school.

Additional incentives

In addition to the financial incentives noted above and school working conditions, research has looked at other incentives to encourage teacher recruitment and/or retention, including offering below market rental rates, living allowances (e.g. London living allowances) and discounted housing in certain areas. In England, these policies have typically existed in London and the South East where it is expensive to live and where housing/travel costs can prevent employees being able to live near where they work. Examples from Australia and America include housing subsidies or offering rental accommodation at below-market rate for teachers willing to work in rural areas (CooperGibson Research 2018).

Unfortunately, the evidence on these kinds of incentives is limited and is often based on small-scale descriptive work or tangential research about wider compensation (Loewus 2018). Unlike for more direct financial incentives and wage compensation, there have been no rigorous evaluations of housing incentives to determine if they work in improving recruitment and retention especially in hard-to-staff areas (Podolsky et al. 2017). Many of these incentives are not new and have been used for a long time in a quest to improve the teacher shortage situation. However, there is little to suggest that these strategies specifically are effective.

In recent years the UK government had acknowledged that despite huge investments in a wide range of initiatives, costing millions of pounds, it has still been unable to address the ongoing shortage of teachers (House of Commons 2017). Has investment been directed towards the 'wrong' approaches? And what evidence has informed decisions by policymakers on this issue? In 2019, the Recruitment and Retention Strategy was launched in England (DfE, 2019b). This identified four key priorities: creating a positive school culture, including workload reduction; providing improved early career support for new teachers; making teaching more attractive by providing new pathways for progression and by supporting flexible working; and enhancing and simplifying the application process for prospective teachers. Little is known yet about the implementation and impact of this ambitious strategy although its progress will be viewed with interest.

This section presents a summary of reviews on strategies to improve teacher recruitment and retention. We acknowledge the wide-ranging and important work that has been conducted and situate our current review within these existing studies.

To the best of our knowledge, there have been no large-scale comprehensive reviews on teacher recruitment and retention policies, with quality appraisal of individual studies included as a key feature. Most have been narrative reviews of available literature (Kelly and Finnigan 2004, Lynch 2012) or focused on particular issues or groups of teachers/schools. Przygocki (2004), for example, looked specifically at teacher supply issues in Catholic schools, while Fore et al. (2002) and Billingsley (2004) were concerned with the shortage of special education teachers. Previous reviews have also tended not to be systematic, instead summarising a collection of studies seeking the consensus view (SACE 2010, Achinstein et al. 2010) or providing a discussion of a small number of key articles (Dauksas and White 2010, Newton and Witherspoon 2007, Oke et al. 2016). Borman and Dowling's (2008) comprehensive review focused on the factors that moderate attrition outcomes rather than examining policy initiatives or interventions designed to improve retention.

A review by Guarino et al. (2004) examined the individual and school characteristics linked to teacher recruitment and retention (RandR), as well as synthesising the evidence for a range of policies and initiatives aiming to reduce the shortage. The authors apply four quality criteria based on sample, measurement procedures, model specification and interpretation to these studies. These quality criteria, however, were used to determine whether studies would be included in the review or not. They were not used to assess the weight that should be allocated to the findings in relation to each intervention. More recently, Hanover Research's review (2014) examined both financial and workplace incentives connected to teacher recruitment and retention. However, the study provides little critical analysis nor consideration of the quality of each of the included evaluations. Gunther (2018) examined non-financial factors influencing teacher recruitment and retention, including a range of research design and quality criteria used for rating of included studies. However, the study focused on personal, school, community and job characteristics or factors, rather than examining the effectiveness of policy interventions introduced to tackle the teacher shortage.

Many review studies have explored strategies that are implemented by "successful" schools or districts (Hubbard et al. 2015, Kennedy 2014, Kowal et al. 2008, Useem and Neild 2005, Ulferts 2015, Viadero 2018). These and others also offered suggestions for improving recruitment and retention (Hirsch 2001, Nielson 2001, Petty et al. 2012, Podolsky et al. 2017). Others have described what they thought were effective strategies used for recruiting and retaining certain kinds of teachers such as minority and STEM subject teachers (Maryland State Dept of Education 1993) or for rural and urban schools (Harmon 2001, Luft 1992). These included the use of incentives such as

childcare for employees, housing support/incentives or creating new certification pathways. Crucially, however, these studies do not refer to robust evidence from any evaluations of these approaches.

Where attempts have been made to consider the quality of the included studies the results have been disappointing. Laurence et al's (2002) review of programmes aimed at attracting and retaining teachers in the US concluded that it was difficult to be certain about the evidence of effectiveness as many of the programmes tended to be small and piecemeal and hence difficult to replicate on a large-scale. Lonsdale and Ingvarson (2003) reviewed recruitment strategies employed in Australia, the US, UK, Canada and NZ and cautioned that many of the strategies have not been formally evaluated, or where they have, evidence tended to be anecdotal and informal.

In addition to more general reviews which have looked at a range of policies designed to improve recruitment and retention, others have focused more specifically on initiatives related to teacher preparation, induction and mentoring. Ingersoll and Kralik's (2004) review explored the impact of mentoring and induction on teacher retention. However, their search revealed no strong studies which would be able to suggest a causal link between mentoring and retention. While they suggest that there may be positive impacts resulting from mentoring of teachers, these findings are necessarily limited by the lack of available high-quality work. A later study (Ingersoll and Strong, 2011) which similarly explored mentoring and early support for new teachers, reported positive effects on new teachers' practice and student achievement. However, the (small number of) large RCTs included in the review found no effects on teacher retention. A systematic review of the Teach for All (TfAm) scheme, a fast-track teacher preparation scheme in New Zealand (McConney et al. 2012) suggests that the programme has had mixed success. While it was effective in recruiting 'better quality' graduates into teaching, it was less successful in retaining those teachers than traditional training routes. Similar schemes exist in the US, Australia and the UK. Heilig and Jez (2010) point towards the higher attrition rates for the Teach for America (TfAm) scheme. They suggest that while there is some evidence that TfAm produces teachers who are slightly more effective than those following a traditional route, the high attrition and turnover presents substantial costs and ongoing recruitment challenges for schools.

Our new review includes studies that evaluate the impact of strategies or policy initiatives to improve the recruitment and retention of teachers. We are specifically focusing on understanding and developing the evidence base of approaches which could be introduced to tackle teacher shortage.

The purpose of this new review is to summarise evidence of the effectiveness of popular initiatives, employed worldwide, to address teacher supply. Knowing more about what 'works' and what does not will allow policymakers and schools to make informed and targeted decisions on strategies to use in their effort to attract and retain teachers. It is essential that the best available evidence is used to support these efforts, and that policy in this area is underpinned by it. It is also vital to understand approaches that have been found to be less effective in order that policymakers do not select these, and that public money and resources are not wasted upon them. For those where the evidence is unclear, robust evaluations can be commissioned in the future.

The main research questions for the study are:

1. What are the most promising approaches/incentives/initiatives in attracting teachers?
2. What are the most promising approaches/incentives/initiatives in retaining teachers?
3. And so, what are the 'best bets' for schools, regions, and policymakers to improve the recruitment and retention of school teachers?

Subsidiary issues include:

4. Do the answers differ for shortage subject areas?
5. What are the most promising approaches for teacher supply in areas where teacher shortages are most problematic?
6. What initiatives/incentives do not appear to work?
7. What specific further research needs to be undertaken to test other approaches?
8. What are the key elements of successful strategies?

METHOD

Search strategy

To search for relevant studies, a list of search terms was developed (see Appendix A). These were applied to 13 educational, psychological and sociological electronic databases, and Google and Google Scholar, including:

- Education Resources Information Clearinghouse
- JSTOR
- The Scholarly Journal Archive
- Social Sciences and Education Full Text
- Web of Science
- Sage
- Science Direct
- Proquest Dissertations and Theses (http://library.dur.ac.uk/record=b2044198~S1)
- British Education Index
- ERIC (Educational Resources Information Center)
- IBSS (International Bibliography of the Social Sciences)
- Ingenta Journals (full text of a large number of journals)
- EBSCOhost (which covers the following databases: PsychINFO, BEI, PsycARTICLES, etc, ProQuest, IBSS

These were supplemented by studies known to us and snow-balling of relevant studies cited in the retrieved studies and from prior reviews of literature.

A scoping review was first conducted to test out the sensitivity of the search terms using well-known sociological, educational and psychological databases to ensure that the search terms picked up relevant pieces of literature, and also pieces already known on this topic. Following this, a very general and inclusive statement of search terms was generated for each database. These were adjusted to suit the idiosyncrasies of each. For different databases we had to modify the syntax but used similar key words.

The search terms were tested, adjusted and retested iteratively to ensure that as little as possible relevant material was missed. The search terms included teacher recruitment, teacher retention, teacher shortages, teacher supply and policy initiatives, incentives, approaches and schemes (and their synonyms). As the purpose of this review was to identify approaches that show evidence of impact, only studies that employ a causal design were included. Therefore, the key words also included any causal term (or a synonym) or any research design that would be appropriate for testing a causal model, such as experiment, quasi-experiment, regression discontinuity and difference-in-difference.

To reduce publication bias, the review included any published or unpublished material that mentioned these key words. The scoping review and previous reviews of literature suggested that there were few robust experimental evaluations of policy initiatives or approaches that aim to improve recruitment and retention of classroom teachers. Therefore, we included any empirical study, including those using cross-sectional and longitudinal designs. These studies will generally have lower security or quality assessment ratings. No date limiter was applied. This was to allow the search to be as broad as possible.

A total of 6,730 records were identified through the electronic database searches, deemed relevant from titles and abstracts. An additional 347 were added from following studies in previous reviews, studies known to us from previous work and from references in identified studies. These included 58 research reports from ProQuest Premium which specifically relate to the effects of induction and mentoring on teacher retention. All were exported to EndNote (a reference manager) for screening.

Screening

Each identified study was then screened to remove the duplicates. The remaining studies were screened again for relevance, first by title and abstracts, removing those that were not relevant to the review questions.

Because the search involved multiple databases, it was not surprising to find a number of duplicates. But there were also similar studies which were presented in different forms, or for different audiences e.g. as a working paper or a report as well as journal articles. In such cases, we generally use the journal article and make reference to the full report, if necessary.

In the initial stage, we included all studies that were about strategies employed in attracting and retaining teachers and potential teachers. There were a substantial number of studies that were surveys conducted to collect ideas about the best way or most effective ways to attract and retain teachers. These were then excluded because they were not evaluations of the effectiveness of incentives or any particular programmes.

At this second stage the full reports were skim-read by one researcher. Any studies now thought not to meet the inclusion criteria were then reviewed by other members of the research team for

consensus. In order to establish inter-rater reliability, all four members of the team independently reviewed 10 randomly selected reports to decide if they agreed on their inclusion or exclusion. We screened the full text of the studies, applying pre-defined inclusion and exclusion criteria. These are as below:

Inclusion criteria

Studies were included if they were:

- Empirical research
- About activities aimed at attracting people into teaching or about retaining teachers in teaching
- Specifically about recruitment and retention of classroom teachers
- About incentives/initiatives/policies or schemes on teacher recruitment and retention
- About mainstream teachers in state-funded/government schools
- Studies that had measurable outcomes (either retention or recruitment)

Exclusion criteria

A number of studies relevant to the research on teacher recruitment and retention were excluded for a number of related reasons:

- Not relevant to the research questions
- Not primary research
- Not reported in English
- Not actually a report of research at all
- Descriptions of programmes or initiatives with no evaluation of strategies or approaches used in teacher recruitment and retention
- Not about strategies or approaches to improve recruitment or retention of teachers (e.g. observational or correlational studies of factors influencing recruitment and retention)
- Studies that have no clear evaluation of outcomes
- Opinion pieces, guidance briefs or manuals on how to attract and retain teachers
- Outcome is not teacher recruitment or retention
- Not about mainstream teachers
- Focus only on specific groups of teachers, e.g. special education teachers or ethnic minority teachers
- Recruitment and retention of school leaders, teaching assistants or school administrators
- Anecdotal accounts from schools about successful strategies

Data extraction

Research studies that were deemed to be relevant were assembled and considered for in-depth review and synthesis (see Figure 1 below). They were judged to be empirical and described in sufficient clarity and contained enough information for us to make judgements about the quality of evidence.

Data extraction involved summarising information about all aspects of the research design relating to the sampling strategy, the sample size, allocation to groups, the instrument used to assess the outcome measure, and the attrition rate. Some further studies were excluded at this stage when it was clear that that they were not evaluations of programmes. Key information from each included study was extracted using the following template:

Overview

- Brief description of the intervention
  How the intervention works. There must be enough information to enable identification of key features of a successful intervention, if it works.
- Aim and type of intervention, e.g. financial incentives (performance-related pay,

scholarships, bursaries, housing benefits, pension scheme)
- Phase: Primary/secondary/general
- Country

Method

Research design:

- Does it have a control and comparison group?
- Does it have pre- and post- event comparison?
- How is randomisation or other allocation to groups carried out?
- Was there an intervention?

Sample

- Size of sample
- How were samples identified?
- School characteristics, e.g. primary, secondary, rural, urban, challenging schools
- How many cases were lost at each stage?

Outcome measures

- What are the outcomes and how were they collected?
- Is there a pre-defined primary outcome, or is there an element of 'dredging' for success?

Analysis (if relevant)

- What kind of analysis was carried out?
- Are there pre- and post-test comparisons?
- Are effect sizes cited or calculable?
- How was the performance of treatment and comparison groups compared?

Findings

- Reviewers' analysis of the results (re-calculate effect sizes if not estimated or if in doubt).

Commentary:

Aspects of the study that might threaten or enhance its validity. This could include fidelity to treatment, quality of counterfactual, extraneous/confounding variables, other programmes going on that may have affected the results, and conflicts of interest.

Synthesising the evidence

Research reports were sorted by outcomes (retention, recruitment or both), and then by approaches (financial incentives, mentoring and induction or professional development).

It is important to judge the quality of any evidence, so that the synthesis is not misled by automatically giving equal weighting to strong and weak studies. To assist consistency in such judgements we assessed the trustworthiness of the findings in each report using a quality assessment 'sieve' (Gorard et al. 2017) based on five criteria (see Table 1). These were whether the design was appropriate for a causal claim, the size of the smallest cell in any comparison, the amount of data lost at all stages, the quality of the outcome measures, and other threats to validity such as lack of fidelity in conducting the study. All such factors are important (Slavin and Smith 2008). In general, simple comparisons between heterogeneous groups are given a 1🔒 rating at best. To be judged 2🔒 the comparison either needs to be based on such a large number of cases that it is, in effect, a population study and selection is minimised, or use a design like matching, difference-in-difference or an instrumental variable.

Each study is assigned a rating ranging from 0 (a study that is so weak it does not help answer the research question) to 4🔒 (the best kind of evidence that can be expected in real-life conditions). Each

study is rated as the lowest row with a matching description for any aspect. Where the report does not provide enough information to make a judgement (very common) the rating is lowered. Usually, after the first few columns are decided on the final rating is already set.

Table 1 - A 'sieve for judging the trustworthiness of research studies

Design	Scale	Dropout	Outcomes	Other threats	Rating
Fair design for comparison (e.g. RCT)	Large number of cases per comparison group	Minimal attrition, no evidence of impact on findings	Standardised pre-specified independent outcome	No evidence of diffusion or other threat	4★
Balanced comparison (e.g. RDD, Difference-in-Difference)	Medium number of cases per comparison group	Some initial imbalance or attrition	Pre-specified outcome, not standardised or not independent	Indication of diffusion or other threat, unintended variation in delivery	3★
Matched comparison (e.g. Propensity score matching)	Small number of cases per comparison group	Initial imbalance or moderate attrition	Not pre-specified but valid outcome	Evidence of experimenter effect, diffusion or variation in delivery	2★
Comparison with poor or no equivalence (e.g. volunteers)	Very small number of cases per comparison group	Substantial imbalance and/or high attrition	Outcome with issues of validity or appropriateness	Strong indication of diffusion or poorly specified approach	1★
No report of comparator	A trivial scale of study, or N unclear	Attrition not reported or too high for any comparison	Too many outcomes, weak measures, or poor reliability	No consideration of threats to validity	0

After the initial screening, research reports were classified into groups according to whether they were about recruitment, retention or both. These were then further sorted according to the types of incentives, initiatives or strategies. A broad classification of incentives/initiatives was created. These include:

- Those that are largely about financial incentives. Under this category are performance payment, bursaries/scholarships, higher salaries, compensatory bonuses or housing grants (e.g. for teaching in areas where recruitment was difficult)
- Those that are about the professional development of teachers
- Mentoring and induction programmes
- Alternative routes to teaching
- Others, such as marketing, advertising campaigns, housing perks, programmes to enhance career advancement of teachers, initiatives involving changing the teacher contract
- A combination of strategies

Four cautions about reviews

Computing average effect sizes across different studies which use different scales for measuring different aspects of similar intervention may not reflect the real impact of each individual type of programme. To illustrate, the studies in this review employ a range of methodologies (e.g. instrumental variables, regression discontinuity, time-series analysis, difference-in-difference and randomised control trials) to estimate the effects of a wide spectrum of measures aimed at improving teacher supply. One of these is financial incentives. Under this umbrella term we have, differential salary compensation, bonus incentive scheme, pension enhancement, scholarship and bursaries and tuition fee waivers. These strategies are not identical, therefore averaging the effect sizes across the different strategies may not reflect the impact for particular strategy. It is also the case in this review that there is often only one or two studies for each type of financial incentive that meet our causal criteria. It is therefore not possible to average the effect size for each type of programme (Slavin 2020).

We do not accept the source of any publication or the reputation of its author or funder as any guarantee of research quality. Instead we judge the quality of evidence for each of the included studies by applying the sieve. This step is essential since much of education policy so far has been based on incorrect, misleading or incomplete evidence, which perhaps explains why some initiatives have not been successful in achieving their objectives.

It is also important not to confuse quality of evidence with its purported outcomes. Strong studies can describe interventions that are beneficial, neutral or harmful. Interventions reported as successful can be reported in research that is weak or strong.

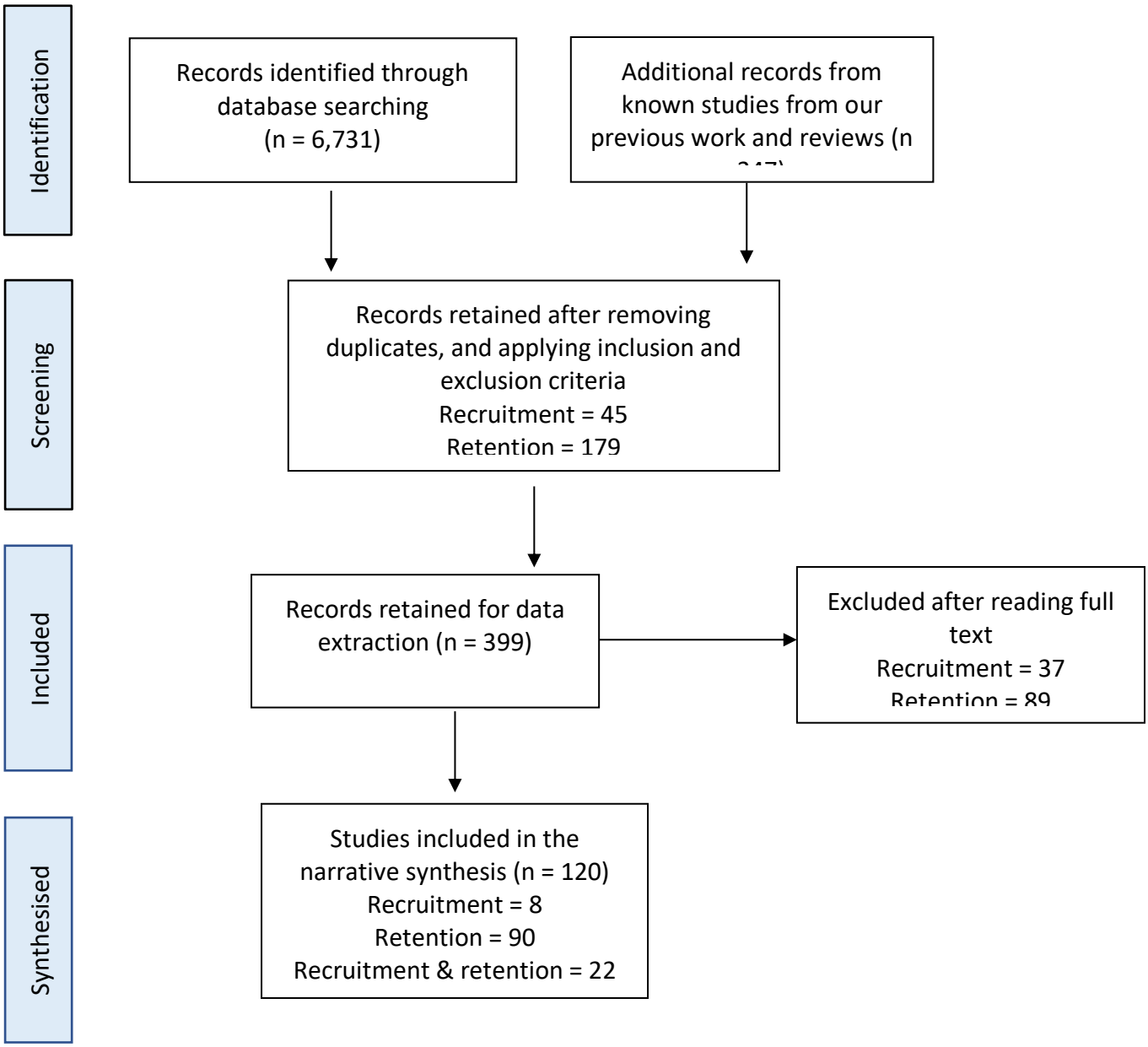
The judgements about any study are for the purposes of this review only. Non-causal descriptive studies may be strong in many other respects (and RCTs and similar can be weaker) to address different research questions.

PRISMA FLOW DIAGRAM FROM IDENTIFICATION OF STUDIES TO SYNTHESIS

The PRISMA diagram (Figure 1) provides information on the number of studies included and excluded at each stage of the review process. A final total of 116 studies judged to be relevant and which evaluate teacher recruitment and retention outcomes are retained in the analysis and synthesised. These include only single studies that evaluate teacher recruitment and retention as an outcome. Research reports that summarise previous studies are not included in the synthesis.

A summary of the results and the strength of the evidence is presented in Table 2.

Figure 1: PRISMA Diagram of included/excluded studies



Outcomes of the quality rating

A total of 120 studies with 157 recruitment and retention outcomes are included within the synthesis (Table 2). Of these, 92 reported positive outcomes, and 50 suggested no impact or negative effect. Fifteen outcomes are mixed or unclear. The majority of stronger studies have positive outcomes. For the rest of this review the focus is on studies rated 2🔒 or above. The relatively large number of weak studies does not change the overall findings for any approach. No studies were judged 4🔒 in quality, which is unusual given the number of studies and the amount of coverage this topic gets.

Table 2 – Number of studies with each quality rating: all included studies

Quality of study	Positive outcome n=92	Unclear/mixed outcome n=15	Neutral or negative outcome n=50
4🔒	-	-	-
3🔒	6	2	3
2🔒	43	6	17
1🔒	40	5	27
0🔒	3	2	3

Below, we separate our reporting, focusing first on studies that examine approaches to recruitment, and then those that focus on retention. There are a number of studies which report on both outcomes which have been included in both sections where appropriate. Studies rated 2🔒, 3🔒 or 4🔒 are included in our synthesis. We do not discuss studies given a rating of 1🔒 or lower.

Table 3 summarises the results of higher quality studies (rated 2🔒 and above) focussing on studies that aimed at improving the recruitment of teachers. None were judged as the highest quality, 4🔒 (this might have been, for example, a RCT, with a large number of cases in each group, low attrition, and a direct measure of teacher recruitment/employment). The highest quality study (3🔒) does not clearly show positive outcomes. Otherwise the results from the 2🔒 studies are predominantly positive. This suggests that there is promising, but far from definitive, evidence on how to improve teacher recruitment. Below, we use the different kinds of interventions/initiatives to organise our reporting. Each study is summarised in turn, and then we synthesise the evidence, drawing some more general conclusions.

All but one of the studies in Table 4 examine approaches which provide financial incentives of some kind.

Table 3 - Quality rating of studies on recruitment

Quality of study	Positive outcome	Unclear/mixed outcome	Neutral or negative outcome
3🔒		Rosen 2012	
2🔒	Boyd et al. 2012 Defeo, Hirschberg and Hill 2016 Dolan, Metcalfe and Navarro-Martinez 2012 Falch 2017 Fitzgerald 1986 Glazerman et al. 2013 Hough and Loeb 2013 Steele et al. 2010 Zarkin 1985	Fulbeck and Richards 2015	Bueno and Sass 2016 Gorard et al. 2020 Kraft et al. (2020)

Alternative routes

Table 4 – Number of studies with each quality rating: Alternative routes and teacher supply

Quality of study	Positive outcome	Unclear/mixed outcome	Neutral or negative outcome
3🔒	-	-	-
2🔒	1	-	-

Only one study (Boyd et al, 2012) that looked at the impact of an alternative teacher preparation programme for teachers of mathematics (Table 4) was rated 2🔒. Boyd et al. (2012) examined the Maths Immersion Program (MIP), an alternative teacher preparation programme introduced to meet the shortage of maths teachers. Uncertified teachers cannot teach in New York, and the number of traditionally and alternatively certified teachers with the required maths qualifications was deemed insufficient for City schools. The study compared the qualifications and retention of Math Immersion teachers to New York City mathematics teachers who began their careers through other pathways. The study found the Maths Immersion programme was successful in attracting highly qualified teachers to teach in some of the most challenging schools. The number of such teachers increased from 2003 to 2008 at a faster rate than those who were prepared through the traditional college (CR), Teaching Fellowships (TF) and Teach For America (TFA) routes. They also had better academic qualifications than traditionally prepared peers, but weaker qualifications than TFA teachers.

Teacher accountability

Table 5 – Number of studies with each quality rating: Teacher accountability and teacher supply

Quality of study	Positive outcome	Unclear/mixed outcome	Neutral or negative outcome
3🔒	-	-	-
2🔒		-	1

There is only one study that examined teacher accountability on the supply and quality of teachers (Table 5). Kraft et al. (2020) took advantage of this differential timing of high stakes teacher evaluation reforms across the different states in the US to estimate the impact of teacher accountability reforms on the supply and quality of new teachers. Using a combination of panel datasets from 2002 to 2016 in a difference-in difference approach they compared teacher supply (the number of licenses granted) and teacher quality (using the Barron's ranking of the teachers' training college) across different states. They compared the outcomes seven or more years prior (pre-reform) to a reform and three or more years after a reform (post-reform). High-stakes evaluation reforms reduced the number of licenses granted in a state by 2.69 per 10,000 18-to-65-year-olds**.** The reforms also made it difficult for hard-to-staff schools to fill vacant positions. On the other hand, teacher evaluation reform did raise the quality of teachers, increasing the likelihood of a teacher graduating from a higher ranking college by 8.1 percentage points. Evaluation reformes also appear to have reduced teacher satisfaction by 14.6 percentage point.

Financial incentives

Table 6 – Number of studies with each quality rating: Financial incentives and teacher supply

Quality of study	Positive outcome N = 8	Unclear/mixed outcome N = 2	Neutral or negative outcome N = 2
3	-	1	-
2	8	1	2

Much more work was identified on the use of monetary approaches to attract teachers, including most of the research judged 1 which is not summarised here (see Appendix B). Overall, these studies and the slightly stronger ones in Table 6 suggest that financial incentives can be used to attract teachers into the profession, and to specific regions, subjects or hard-to-staff schools.

Rosen (2012) evaluated whether districts that offer incentives had better recruitment and retention of shortage subject teachers than comparable districts that do not offer incentives. This is the only 3 study within this section on recruitment. The study utilised an instrumental variables model using data from the School and Staffing Survey from 1999/2000 to 2007/08 which contained data from 106,930 public school teachers in 6,540 public school districts. This is perhaps the largest study of its kind and several models were employed within it. One compared teachers in districts that offered incentives with matched teachers in other districts. This does not overcome the problem that districts that did and did not offer such incentives may have other differences that could influence teacher recruitment and retention. The results were mixed, but there was no clear evidence that the use of incentives improved teacher recruitment or quality. Incentives were most attractive to those who were already interested in becoming teachers.

Defeo et al. (2016) analysed data from twelve Alaskan school communities in three districts to determine the minimum salary needed to attract highly qualified teachers in rural communities in Alaska, and how much more is needed to get teachers to teach in difficult-to-staff schools. They estimated that the differential to compensate for factors that might make a community or school more or less attractive ranged from 0.85 to 2.01, with remote rural communities having higher differentials. The differentials include costs of living among other working and living conditions that affect teachers' staying or leaving communities. Higher salaries are therefore needed to attract more qualified teachers where the characteristics of the school and their salary predict less than the national standard. So, it might be the case that to attract maths and science graduates (who would command higher salaries elsewhere), the salary differential would have to be big enough to compensate for the difference they would otherwise get. It has to be mentioned that the amount of the bonus was determined by the salary differences on the state salary schedule, not a teacher's actual salary, and some districts were already paying teachers more than was stipulated in the state salary schedule. This suggests that even with the compensatory bonus teachers' salaries could be the same or even below what they were already getting.

Fitzgerald (1986) reported positive results of the High Priority Location Stipend Program in lowering the number of teacher vacancies. The stipends varied between $500 and $2,000 annually depending on the position of the staff and the number of years they worked in the high priority areas. This was a quasi-experimental study comparing 25 schools in the programme with 25 comparable control schools. High priority schools were those with a high proportion of students receiving free/reduced lunches. Control schools were similar in pupil and teacher characteristics but not designated as high priority schools. Over three years, vacancies in treatment schools fell substantially from the base year, teacher and vacancies in the control schools went up (effect size 1.3). The treatment schools were selected for the stipend based on their high vacancies and lower retention of teachers suggesting that there were some inherent differences between them. Control schools may be more attractive to teachers by virtue of the fact that they had lower vacancies to start with. The design was unable to take account of changes in circumstances within the schools (such as pupil intake), which could have affected teacher satisfaction and thus the retention rates.

Glazerman et al. (2013) examined the impact of the Talent Transfer Initiative, which offered bonuses to the highest performing teachers for agreeing to move to and stay in low-performing schools. The incentive was $20,000 paid in instalments over a two-year period. Teachers who were already teaching in low-performing schools received a $10,000 retention stipend if they remained in the school over the two-year period. The participants included 85 teacher pairs matched on school characteristics and randomised to intervention or not, across 114 elementary and middle schools. Because the teacher pairs changed their personnel between randomisation and the start of the school year, the two groups were no longer equivalent at the beginning of the study. Of the vacancies assigned to the scheme, 88% were filled, compared to 44% the year before, and 71% in the comparison group.

Hough and Loeb (2013) used a difference-in-difference approach, comparing the recruitment and retention of 1,611 applicants in the San Francisco Unified School District. The district awards higher salaries/bonuses for teachers teaching shortage subjects, and in schools with a high proportion of poor and ethnic minority students. Teachers were also given a retention bonus if they stayed on after four years and more after eight years. The results showed an increase in the proportion of shortage subject teachers in hard-to-staff areas from 27% to 37%. There was also an increase in the proportion of new hires in the targeted group (those that received the incentives) from 49% to 54%.

Steele et al. (2010) evaluated the Governor's Teaching Fellowship (GTF) scheme, involving a $20,000 incentive to attract and retain new teachers to low-performing schools for four years. Teachers had to repay $5,000 for each year that they did not meet the commitment. An instrumental variable design was used, based on 718 GTF teachers, excluding those who could not be tracked, were missing data, or not enrolled at recognised institutions. GTF recipients were not randomly selected, and so may have had a predisposition to teach in low-performing schools. Twice as many teachers were enrolled during GTF as in the years before and after, and 28% more taught in low

performing schools. It seemed that money was an attractor.

A UK study suggested (indirectly) that monetary incentives may be effective only in attracting those already intending to teach, not those who would not have considered teaching anyway (Dolan, Metcalfe and Navarro-Martinez 2012). This was an experiment with 1,574 undergraduates (but data for 1,496 was analysed) to test whether financial incentives would attract high ability students into teaching. Instead of asking student directly whether they would be motivated by financial incentives, which runs the risk of students giving answers which they think are desirable or acceptable, the authors presented participants with a hypothetical task for which they were rewarded for effort. In addition, they were offered an initial up-front payment or "endowment" conditional on their subject and predicted degree classification. This was to mimic the incentives offered for initial teacher training (ITT) bursaries. In England, the government offered differentiated bursaries for different degree subjects and degree class with high priority subjects attracting higher bursaries. Bursaries were found to be strongly and positively associated with intentions to become a teacher and to do initial teacher training, although the causality appears to be in the opposite direction. Those intending to be teachers were more likely to give greater importance to bursaries, instead of (or as well as) the other way around. The effect was stronger for women who were more likely to want to be primary school teachers than secondary. Those in the third year of study were also less likely to express intention to teach. This study was based on hypotheticals and on participants' expression of intention to become a teacher which weakens its validity.

Using a difference-in-difference approach, Falch (2017) compared the recruitment rate of teachers within Norwegian public schools with variable wage premium using data from the 1990s when wages were centralized. Treatment schools had a certain level of teacher shortage and were thus eligible for wage premium. Of 79,135 teachers, 10,868 worked in one of the three counties with treatment schools, and 2,034 worked at a treatment school. Because control schools did not have recruitment issues, comparisons were made with schools with persistent teacher shortages outside the three counties, which were not eligible for the wage premium. The results showed that the recruitment rate was higher in treatment schools than non-treatment schools (effect size 0.13). A 10% increase in wage increased recruitment by about 30%. The wage premium appeared to be more effective in attracting young female teachers into teaching than older male teachers. Although a large study this was a passive design.

In a longitudinal time-series analysis Zarkin (1985) developed an economic model to test how responsive the "reserve pool" of teachers is to the teacher salary at the time. The reserve pool of teachers in one year was estimated as the average proportion of certified teachers to the total certified over the 20-year period, multiplied by the total number meeting the minimum certification requirements in that year. They estimated that a 20% increase in wages could induce a 14% increase in the supply of secondary school teachers, and that secondary teachers were more responsive than primary teachers to increase in salaries.

Fulbeck and Richards (2015) explored the effects of ProComp, a performance-based financial incentive, on teacher mobility. Teachers were awarded an additional $2,4000 if they taught in top performing schools, high growth schools or hard-to-staff schools. Seven such incentives were given to individual teachers for meeting student performance targets, and three were school-based incentives awarded to teachers who taught at hard-to-staff schools serving low-income population, high performing schools and schools that make the most progress in maths and reading. However, ProComp was eligible only to those who were members of teacher unions and who did not work in Charter schools. The sample included all public school teachers in Denver from 2006-2010 who were eligible for the incentive (regardless of whether they received it) and who made at least one voluntary move within the district (n= 989). Using conditional logit models, the authors predicted which school a teacher would transfer to given their individual characteristics, the characteristics of their current school, and the characteristics of the schools they could be transferring to. The results portrayed the incentive as successful in attracting teachers to high growth and high performing schools, but less successful in getting teachers into schools with a high proportion of low-income pupils or hard-to-staff schools. Financial incentives also did not encourage teachers to move out of the area they were currently in.

Bueno and Sass (2016) assessed the impact of the Georgia's bonus system (a monetary compensation) on the recruitment and retention of maths and science teachers. The bonus system increased the pay of new maths and science teachers to make it equal to that of a teacher with six years of experience. A difference-in-difference model was used to estimate the impact of the differential pay programme on the likelihood of becoming a teacher by comparing the difference between graduates with majors in maths and science and other education majors in the change before and after the programme period. They found that differential pay did not increase the number of maths or science teachers; nor did it encourage people to switch to maths or science.

Gorard et al. (2020) compared three groups of 4,469 UK undergraduates, classified as never considered teaching, considered teaching but rejected it, and intending to teach. Before being asked about teaching, students were asked about what they were looking for in a career. The never considered teaching group was clearly the most different, and already on a trajectory to a "vocational" outcome like dentistry, medicine, architecture, engineering and so on. Once background factors, especially prior qualifications, had been accounted for there was no difference between those intending to be teachers and the rest in terms of the extent to which prospective pay was a factor in their decision.

Conclusions

It bears repeating that there is very little strong and secure research in this area, for the purposes of judging how to improve the recruitment of teachers. There are no robust studies at all on most of the approaches that we identified in the early sections of this report. We found one medium-quality piece on alternative routes to teaching. This is not enough to judge whether different ways of preparing teachers could be more successful,

particularly as it was carried out in a specific context with just one group of teachers (secondary maths teachers). This situation requires addressing with more robust evaluations of different routes in to teaching required.

Most of the research that has been completed relates to financial incentives. There are some potentially positive findings in this area but we should not yet conclude that extrinsic motivators are necessarily the best or only approach to improving recruitment in to teaching. These strategies appear to be what governments try most often, and so are most widely evaluated. In some ways, this is perhaps because large-scale (usually secondary) data relating to financial incentives are more readily available and accessible, and efficient to examine for researchers, than carrying out an experimental study on, for example, alternative pathways in to teaching. Even for financial incentives though, we find no studies of the highest quality. Most are based on passive designs and complex modelling. Experiments have been occasionally attempted but with no direct measures of employment outcomes.

Based on the evidence that does exist, there are repeated studies showing that substantial increases in salary are linked to improved recruitment in general, and perhaps in hard-to-staff areas and schools as well. However, studies that take the background of teachers or potential teachers into account suggest that salaries are not as important. It is not so clear that the same level of salary increase could attract teachers in shortage subjects such as maths and science teachers. The situation is also less clear for incentives and one-off bonuses. The evidence indicates that such incentives may disproportionately attract those already interested in teaching, and may encourage trainees into desirable schools rather than hard-to-staff ones. Perhaps "reluctant" teachers drawn by incentives are differently motivated to others. Where incentives are used to try and attract teachers to specific local areas or schools some studies warn that, where successful, this could have a detrimental effect on other schools, thus calling in to question the benefit for the system as a whole.

EVIDENCE ON INTERVENTIONS TO IMPROVE RETENTION

The picture for the evidence on teacher retention is more mixed than for recruitment (Table 7). Again, there are no 4🔒 studies but there are eight studies with a 3🔒 rating, all with unclear, neutral or negative outcomes. Across the 2🔒 studies there are more of a range of positive, mixed, neutral or negative outcomes. None suggest a clear benefit for retention. The majority of studies in this section either focus on financial incentive interventions or those which provide professional development and/or mentoring. Several of those relating to financial incentives have already been described above under recruitment, and so are referred to only briefly below.

Table 7 - Quality rating of studies on retention – all studies

Quality of study	Positive outcome	Unclear/mixed outcome	Neutral or negative outcome
3		Rosen 2012 Shifrer, Turley and Heard 2017 Springer, Swain and Rodriquez 2016	Clotfelter et al. 2007/8 Fryer 2013 Glazerman et al. 2010 Helms-Lorenz et al. 2016 Steele et al. 2010
2	Allen and Sims 2017, in profession Bueno and Sass 2016, while paid extra Cohen 2005 De Angelis, Wall and Che 2013 Falch 2010, 2011 effective for older, male teachers Feng and Sass 2015, 2018, short term Fitzgerald 1986 Glazerman and Seifullah 2012 Glazerman et al. 2013, only while pay Ingersoll and Smith 2004 Koedel and Xiang 2017, for retirement age Latham and Vogt 2007 Murnane and Olsen 1990 Papay et al. 2012 Ronfeldt and McQueen 2017 Speidel 2005 Springer and Taylor 2016 Springer et al. 2010	Booker and Glazerman 2009 Choi 2015 Fuchsman, Sass and Zamarro 2020 Fulbeck 2011 Fulbeck 2014, not effective in high poverty schools Shirrell 2014 Silva et al. 2014, 2015 Weisbender 1989	Anders et al. 2019 Boyd et al. 2012 Dee and Wyckoff 2013 Hendricks 2014 Hough and Loeb 2013 Jones 2013

Alternative routes to teaching

Fourteen studies meeting our inclusion criteria were found that examined alternative routes into teaching for attracting and retaining teachers. Only two were rated 2 and above, and neither were very promising (Table 8).

Table 8 – Number of studies with quality rating: Alternative routes and retention

Quality of study	Positive outcome	Unclear/mixed outcome	Neutral or negative outcome
3🔒	-	-	-
2🔒	-	1	1

Silva et al. (2014) suggested mixed results. They looked at a teacher residency programme (known as the Teaching Quality Partnership Grants Program), which works in partnership with local school districts and universities where prospective teachers complete a coursework with supervised fieldwork experience teaching in a school for at least a year (known as the period of residency). It recruits highly qualified individuals, either recent graduates or mid-career professionals, to teach in high-need schools under the guidance of an experienced teacher. In exchange for teaching full-time in the high need school for a minimum of three years, TRP residents receive a living stipend or salary. The sample included 390 residents who were surveyed and 406 mentors. Another 435 novice teachers who had completed the TRPs were also surveyed together with 376 teachers from other programmes. To control for differences between TRP and non-TRP teachers (TRP teachers were intended to be placed in high-need schools), school characteristics and subject taught were controlled for. In an update (Silva et al.2015), the authors tracked the first cohort of residents from their first to their third year of teaching, for 377 TRP teachers and 376 non-TRP teachers. The results are mixed. The data shows that there is no difference in the retention rates of TRP and non-TRP teachers within district (89% and 87% respectively) and within schools (77% for TRP and 79% for non-TRP). But looking at new teachers only, TRP teachers were more likely to stay in the same district than other non-TRP teachers (82% vs 72%). There is no difference in retention rates within school for TRP and non-TRP novice teachers. Teachers who moved schools were more likely to move to higher performing schools with a smaller proportion of ethnic minority children. Although the authors controlled for school characteristics, individuals who opted for TRP may be different to those who did not in terms of motivation. These confounding factors were not accounted for. The evidence is therefore rather weak.

Boyd et al. (2012) compared the Maths Immersion Programme with traditional certification and Teach for America (TFA). Compared to their traditionally prepared peers, immersion teachers were more likely to leave teaching in NYC (ES=- 0.14) although less so than TFA teachers (ES=-0.3). They were also more likely than traditionally prepared teachers to transfer or leave their school (ES=- 0.2). TFA teachers were more likely to leave teaching after four years but less likely to leave their schools. This is a large study using administrative data.

Teacher development and support

This section looks at studies of teacher development including mentoring for inexperienced teachers and induction for early career teachers (Table 9). The weaker studies are disproportionately positive whereas the strongest studies have

negative outcomes. This is not unusual in social science (Gorard et al. 2017).

Table 9 – Number of studies with quality rating: Teacher support and retention

Quality of study	Positive outcome	Unclear/mixed outcome	Neutral or negative outcome
3🔒	-	-	2
2🔒	10	1	-

Glazerman et al. (2010) conducted a three-year randomised control trial of a comprehensive teacher induction programme in Princeton, New Jersey (US). They found that the extra induction support for treatment teachers did not translate into impact. For teachers who received either one or two years of comprehensive induction, there was no impact on retention. There was no impact on teacher retention within school, district or teaching profession for both one-year and two-year programmes over the first four years of the teachers' careers. This was one of the strongest studies using a randomised control design involving 1,009 teachers in 418 schools. Districts that had previous exposure to similar induction programmes to the one selected for the study were excluded, such as those that offered additional incentives, e.g. full-time mentoring or stipends for mentors. The mentoring programme consists of a year-long curriculum for beginning teachers that focuses on effective teaching. Mentors also arranged opportunities for mentees to observe experience teachers. In the second year monthly Teaching and Learning Communities were held where mentors and mentees met for peer support and to discuss aspects of classroom instruction. In the second year, beginning teachers also received between 35 and 42 hours of professional development.

A randomised control evaluation of an induction programme for beginning teachers in the Netherlands also showed no clear effect on teacher retention (Helms-Lorenz et al. 2016). The aim of the programme was to reduce teacher workload, provide professional development, and support effective teaching classroom behaviour. It involved 71 schools with 338 beginning secondary education teachers who were randomly allocated to an experimental condition (which were offered the induction arrangements) or a business-as-usual control group. Because schools routinely provide beginning teachers extra support, control teachers also received some induction albeit only for a maximum of one year. Experimental teachers, on the other hand, followed the programme for three years under controlled condition arranged by the schools, which included workload reduction and professional development. Both groups were similar in background characteristics. The results showed that three years later, 14% of the control group and 12% of the experimental group had left (ES=+0.076). Importantly, the study found the it was the lack of certification and the low teaching skills that most explained teachers leaving the profession.

Allen and Sims (2017) evaluated STEM Learning Network professional development courses intended to improve teachers' subject, pedagogical and career

knowledge, confidence and motivation. They used retention data of teachers from England's Department for Education (DfE) School Workforce Census. This was matched with the National STEM Learning Network to identify teachers who participated in the CPD courses. The authors used propensity score matching, matching participants with non-participants by known characteristics. To control for unobserved differences, comparisons were made between those who participated in 2010 with those who participated later. The authors argued that these individuals were therefore more likely to be similar in terms of motivation and career plans. Further analyses were also made comparing science departments in schools before and after the treatment. The study suggests that taking part in National STEM Learning Network professional development is associated with an increase in retention in the profession as a whole. The odds that a participant stays in the profession one year after completing these courses was around 160% higher than for similar non-participants, and the positive association is sustained two years later for recently qualified teachers. Using the more rigorous double-difference and triple-difference models that takes into account factors that are not included in the demographic and background measures, the positive association is maintained. However, there is no evidence that completing CPD courses improves retention within the schools that teachers were working in at the time of participation.

Cohen (2005) used administrative data for 51,811 US public school beginning teachers comparing whether they had received a formal induction programme or not, and their perceptions of workload and classroom support. They correlated these variables with whether teachers stayed on the following year. Analysis on teacher induction was based on 3,172 new public school teachers. This indicated that teachers who left reported less mentoring than stayers (effect size 0.12) and less supportive communication (effect size -0.04) and less common planning (effect size 0.11). Higher workload reduction levels did not relate to turnover.

De Angelis, Wall and Che (2013) found that having more comprehensive mentoring and induction support significantly decreased the odds of new teachers changing districts and leaving the profession after one year. Quality of teacher support was based on teachers' self-report of their perceptions. It is therefore possible that teachers who were more likely to leave or had no intention to stay in teaching were more likely to report less favourable perceptions of programme quality.

De Jong and Campoli (2018) analysed the observational data from the 2007-2008 Schools and Staffing Survey (SASS) to see if the use of curricular coaches is associated with teacher retention. Curricular coaching provides new teachers with the techniques to incorporate evidence-based instructional methods in their local context. Using multinomial logistic regression analysis they compared the likelihood of teachers leaving profession, staying or moving school of those who had a curricular coach and those who did not. They found that early career teachers in a school with a curricular coach was less likely to leave the profession (relative risk ratio = -.52). The effect was stronger for first year teachers, but much less so for second and third year teachers. However, having a curricular coach did not have an influence on early career teachers'

decision to move school. It is possible that this was the period of economic recession when there is less incentive to change profession.

Glazerman and Seifullah (2012) evaluated the Chicago Teacher Advancement Program (TAP), a teacher development and compensation programme. The implementation of the programme was staggered across all schools with schools randomly assigned to implement sooner or later, creating comparison group for analysis. Teacher retention was measured by comparing the retention of a matched sample of over 2,600 teachers in Chicago TAP and conventional public schools. In this programme teachers and mentors met weekly in their "cluster groups". Teachers were also given performance incentives and had the opportunity to assume leadership roles. The results showed positive effects on school retention only for the first cohort but the effect was not consistent across cohorts. More teachers from the first cohort returned to their same school three years later compared to teachers in non-TAP schools, an impact of nearly 12 percentage points. In other words, teachers in Chicago TAP schools were about 20% more likely than teachers in comparison schools to be in those same schools three years later. For teachers in schools that started the Chicago TAP in later years, the impact was not obvious. There was some evidence of impacts on retention for subgroups of teachers, such as those with less experience, but the pattern of findings was not consistent.

A correlational study using a nationally representative sample showed a positive correlation between participation in induction/mentoring programmes and the likelihood of teachers leaving or moving school. However, it is not just having mentors, but having same-subject mentors that mattered (Ingersoll and Smith 2004). Having mentors from different subject areas had no influence on beginning teachers' decision to leave. The study analysed data from the School Staffing Survey (SASS) and the Teacher Follow-up Survey (TFS) which included a sample of 3,235 beginning teachers in their first year of teaching. The survey asked teachers about their participation in any form of induction programme including mentoring, CPD, collaboration with other teachers and support. The multiple kinds of support included in these induction programmes meant that it was not possible to isolate which of these were most effective. Although the authors controlled for school and teacher effects, it was unable to control for unobserved differences between teachers and schools. Because those who received mentoring and those who did not were not randomly allocated, there may be inherent differences between these two groups. It could be that schools or districts that offer mentoring support are generally more supportive of their teachers, or have better working environment.

Latham and Vogt (2007) compared the retention propensity of 506 elementary education graduates in Illinois who had opted to undertake teacher preparation in a professional development school (PDS) with another group of 559 traditionally prepared graduates matched on demographic characteristics. The authors claimed that those trained in PDSs were more likely to stay in teaching for longer (about 0.25 of SD more than those who did not). Recall that the PDS group were self-selected and hence are likely to be different to those not in the non-PDS group. PDS is defined as having elements

of field placement, onsite coursework and professional development.

Papay et al. (2012) found that graduates of the Boston Teacher Residency Programme were less likely to leave teaching in the first year (12%) than other new Boston public school teachers (27%). By the fifth year retention rates among BTR teachers were still higher than other public school teachers in Boston (49% vs 25%). However, it has to be mentioned that BTR teachers were committed to teach in Boston for three years after their residency year or pay a penalty equivalent to the programme tuition fees of up to $10,000. They were more likely to stay until their fifth year, and did not leave suddenly after their third year when their commitment had been fulfilled.

Ronfeldt and McQueen (2017) drew on the SASS, TFS and BTLS data to investigate whether different kinds of induction supports predict teacher turnover among first-year teachers. To mitigate against unobserved factors, the authors compared teachers to demographically similar teachers who had experienced different support (using propensity score matching to find teachers with similar characteristics). Propensity scores of 1,600 teachers receiving extensive induction (i.e. 4 to 6 induction supports) were matched with 1,130 teachers not receiving extensive induction (i.e. 0 to 3 types of support). Unlike previous studies that focused on only one cohort, this study looked at three recent cohorts of teachers. In total there were 13,000 across the three waves. Of these only 2,340 were first year teachers that could be linked to both teacher and school characteristics. The authors correlated the level of induction support with teacher outcomes (leaving school and leaving profession). Multilevel regression models were used to estimate the likelihood of teachers leaving schools in their second year. The results showed a negative correlation between the number of combined induction supports and teachers' likelihood of leaving school or teaching in their second year and across five years. Receiving extensive induction supports reduced migration by 5% compared with not receiving extensive induction supports. Of all the induction supports, supportive communication with school leadership had the biggest impact, reducing the odds by 55% to 67%. Every additional induction support is associated with an average decrease in the odds of leaving teaching by between 18% and 22%. One major limitation of this study is that the measure of induction is based on teacher self-report and this is prone to reporting biases.

Speidel (2005) evaluated a teacher development programme in the Volusia County Schools, Florida designed for teachers of students with special needs. The programme is known as the Skills, Tips, and Routines for Teacher Success (STARTS) initiative. The study utilized data on the employment histories of 771 new special needs teachers for school years 1998/99 to 2003/2004. Of these 349 teachers participated in STARTS and the other 422 did not. The findings suggest that the programme makes a positive difference in the retention rate of teachers who took part in STARTS. However, there were no controls for differences between the two groups of teachers. There were other variables that might have been in play with respect to teacher retention, that were not accounted for.

An older study evaluated the California Mentor Teacher Program which was developed to retain experienced teachers

and to assist new teachers in the transition into teaching (Weisbender 1989). Under this scheme highly talented classroom teachers (mentors) were given the incentives continue teaching and to use their instructional expertise to mentor their peers and new teachers (mentees). The study included 336 mentors and 638 of their mentees in 240 schools and 46 retirees in the Priority Staffing Program serving 46 schools. Personnel records and questionnaires over a 5-year period were collected to assess the length of time each cohort stayed in the district. Comparisons were made between mentors and a matched group of non-mentors. Results varied from cohort to cohort. There was no benefit for retention of the first cohort, with non-mentees being more likely to stay within the school district compared to mentees. With the subsequent cohorts mentees were more likely to stay compared to non-mentees. On the other hand, mentors were also more likely to leave over the 5-year period than non-mentors. Although comparison mentors were matched, the selection of highly effective teachers suggest that the two groups may not be equal. As Shifrer et al. (2017) noted, it may be the case the high performing teachers can find jobs more easily and are therefore more mobile.

Financial incentives

The evidence on incentives for retention is much more mixed than for recruitment (above). Fewer than half the studies suggest clear benefits, and these are all of the weakest kind included in the summary (Table 10). All of the stronger studies do not suggest clear benefits.

Table 10 – Number of studies with quality rating: Financial incentives and retention

Quality of study	Positive outcome	Unclear/mixed outcome	Neutral or negative outcome
3	-	3	3
2	9	4	4

The large study by Rosen (2012), discussed more fully in the recruitment section above, found no clear evidence that districts offering incentives had higher teacher retention, at least after the first year.

Shifrer, Turley and Heard (2017) looked at whether actual receipt and the amount of performance pay award in an urban school district as opposed to eligibility made a difference to teachers' decision to leave or stay. Using the difference between a large and a small award as the cut-off threshold, they conducted a regression discontinuity analysis using census data for 12,000 teachers although they focused only on 3,363 teachers. Teachers in the top quartile of value-added scores were rewarded with a large award and teachers with a value-added score in the second quartile a small award. They analysed the amount of award rather than eligibility. Their analysis showed that likelihood of retention was slightly higher for teachers who received a small award rather than no award. However, this study found that teachers who received a large award were less likely than teachers who received a small award to be retained in the district. Perhaps teachers in receipt of a large

award are high performing teachers who can easily find better paid jobs elsewhere.

Springer, Swain and Rodriquez (2016) evaluated the US$5,000 retention bonus program for effective teachers in Tennessee's Priority Schools (high poverty, high minority schools). The study showed that the bonus incentive did not increase the retention of Level 5 (Diploma in Education and Training) teachers, but increased the retention of teachers in tested subjects and grades. This was a quasi-experimental study using a regression discontinuity design exploiting the sharp cutoff in a teacher's overall evaluation rating that determines eligibility for the retention bonus in participating schools. Nationally representative administrative data supplemented by county-level economic data and data from the TVAAS and Tennessee's online teacher evaluation platform, CODE (contains value-added estimates for teachers) were utilised for the analysis. The sample included all teachers working in Priority Schools in Tennessee during the 2012– 2013 school year. Of the 82 eligible schools, 56 employing 2,005 teachers elected to participate.

Steele et al. (2010) evaluated the Governor's Teaching Fellowship (GTF) scheme, involving a $20,000 incentive to attract new teachers to low-performing schools. Teachers had to repay $5,000 for each of the first four year that they did not meet the commitment. There was no difference in retention rates (75% over four years) between recipient and non-recipients, despite the penalty clause.

Two reasonably strong studies found no impact. Clotfelter et al. (2008) evaluated the North Carolina bonus incentive scheme aimed at keeping qualified teachers teaching targeted subjects in high poverty or academically challenging schools. The scheme was in the form of an annual bonus of $1,800. Teachers were eligible only if they taught in an eligible school, and they continued to receive the bonus as long as they stayed in the same school and taught the same subjects. Using a difference-in-difference approach, the authors compared hazard rates before and after the implementation of the bonus programme; eligible and ineligible teachers in the same schools; The third difference-in-difference is a hybrid of a randomized experiment and a regression discontinuity design. Experimental schools were those with over 80% percent of students in a school who were eligible for subsidised lunch and over 50% of pupils who failed maths (algebra) and science (biology) across the 4 years (2 years prior to the programme and the first 2 years of the programme). Control schools were those which were near the threshold of eligibility and hence missed out on the bonus. Comparison was made with teachers across eligible schools and those in schools that narrowly missed out based on the threshold eligibility. The results showed that teachers receiving a bonus were 15% less likely to leave at the end of the school year compared to other teachers in the same school. This increased to 17% after controlling for subject taught. A 10% increase reduces the probability of teachers leaving by 1-4 % points. But this reflects patterns already in place even before the programme was introduced. Including the school fixed effects in the regression the effect was negative. Overall, the results suggest that the bonus incentive did not reduce turnover rates. However, it is not clear whether this is because the $1,800 bonus was not large enough or is it because there was a flaw in

the design and implementation of the program. The implementation was flawed because not all teachers who were eligible actually received the bonus. Survey responses from principals and teachers indicated that the $1800 bonus alone was not enough to retain teachers. They suggested that administrative support, improving school conditions and facilitating professional development might be better options.

A cluster randomised control trial examined a school-wide performance bonus scheme that provided performance bonuses to school staff based on their schools' progress reports (Fryer 2013). Participating schools were given a lump sum incentive on $3,000 per full union teacher. Schools could decide to award a subset of teachers with the highest value-added or divide among teachers by lottery. However, schools were not allowed to distribute rewards by seniority. In the study, the majority of schools decided on group incentives. Data on students and teachers from 396 high-need public elementary, middle, and high schools from 2007-08 through 2009-10 were analysed. Schools were selected based on some criteria, e.g. level of poverty. Of these schools, 233 were randomly assigned to the intervention group and 163 to the comparison group. The study estimated the effects of the bonus program by comparing the outcomes in schools that were offered participation in the program - even if they ultimately declined to participate - with the outcomes in schools that were not offered the opportunity to participate. Because some of the schools that were eligible to participate in the bonus program did not ultimately participate, the study estimated both an intention-to-treat (ITT) estimate of the effect of being eligible to participate in the program, as well as a "treatment on the treated" estimate of the effect of participating in the bonus program. Both results showed that the teacher performance bonus program had no effect on teacher retention. Some reasons were suggested for the nil effect. These included incentives not being large enough, incentive scheme was too complex and group-based incentives may not be effective.

Bueno and Sass (2016) found that the salary compensation only had a short-term effect on the retention of teachers. Comparing teachers who were eligible with those who were not, the rate of attrition was lower for bonus recipients in the first five years compared to non-recipients, but not after five years when teachers stopped receiving the bonus. Working and living conditions, lack of community engagements were reported to be important factors in teachers' decision to stay or leave.

Falch (2010, 2011) looked at whether giving teachers a higher salary would make them more likely to stay in teaching. The study is a natural experiment taking advantage of changes in the wage system in Norway over a nine-year period (1993/94-2002/03). Over that time, teachers in schools with high teacher vacancies were eligible to receive a wage premium of between 7.5% and 12%. As the eligibility criterion is the proportion of vacancies, the number of schools was not the same over the nine-year period. Schools that received a wage premium at least once over the nine-year period were designated as "experimental" schools. In total there were 161 treatment schools. Of these 104 received wage premium for less than four years. The study used a difference-in-difference approach, to

estimate the probability of a teacher leaving school by comparing the turnover rates before and after wage premium was introduced. The wage premium reduced the probability of quitting a school by 4.8 percentage points. Taking into account school district characteristics, the effect of the wage premium increased to 5.8 percentage points. Put another way, teachers receiving the wage premium were 3.5 times less likely to leave. The wage effect was found to be larger for males and for the married teachers than for females and unmarried. Teachers' age and whether they have children or not also affect the size of the effect. Overall, there was no impact of retention for younger teachers, and female teachers were less responsive to wage increases than older and male teachers.

Feng and Sass (2015, 2018) evaluated the Florida Critical Shortage programme, a state-wide programme to increase the supply of teachers in shortage subjects (special education, maths and science). The study evaluated the effects of two components of the scheme on teacher recruitment and retention. The loan forgiveness component of the programme was targeted at beginning teachers teaching in shortage areas where teachers qualified in that subject were given up to $10,000 to pay off their student loan if they continued to teach in shortage subjects for at least 90 days. The other component of the programme was the one-off retention bonuses for teachers teaching certain subjects and grade levels. Retention bonus was capped at $1,200 per teacher. To be eligible teachers would have taught in a shortage area, agreed to continue teaching that subject the following year and have had a favourable performance appraisal. Using difference-in-difference and instrumental variable approaches, the authors compared the probability of attrition and recruitment of eligible and non-eligible teachers for each shortage subject. The effect of loan forgiveness was estimated by comparing changes in retention of eligible teachers when a subject was designated as a shortage subject with those of non-eligible teachers over time. The results showed that loan forgiveness reduced the probability of overall attrition by 12% (10% for maths and 9% for science teachers). The effect disappeared when the funding was reduced. The one-off retention bonus resulted in a reduction of likelihood of shortage subject teachers leaving by 25%. This was for retention in Florida but not in the school they were currently teaching.

Fitzgerald (1986) showed that the impact of the High Priority Location Stipend Program on retention was short-lived. Only the differential retention rate in the first year after implementation was notable. No differences were found in the following years. Staff who left indicated that while they were appreciative of the incentives, they did not think the stipend was high enough. Their main concerns were the working conditions, discipline in school, management support and admin/teacher relations. Control teachers also indicated that they would be happy to work in the high priority areas if student discipline, working conditions and admin/teacher relations were improved.

Another type of financial inducement is pension enhancement to encourage teachers to stay until their retirement. Koedel and Xiang (2017) examined one such scheme used in St Louis, Mississippi. The researchers used a six-year administrative panel data from the Missouri Department of Elementary and Secondary Education (DESE) covering the

school years 1994–95 through 1999–2000 for the empirical analysis. Using a difference-in-difference model they compared the likelihood of eligible teachers (i.e. those retiring after June 1999) with those not eligible. The pension formula was implemented retroactively so that individuals who retired under the enhanced rules had the higher rate applied to all service years. This resulted in a 60% increase in pension wealth for the eligible teachers. Enhanced pension was effective only in delaying the retirement of teachers who were a year close to retirement. No retention effects were detected for other groups.

The Talent Transfer Initiative was linked to increased retention of teachers (Glazerman et al. 2013). Retention after one year was 93% (70% in the comparator group), and 60% after two years (compared to 51% in the comparator group). The results suggest that while the transfer incentive may have had a positive impact on teacher recruitment and retention during the payout period, the effect did not last or was weaker once the payment stopped.

Murnane and Olsen (1990) used a longitudinal dataset that provides information on the career histories of 13,890 North Carolina teachers. Regression models were developed using a number of key explanatory variables to predict the length of stay in teaching. Results of the analysis indicated that salaries have an important impact on length of stay in teaching. A $1,000 increase in each step of the salary scale (measured in 1987 US Dollars) is associated with an increase in median duration of two to three years for a teacher starting their career in 1970. The findings suggest that a uniform salary scale may not work in retaining teachers in fields such as chemistry and physics that are in demand in business and industry. This echoes the findings of other studies which found that for financial compensation to be effective it has to be large enough to cover the differential salary that teachers would get if they had not gone into teaching.

Springer et al. (2010) evaluated the District Awards for Teaching Excellence (D.A.T.E), which is a state-funded incentive pay award in Texas that provided grants to districts for the implementation of locally-designed incentive pay plans. All districts in the state were eligible to receive grants, but participation was voluntary. D.A.T.E. was implemented towards the end of other incentive pay programmes in Texas, such as the GEEG (Governor's Education Excellence Grant) and the TEEG (Texas Education Excellence grants). The average award for teachers in districts with district-wide plans was $1,361, while the average total award for teachers in districts with select school plans was $3,344. The study showed that the probability of turnover among teachers who did not receive the incentive award increased, while it fell sharply among teachers who did receive such an award. The size of the award also matters. In districts with relatively small maximum awards, turnover increased, and decreased as the proposed maximum amount increased until it exceeds $6,000 beyond which it makes no difference. Larger awards are needed for some schools to reduce teacher turnover. However, not all districts and not all schools were eligible for participation, although it is not clear what the eligibility criteria were. Therefore, comparing the turnover rates of teachers receiving D.A.T.E. or not, may not be a fair comparison as the factors that exclude them for eligibility may be relevant to

teacher turnover. However, looking at the size of the award maybe a better comparison.

In a pilot study, Springer and Taylor (2016) found mixed effects on a pay-for-performance program (Governor's Educator Excellence Grants/GEEG) in Texas. The Texas GEEG programme, was a three-year programme involving 100 schools (analysis performed with 94 schools), identified as the highest-poverty, high-performing schools in the state, which were awarded non-competitive grants ranging from $60,000 to $220,000 each year for three years. The individual award for each full-time teacher was between $3,000 and $10,000. Data on teacher turnover for six academic years was taken from administrative records of the Texas State Board for Educator Certification (SBEC). Data on other nonwage school, district and location characteristics came from the TEA, the National Center for Education Statistics, and the U.S. Bureau of Labor Statistics. The results showed that among beginning teachers, turnover was higher in schools with only individual incentives than in schools with only schoolwide incentives, but only in the first year. No differences were detected in subsequent years. The opposite was true for experienced teachers where turnover was lower in schools with school-level incentives than in schools with a combination of individual and school level incentives in the first year, but the pattern was reversed in the second year. No differences were detected between school and individual level incentives in the third year.

Booker and Glazerman (2009) evaluated the Missouri Career Ladder (CL) Program to test the effect of an incentive on teachers at different stages of their career. The theory is that teachers at different stages of their career may be differentially motivated by incentive payments. Based on their performance-level eligible teachers received supplementary pay for spending a certain amount of their time on certain responsibilities or professional development outside their contracted hours. Teachers were observed and evaluated as they moved up the career ladder in three stages. The amount of bonus was also related to the length of teaching experience. For each stage teachers received more supplementary pay up to £1,500 for Stage 1, £3000 for Stage 2 and £5000 for Stage 3. Around 26% (or 17,000) of teachers in Missouri took part in the programme during the 2005/06 period. The effects of the programme were estimated by comparing the retention rates of teachers in districts offering the Career Ladder incentive with similar teachers in non-Career Ladder districts. To account for unobserved differences statistical controls for measured variables (using propensity score matching of observable characteristics) and instrumental variables for unmeasured factors were used. The programme was shown to be effective in retaining teachers within the district, and in the profession. However, controlling for observable differences such as wealth, size and population density using regression modelling, there was no difference in retention rates between CL and non-CL districts. Using IV controlling for district selection into CL participation, teachers in CL districts were less likely to move to a different district. The model predicted that after 10 years teachers in CL districts were less likely to move compared to similar teachers in non-CL districts (81% remain vs 77%). The oldest teachers (after 11 years and receiving the biggest bonuses) were half as likely to move compared to their

non-CL peers. It was more effective in retaining younger teachers in the profession but not necessarily in the district. The findings suggest that incentive payments need to exceed 25% of teacher salary to neutralise the effects of turnover in hard-to-staff urban schools. One complication is that this programme also had an element of enhancing teacher autonomy where teachers were empowered to design their own work plan. Therefore, it is not clear how much of the effect was due to the incentive and how much was the result of teachers' enhanced autonomy.

Fulbeck (2011) examined whether offering higher salaries to teachers in areas of high deprivation would increase their retention rate in Denver, US. This was a quasi-experiment using interrupted time-series and difference-in-difference regression models to analyse the impact of Denver's Professional Compensation for Teachers Program (ProComp), a teacher incentive programme that awards salary increases and/or annual incentives to teachers who meet a range of requirements, such as having advanced qualifications, complete professional development, teach in a hard-to-staff school or shortage subject and work at a high-achieving school. ProComp had been championed by Barack Obama as a model for teacher compensation reform. The ProComp hard-to-serve incentive initiative (HTS) is one of 10 financial incentives aimed at retaining teachers in schools with a high proportion of poor students. The number of teachers under the scheme was between 3,900 and 4,200 each year. Panel data, teacher interview data, and data on school characteristics were taken from Denver Public School and ProComp school-level information. The study compared the retention rates of teachers before and after ProComp. It reported that participation in ProComp increased retention rates by 2.1 percentage points. Regression analysis showed that ProComp accounted for 2.5% of the variation in changes in retention rates. ProComp is reportedly more effective in challenging schools at or above average participation (ES = 0.30), but less meaningful for non HTS school (ES = 0.05). The findings are really difficult to interpret as the graphs seem to contradict the findings reported. For example, Fig. 4.2, p. 113 shows that high participation schools had lower retention rates compared to low participation schools. The author explained that this could be the higher number of new teachers in high participation school, who were more likely to leave in the first few years of service. Figure 4.3 shows that retention rates of HTS are similar to those of non-HTS schools and Figure 4.4 suggests that Pro-comp is effective in reducing retention in non-HTS schools but not HTS schools. There were a number of factors that could have influenced the findings. For example, the period coincided with the economic recession (Isidore 2008) and it was also the year when the HTS incentive came in.

Fulbeck (2014) used multinomial hierarchical regression modelling of data taken over a year to estimate the risk of teachers moving within district and moving out of the district by comparing the hazard rates of teachers who received ProComp with those who did not, and also between teachers who taught in high poverty schools with those who did not. The results of the analysis showed that receipt of ProComp reduced the odds of teachers leaving the district, but did not reduce their likelihood of moving out of schools within the district. This relates only to those who volunteered to participate in ProComp and received the $5,000+ incentive. There was

no effect on those who volunteered but did not receive the incentive. These are likely to be teachers who did not meet the eligibility criteria in terms of performance and knowledge/skills. However, ProComp was not effective in high poverty schools. In other words, ProComp did not compensate for poor working conditions, school leadership and climate.

Choi (2015) showed positive effects of Q Comp for retention only in schools with five years of implementation compared with schools that did not have Q Comp for five years (6.3 percentage points higher). There was no benefit for charter schools (retention rates 10.5 percentage points lower than other schools). The study examined the effect of the Quality Compensation program (Q Comp), an alternative teacher compensation program (ACPs) on teacher retention. Under this programme teachers' pay were based on their performance, measured in terms of student achievement, leadership, professional knowledge and skills, and instructional behaviour. The study used a difference-in-difference-in-difference approach and analysed data for 12,708 teachers and 1,734 schools over 8 years. Teacher retention was calculated by comparing the list of teachers in two subsequent years. Teachers who were on the list on both years were considered as stayers. Retention rates were estimated for teachers teaching academic core subjects and teachers with 3 or more years of experience. Multiple regression analysis was performed to control for variables that might be associated with retention. To control unobserved time-variant variables across schools, a fixed effect model was used.

One study in England looked at whether pay reforms in England where schools are given the freedom to set pay based on performance rather than seniority have impacted on teacher retention. Anders et al. (2019) compared three groups of schools – the positive adopters where pay progression on average was faster than pre-reform seniority-based salary schedule; negative adopters where pay progression was slower than expected under pre-reform; and mean-zero adopters where pay progression was as expected under pre-reform pay schedule based on seniority. Using a difference-in-difference framework the authors estimated the effect of pay reforms on teacher retention, using adopters as treatment groups. The effect of the reform increased teachers' pay at positive adopter schools by 4% while pay of teachers in negative adopter schools fell by 3%. However, there were no effects on retention.

Dee and Wyckoff (2013) reported that IMPACT, a performance incentive for retention of public school teachers in the District of Columbia, had been successful in removing low performing teachers and retaining high-performing teachers. Teachers were evaluated on a multifaceted measure of teacher performance. Based on these evaluations low-performing teachers may be dismissed and high performing teachers receive large financial incentives. The financial incentives included one-time bonuses of up to $25,000 and permanent increases to base pay of up to $27,000 per year. The study employed a regression discontinuity design that compared the retention and performance outcomes among 4000 low-performing teachers whose ratings placed them near the threshold that implied a strong dismissal threat. The study also compared outcomes among 2000 teachers who had IMPACT scores just above and just

below the threshold between Effective and Highly Effective. At the threshold of being labelled minimally effective versus ineffective, voluntary attrition for minimally effective teachers increased 50%. For high-performing teachers, financial incentives did not improve retention.

Hendricks (2014) compared attrition of teachers in districts which award teachers via pay for year of experiences, with districts that do not. Districts differ in terms of labour and market outcomes. Districts that award pay increases by years of experience may already be experiencing high attrition of more senior teachers. However, the study found no relationship between teacher pay and turnover.

Hough and Loeb (2013), described above, found no difference in the retention rates of targeted and non-targeted teachers for higher salaries/bonuses. Over 90% of teachers stayed on in the district and over 85% stayed in their school, in both groups. The comparison is made difficult because of the economic downturn in 2008 when unemployment was high. A retention bonus might be more effective in a more competitive labour market.

Teacher accountability

Three further studies looked at stress and accountability. Reducing these does not seem to have a clear benefit on retention, but the evidence base is particularly weak here (Table 11).

Table 11 – Number of studies with quality rating: Teacher accountability and retention

Quality of study	Positive outcome	Unclear/mixed outcome	Neutral or negative outcome
3	-	-	-
2	-	2	1

High stakes tests which increase teacher accountability are a reported source of stress. Fuchsman, Sass and Zamarro (2020) took advantage of a policy change in Georgia, US in 2011 when testing was removed for Grades one and two and from 2017 onwards when testing for science and social science were removed for Grades 6 and 7. Data was taken from Georgia's state-wide longitudinal database, Georgia's Academic and Workforce Analysis and Research Data System (GA•AWARDS). GA•AWARDS combines data from all educational agencies in Georgia as well as unemployment insurance (UI) records. Using a difference-in-difference analysis, the study. compared the attrition rates of teachers in grades one to eight, before and after testing and with teachers in other grades where testing had not been removed. The study found no impact on teachers' likelihood of leaving teaching, changing schools within a district, or moving between districts. However, there is a reduction in the probability of early-career teachers leaving the profession when testing requirements were relaxed. In particular, the average probability of exit for teachers with 0-4 years of experience fell from 14 to 13 percentage points for teachers in grades 1 and 2 and from 14 to 11 percentage points

in grades 6 and 7. Although comparisons were made before and after testing, the comparisons were not between similar groups.

An important element of working conditions is school accountability. Under the No Child Left Behind Act (NCLB), schools were held accountable for the performance of minority ethnic subgroups only if the number of students in those subgroups exceeded a minimum subgroup size. In North Carolina the minimum subgroup size was set at 40. Shirrell (2014) used the threshold of 40 subgroup students for a regression discontinuity analysis to compare schools on either side of the threshold before and after NCLB. The effect of accountability was estimated by the jump in teacher attrition at the cut-off of 40. In addition, a difference-in-difference analysis was used to compare teachers of different ethnic sub-groups to series of ordered logistic regressions to investigate changes in student teachers' career plans during student teaching, and the associations between these changes and the working conditions of student teaching schools. Student teachers were surveyed twice, once before their student teaching began and once after student teaching was complete. This showed that challenging working conditions generally do not predict the direction of changes in student teachers' career plans, although some evidence suggests that worse working conditions in student teaching schools are associated with decreases in the lengths of time student teachers plan to teach during their careers. The evidence for this part of the study is weaker because there is no counterfactual. Overall, there was no evidence that working conditions and accountability had any effect on attrition of ethnic minority primary school teachers.

account for differential response by teachers to accountability. The increase in pressure as a result of accountability had the opposite effect on Black teachers' attrition. Black teachers in schools that were held accountable for the performance of the Black student subgroup left teaching at significantly lower rates than Black teachers that taught in schools not accountable for the Black subgroup's performance. Accountability for the White subgroup, in contrast, had no effect on Black or White teachers. One reason suggested could be that Black teachers were more likely to be paired with minority ethnic pupils and it is possible that these teachers were motivated to stay on in the school seeing that the schools were taking action to address the achievement gap between Black and White students. A second part of the study used survey data from student teachers in a large urban district and a

Jones (2013) used an instrumental variable approach to estimate teacher turnover under performance pay incentives for maths and English teachers (an accountability system), employing nationally representative datasets. The instrumental variable is the distance from an undergraduate institution to the nearest performance pay district. Teachers in performance pay districts earned a salary that was $2,825 less than their counterparts in non-performance pay districts and the performance pay may be used to compensate for the difference. Data from Teacher Follow-up Survey, showed that performance pay was not considered as the most important reason for teachers' decision to leave. Because the sample consisted of only 64 teachers caution is urged in interpreting this result. Since the performance pay incentives were rewarded at the school level, this finding

may also suggest that other teachers were free-riding on the efforts of Math and English teachers. In summary, the evidence on retention is not clear. The author cautioned against generalising performance pay incentive as implementation can vary between districts. For example, performance pay was more effective in reducing turnover when it was implemented on a school level than on an individual level, and male teachers also responded more positively than female teachers to performance pay.

Conclusions

Financial incentives are less clearly useful for encouraging retention than they are for the recruitment of teachers. The included studies above highlight the range of financial incentives and initiatives that have been used to try and retain teachers. The findings indicate a mix of positive and negative outcomes, with the strongest studies tending to suggest that incentives do not work, or do not work easily, to improve retention. Where a randomised trial has been possible, or where large studies can control for context, there appears to be no benefit. Even for studies with more positive results, there are strong suggestions that retention is only improved while the incentive is applied. If they are temporary, then teachers may be just as likely to leave once the incentives come to an end, resulting in a relatively short-term solution and not one which is likely to improve the teacher shortage crisis substantially. The use of discriminatory incentives may even worsen overall retention. There is also some evidence that incentives have to be substantial. Eligibility for an incentive, or a small incentive seems to make little difference.

The continuing development and support of teachers is slightly more promising. It is tempting to conclude that money gets them in, and professional development (perhaps including mentoring and support), keeps them in the profession. However, the results are more complex than that. The evidence for mentoring and professional development is uniformly positive for mentees but is not of the strongest quality (2🔒 at best). Research indicates that, for secondary teachers, mentors from the same subject may well provide positive outcomes. There is little evidence on induction for new teachers, and for differing routes into and preparation for teaching, and where it does exist the findings are mixed and sometimes unclear. The strongest studies find little or no impact. Those with positive findings often have a combination of activities in the intervention making it unclear which are the 'active' elements in any success. Some of these studies also use 'intention' to stay in the profession as an outcome rather than actual attrition figures.

There are only three evaluations of at least 2🔒 quality looking at other factors. These attempt to examine issues relating to accountability and working conditions, more broadly. Higher accountability (and so responsibility) may actually improve retention but only for groups of teachers with shared characteristics with the students they are responsible for. Dealing with high stakes tests can be stressful for teachers and some may argue that such pressure to produce results may cause teachers to quit. One study shows that removing these high stakes exams does

not seem to make a difference to the retention of established teachers. There is only one study each on accountability and high stakes exams. Replication of these studies will be needed to increase our confidence in the effects.

DISCUSSION

In summary, financial incentives seem promising for attracting new teachers into teaching. Monetary inducements also appear to be effective in increasing the number of teachers in challenging schools with a high proportion of poor or disadvantaged children, but the effect is greater for high performing schools and schools with lower proportions of disadvantaged children. However, for financial incentives to work, they have to be large enough to compensate for the challenges of working in certain schools or areas, or to compensate for the salary that teachers would receive if they had been in comparable profession. This is especially so for shortage subject teachers like maths and science where, as graduates from these subjects, they might command a higher salary in the labour market.

In England bursaries are offered to trainees in secondary shortage subjects. The lower proportion of bursary holders in state-funded schools in England compared to non-bursary holders suggests that the bursaries are not attracting shortage subject teachers to state-funded schools. This may be because the bursaries are not large enough. It is also possible that individuals who were awarded bursaries do not eventually enter teaching because, unlike in many states in the US, there are no bonds or tie-ins to commit bursary recipients to teaching.

The effect of financial incentives is also not consistent across genders and age groups. Wage premiums, for example, are potentially more effective in attracting young female teachers than older male teachers, but more effective in retaining older male teachers.

While money may help in retaining teachers, the evidence is weak, and any effect is overall short-lived. When financial incentives are withdrawn or when the pay-out period ends, the retention effect seems to disappear. It is also important to note that in many of cases, monetary incentives work because teachers are required to commit to teach for a specified period as part of the contract agreement; in some cases, breaking this can result in them having to pay a penalty. This perhaps is a kind of enforced retention. Many of the correlational studies point towards the importance of factors beyond financial incentives. The promotion and implementation of good working conditions for staff are arguably significant for retention (and certainly important in their own right) but, more evidence is needed if policymakers are going to foreground these within decisions relating to recruitment and retention of teachers.

Another popular strategy to increase the number of teachers is by providing alternative pathways into teaching. Some of these may be viewed more favourably by applicants or may make it easier for them to gain certification. Teach for America and its international equivalents, as well as other school-based training such as School Direct, the Boston Residency

programme, School Centred Initial Teacher Training and the Troops to Teachers initiatives are examples of alternative routes into teaching. Our review, however, finds little robust evidence that alternative routes work in increasing the number of teachers largely because those who chose the alternative teaching programmes are self-selected.

The studies focusing on alternative pathways in to teaching highlight the myriad routes and options that potential teachers have in some countries or states. On the one hand this may be viewed as positive; different routes offer more choice, and perhaps open up the profession to those who otherwise would not have been able to enter it. However, by including different training routes and methods for certification, complexity is added to the recruitment system. Without high-quality information and clear evidence for the different pathways and what they involve, this choice may actually be confusing and off-putting to some. Studying 'alternative routes' into teaching and their impact on recruitment or retention is also difficult because there is such variation in what these approaches entail, who they are targeted at and recruit, and the extent to which they are actually different from the 'traditional' route on offer.

Irrespective of training pathway, inadequate induction and preparation for teaching has frequently been cited as a reason why teachers do not stay in the profession. Many countries are now turning to policies designed to improve the quality and quantity of induction and mentoring that new teachers receive as well as working to embed higher-quality professional development. The aims here centre around supporting teachers to effectively transition into classroom teaching, developing new knowledge and skills by working with experienced practitioners and engaging with ongoing professional learning throughout their career. Continuing professional development and mentoring look promising as an approach to retention but there are no strong studies in this area, so we cannot be definitive about this. There is no evidence, on the other hand, for induction as an effective approach to retention.

In England, the government has introduced the new Early Career Framework (ECF) with a view to providing teachers with early professional support, access to high quality professional training materials, curricula and mentoring. Based upon the positive findings relating to teacher induction and mentoring in our review, we are hopeful that this new policy approach may be beneficial for teachers. However, given the relative weakness of the studies in this area, it is difficult to be too certain at this stage. Robust evaluations of the ECF in its early years, however, would provide some much-needed evidence in this area and will be vital for informing ongoing iterations of the policy or those like it.

Evidence on improving working conditions as a strategy to improving teacher supply is weak because there are few robust studies. A number of studies attributed working conditions and school leadership support as important in retaining teachers. These are mainly correlational studies based on teacher self-report. Only two studies on accountability as a source of stress, which is related tp working conditions, are of sufficiently good quality. These two studies are not exactly the same – one was about removing high stake exams and the other was accountability for

the performance of minority ethnic groups. None have not replicated and so it is difficult to tell from just one study if these approaches work.

As with so many reviews, more work is needed. But of a specific kind. There is currently no good evidence base for using different routes into teaching (in terms of recruitment or retention), or even for induction and mentoring schemes. Because of the unbalanced nature of research so far, **the conclusion has to be that payment is the most promising way to recruit teachers, and to retain while the incentive operates, especially for hard to staff schools and areas**. However, there may be other approaches such as those listed at the start of the paper that would work just as well, and might be cheaper or based on greater intrinsic motivations. Apparently, no one has so far tested them robustly.

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APPENDIX A - SEARCH TERMS USED FOR EACH DATABASE

Database	Search terms	Number of hits
EbscoHost	teacher supply OR teacher demand OR teacher retention OR teacher shortage OR teacher recruitment AND initiative OR incentive* OR policy/scheme (TX All Text) AND experiment OR quasi-experiment OR randomised control* trial RCT OR regression discontinuity OR difference in difference OR time series OR longitudinal OR systematic review OR review OR meta-analys* AND impact OR evaluation OR effect	113 12 deemed relevant
ERIC ProQuest	teacher supply OR teacher demand OR teacher retention OR teacher shortage OR teacher recruitment (Anywhere) AND initiative OR incentive* OR policy OR scheme (Anywhere) AND experiment OR quasi-experiment OR randomised control* trial RCT OR regression discontinuity OR difference in difference OR time series OR longitudinal OR systematic review OR review OR meta-analys* (Anywhere) AND impact OR evaluation OR effect (Anywhere)	921 31 deemed relevant
JSTOR	teacher retention OR teacher shortage OR teacher recruitment (All fields) AND Experiment* OR quasi-experiment OR regression discontinuity OR difference in difference OR time series OR longitudinal OR review (Abstract) AND impact OR effect (All fields)	2,153 hits 8 deemed relevant

PsycINFO: • OpenDissertations • British Education Index • Education Abstracts (H.W. Wilson) • Educational Administration Abstracts • PsycARTICLES • PsycINFO	teacher supply OR teacher demand OR teacher retention OR teacher shortage OR teacher recruitment AND initiative OR incentive* OR policy/scheme AND experiment OR quasi-experiment OR randomised control* trial RCT OR regression discontinuity OR difference in difference OR time series OR longitudinal OR systematic review OR review OR meta-analys* AND impact OR evaluation OR effect	165 hits 6 deemed relevant
Web of Science	teacher supply OR teacher demand OR teacher retention OR teacher shortage OR teacher recruitment AND initiative OR incentive* OR policy/scheme AND experiment OR quasi-experiment OR randomised control* trial RCT OR regression discontinuity OR difference in difference OR time series OR longitudinal OR systematic review OR review OR meta-analys* AND impact OR evaluation OR effect	56 hits 1 non-duplicate deemed relevant
ProQuest Dissertations and Theses Global	teacher supply OR teacher demand OR teacher retention OR teacher shortage OR teacher recruitment AND initiative OR incentive* OR policy/scheme AND experiment OR quasi-experiment OR randomised control* trial RCT OR regression discontinuity OR difference in difference OR time series OR longitudinal OR systematic review OR review OR meta-analys* AND impact OR evaluation OR effect	828 hits 41 deemed relevant
International Bibliography of the Social Sciences (IBSS)	teacher supply OR teacher demand OR teacher retention OR teacher shortage OR teacher recruitment AND initiative OR incentive* OR policy/scheme AND	595 hits 22 non-duplicates deemed relevant

	experiment OR quasi-experiment OR randomised control* trial RCT OR regression discontinuity OR difference in difference OR time series OR longitudinal OR systematic review OR review OR meta-analys* AND impact OR evaluation OR effect	
Sage Journals	"teacher supply" OR "teacher demand" OR "teacher retention" OR "teacher shortage" OR "teacher recruitment" AND initiative OR incentive* OR policy OR scheme AND experiment OR quasi-experiment OR "randomised control* trial RCT" OR "regression discontinuity" OR "difference in difference" OR "time series" OR longitudinal OR "systematic review" OR review OR meta-analys* AND impact OR evaluation OR effect	1,814 hits 25 deemed relevant
Academic OneFile		4 hits
Applied Social Sciences Index and Abstracts (ASSIA)	A great number of studies were found of relevance to teacher retention in special education.	No hits
British Education Index -- Ebscohost		1 hit
British Education Index		36 hits 2 deemed relevant
Science Direct		4 hits
Taylor and Francis		6 hits
Wiley Online Library Springer Link Scopus First Search	These databases did not contain new relevant studies that have not already been covered in the other data bases.	0 hits
Google Scholar and Google		34 further hits
Following up on known pieces		347 further hits

Table A1 – Weaker evidence on recruitment and retention

Study	Strategy	Impact	Evidence
Adnot et al. 2017	Performance incentive (financial incentives)	Positive effect in keeping high-performing teachers in high-poverty schools but not in low-poverty schools	The analysis did not compare teacher retention rates before and after IMPACT nor did it evaluate whether IMPACT improve retention of teachers in general. The study was unable to identify high-performing teachers who leave DCPS because of IMPACT, the estimates indicated that replacing high-performing teachers who exit with teachers who perform similarly is difficult. Also leavers include both voluntary and involuntary leavers.
Afolabi 2013	Professional development (Cross Career Learning Communities)	Positive effect Fewer treatment teachers left teaching or moved from their school than control teachers	QED Groups were matched on individual and school characteristics Teachers participating in CCLC were already in schools with a culture of professional development (groups are not equivalent) The study period also coincided with economic recession which may explain the high retention and lower mobility
Barnett and Hudgens 2014	TAP (Teacher and Student Advancement Programme)	Small positive effect (ES = 0.05)	TAP schools are self-selected. These schools are likely to be different to the national average. Schools that stopped TAP were not included in the analysis. These maybe schools where the programme had

			not worked. In other words, only successful schools were considered in the analysis.
Beattie 2013	Mentoring	No difference between groups but teachers receiving support from full-release mentors reported more positive experience	Small sample (87) Some teachers were selected to receive full-release mentors and some to school-based mentors Evidence based on teachers' report of intention rather than actual attrition
Bemis 1999	Mentoring	There is no clear impact of mentoring on retention despite the author's claim that mentoring programs were found to be most influential on new teacher retention for elementary level teachers.	Small sample Retention based on teachers' self-report High attrition, therefore, those who did not respond may be different to those who did. The results are therefore not reliable. Districts with mentoring may be different to disctricts with no mentoring. Different attrition rate may be a reflection of differences in the districts.
Bobronnikov et al. 2013	Incentive grant	+ Increase in number going into teaching, 80% teaching in high need areas (but no comparator). Not enough data to calculate ES Unclear retention Majority indicated they'd stay on. But of the 6 states, 2 states showed negative impact (no comparison groups)	
Bond (2001)	Salary	+ States where salary was markedly lower than similarly-	

		education professionals, there was higher teacher turnover and reverse is true (after controlling for family background)	
Bowman 2007	Mentoring	Negative impact on retention Experimental teachers were more aware of the career commitment which negatively affect their withdrawal intention.	Small sample (n=30) Comparison groups were not equivalent. Control teachers had more teaching experience than experimental teachers. No actual data on retention was collected
Cheng and Brown 1992	Peer support/mentoring	Mixed results • Positive effect in the first year (ES = +0.12) but no effect in the second year (ES = +0.03	Evidence was based on teachers' self-report. The sample was small and imbalance. The 2 groups were not equivalent. Comparison teachers were those that were not eligible for the programme. In the second year, comparison teachers were randomly selected to be in the experimental group. Experimental teachers were also designed to include those that did not have prior experience.
Chou 2015	Mentoring (full-time release for mentors with financial rewards)	Negative result of full-time release mentoring	The 2 school districts being compared are different and the sample size of only 23 is too small to make any sensible judgements on effectiveness.
Clamp 2011	Mentoring	No effect	Comparison groups were self-selected, coupled with the high attrition rates and the self-report survey, the evidence is weak.
Clewell and Villegas 2001	Alternative certification	Impact on recruitment unclear (more pathways graduates completed (75% vs 60%) and	ES =0.1

		ended up teaching in HTSS (84% no comparison) than traditionally certified teachers + on retention	
Colson and Satterfield 2018	Financial incentive (The Innovation Acceleration Fund grant, a compensation scheme)	+ impact on retention 80% of teachers on the scheme were retained compared to 70% not on the scheme (ES = 0.07)	
Counts 2012	Induction	Positive effect Administrative support and workload were the strongest predictor of teachers' commitment to stay in the school (R^2 = 0.19 for both).	Calculation of means was used for categorical variables (e.g. strongly agree to strongly disagree). Only 22% of teachers responded to the survey. The views of the majority 78% of new teachers were not captured.
Cowman 2004	Alternative certification	Unclear results But looks like mentoring did not influence retention All programs had relatively high rates of retention; ACP had the highest retention (96.81%), followed by ECP (90%) and then CPDT (89.9%). CPDT teachers reported receiving the most support as they were paired with experienced teachers during the internship, they have the highest attrition. This suggests that factors other than mentoring and support could determine teachers' decision to leave.	Record of attrition may not be accurate. Teachers who are still teaching but have left the state of Texas are treated as teachers who have left the profession because their employment histories are no longer trackable. Those who left temporarily (e.g. maternity) sare treated as having left teaching.

		ACP had the highest retention rates likely because of their selective process.	
Croffut 2015	Mentoring and Induction	No effect Turnover rate of beginning teachers in the district decreased by 1 percentage point between 2012-14 and 2014-15. Comparing teachers' self-report intention to stay or not, showed no difference between expected and actual response rate. In fact, actual response rate was 88% compared to the expected rate of 90%.	High level of missing data (only 29% responded to survey). Therefore responses could be from self-selected individuals. Evidence of bias in reporting Despite the data showing no effect, the author concluded "While there is no statistically significant difference, the data reveal the district is maintaining the beginning teacher turnover rate which would indicate the district's beginning teacher program is positively impacting the teacher retention rate"
Dwinal 2012	Alternative certification (Teach For America)	No effect	Based on interviews with superintendents and principals with low response rates (under 20%). Poor reporting. Based on vacancies not placements.
Eberhard, Reinhardt-Mondragon and Stottlemyer 2000	Mentoring and Alternative Certification	+ effect of mentoring (compared to no mentoring) + effect of alternative certification (compared to standard certification) Negative effect of emergency certification compared to fully certified teachers	
Elmore 2003	Mentoring	No difference in retention rates although retention of	No pure control

		teachers using MTC continued to increase over 2 years while those using peer mentors continued to decrease	Comparison was with Peer Mentors and Mentor Teacher Consultants Schools were selected for MTC based on high turnover rates and low performance. Schools are therefore different
Fleener 1998	Alternative certification	Positive effect for field-based training (2.1% attrition) compared to university-based training (6.7%)	The 2 groups are self-selected so may be different in terms of motivation and commitment. Also a large number who did not end up in state-funded teaching were excluded. This may have already excluded those who would be likely to leave teaching anyway
Fowler 2003	Massachussets Signing Bonus	- No effect on recruiting to high need districts (no comparator, so cannot calculate ES)	
Fuller (2003)	Mentoring	+ effect on retention Although differences in retention rates of participants and non-participants are "significant" effect sizes calculated by reviewer are small (around 0.05 for all the 3 years)	Participants were self-selected or "qualified" for inclusion. Therefore groups being compared were different. The programme had a lot of components, so it was difficult to isolate the effects of mentoring In some all beginning teachers had a mentor, in others there were few or no mentoring for new teachers
Gaikhorst et al. 2015	Professional development for beginning teachers	No effect on retention	Evidence based on teachers' report of their intention to stay. Experimental teachers were those who volunteered to take part. These were compared with those who did not take part

Gold 1987	Mentoring (New York City retired teachers-as-mentors programme)	+ - lower attrition rates among mentored teachers compared to non-mentored, but tiny numbers	This was a small-scale RCT. Although principals were asked to assign mentors at random, it was not clear how this was done. In some cases teachers rejected the offer of a mentor. Assignment was therefore no longer random
Goldhaber, Destler and Player 2010	Financial incentives	+ effect Additional $5790 needed for a 50% increase in number of teachers teaching in schools with high proportion of minority children, but only $706 extra for a 50% increase in number of teachers teaching in high poverty schools	
Gordon and Vegas 2004	FUNDEF (Financial incentives)	Increase in number of teachers in poorer regions but no effect on proportion of secondary teachers with higher degrees	
Hancock 2008	External support, mentoring and induction and financial incentives	Mentoring and induction did not predict likelihood of attrition Parent and administrative support reduced the risk of attrition Salary is also significant. For every I unit increase in salary bracket (c. $10,000), there is a 38% reduction in risk (OR = 0.62).	The evidence is based on a large sample of participants based on administrative data. But because the evidence is based on self-report of intention to stay or leave, the evidence is not strong
Hansen et al. 2016	Alternative certification (Teach for America)	Effects are mixed. Clustering has a positive effect on retention of teachers in	This study can only establish correlation but not causality. It also cannot determine the direction of

		schools in the district. The higher the density of TFA corps members in a school increases, they are less likely to move schools within district However, it has a negative effect on retention of teachers within district. A 1 percentage point increase in TFA density in the school is associated with a 1.5% greater likelihood of exiting the district	causation. It is possible that schools with high out-of-district exits are more likely to rely on TFA staffing.
Hardie 2008 [full paper not available)	Alternative preparation	No effect on retention	The two groups of teachers were not randomly allocated and no controls were made of teacher background characteristics
Harrell and Harris 2006	Alternative certification (Online post-baccalaureate teacher certification programme)	+ effect on recruiting males (ES = 0.2) and minority candidates (ES = 0.19) + effect on recruiting maths and science teachers (ES =0.2) + effect on recruiting career changers (no comparison for ES calculation)	Because of self-selection into programmes candidates who signed up for traditional programmes are likely to be different to those who signed up for the online programme. The groups are therefore not balanced. Also comparison is made for only one year, it is not possible to rule out other exogenous factors (e.g. economic performance) which may have affected a larger number of people who change career Data was taken from one faculty in one institution and for one academic year only. Sample may not be generalised to other years and institutions. Hence the 1🔒 rating.

Harris-McIntyre 2014	Induction	No clear effect No evidence that alternative (on-the-job training as in Teach First in England) has been effective in retaining teachers in the district. However, non lateral teachers were over twice more likely to stay in teaching in the first and second year, but no difference in the 3rd year	The teachers were neither randomised nor matched by background characteristics. There are likely to be unobservable differences which have not been controlled for in the analysis.
Henke, Chen and Geis 2000	Induction	+ effect on retention (15% left compared to 26% not on induction programme, ES = 0.27)	Used data from the Baccalaureate and Beyond Longitudinal Survey (n = 7,294) It is not clear how many missing cases there were that had not been accounted for. Also the two groups may be different as teachers participating in induction programmes may be in more supportive schools with better working conditions etc. So it is not possible to attribute the lower attrition rate simply to induction alone. • The analysis is based on bivariate correlations between two factors. It could not account for unobserved factors.
Henry, Bastian and Adrienne 2012	Financial Merit-based scholarships	+ recruitment of high quality graduates (SAT scores of high school scholars 113 points higher than traditionally prepared teachers and	Comparisons were not made with similar teachers Scholarship recipients were high-flying graduates who applied and were therefore self-selected.

		GPA scores are 0.6 points higher non-teaching fellows; ranked among the top 10% of graduates) + retention (scholarship recipients more than 1.1 times more likely to stay on for 5 years than other in-state prepared teachers)	Unobserved confounders such as scholars' motivations and intentions could not be controlled for.
Hopkins 1997	Induction	No effect on retention (Effect size = 0.03)	Groups not equivalent Missing cases and non-response meant that the groups were no longer balanced Retention based on reported intention
Humphrey et al. 2018	Behaviour management as CPD	No impact on teacher retention (ES = -0.01)	A lot of missing data Low compliance No actual retention data (based on teachers' expression of intention)
Ingersoll, Merrill and May 2014	Teacher preparation	Positive effect Those that have more pedagogy in their training were less likely to leave Training in teaching strategies and methods made no difference	The study could not control for unobserved differences. Those who chose the traditional teacher preparation route may view teaching as a career to which they are committed. Those with an education degree may be more committed to teaching because they have fewer alternative career options than those with a maths or science degree.
Jacobson 1988	Salary differentials	+ recruitment (positive correlation between entry-level salary ranking and recruitment of highly qualified teachers	

		+ retention (positive correlation between salary ranking of mid-career teachers and retention of mid-career teachers)	
Jones 2004	Mentoring	No effect No difference between the in-house and full-time mentoring in terms of teachers' reported intention to stay (Cramer's V effect size = 0.0067) No differences between the two groups in terms of reasons for leaving Lack of collaboration with colleagues and administrative and mentor support as top reasons for leaving	1 Schools offering Full-Time mentoring programme were selected based on certain criteria, not randomised. Measure of retention was based on participants' self-report.
Kelley 2004	Induction and mentoring	Positive effect on retention	Compare 10 cohorts of new teachers with national average. These teachers were self-selected based on their qualifications and also they received higher salaries after completion than most novice teachers. The number involved in each year is small (under 50)
Kelly and Northrop	Teacher preparation	Teachers from less selective training colleges are less likely to leave their school (including moving school and leaving profession	Those from highly selective colleges may have greater job opportunities. Large amount of missing data. Very small sample from selective colleges.
Lawrason 2008	Teacher induction	Some positive responses but weak links	Results collected from surveys of participants' reported intention (compared with other induction programmes)

			Small sample of 54
Lyons 2007	Induction programme (known as Center X programme)	+ effect • Beginning teachers who were exposed to all programme types (i.e. better prepared) were less likely to leave classroom teaching or education than those who were not.	This study was based on a comparison of observed and predicted rates of retention using logistic regression analysis to control for observable characteristics.
McBride 2012	Induction and mentoring	Positive effect Association between induction and mentoring variables, and likelihood of teacher remaining in teaching for the following year	Uses 3 admin datasets looking at the outcomes of those involved in induction and mentoring.
McGlamery and Edick 2004	Teacher induction The CADRE project	Positive effect Compared with national sample (40% attrition rate), retention of CADRE participants was 89% over 5 years	153 1st and 2nd year CADRE teachers Risk of selection bias
Mordan 2012	Mentoring of beginning Career and Technical Education teachers	Positive effect on retention. Beginning CTE teachers assigned a mentor were 6.64 times more likely to remain in teaching	Uses 3 admin datasets (SASS, TFS and BTLS) Weak comparisons Small target group (N = 110) Focus of study was on teachers' experience rather than retention outcomes
Morrell and Salomon (2017)	Scholarship scheme	Inconclusive	Claims that it was successful in assisting undergraduates with a STEM background into teaching, but not supported by the data
Murphy 2004	Grow Your Own (A collaborative partnership with local education	Positive effect Large percentage of participants who have received Consortium	Weak causal evidence Focus on participants in the Consortium programmes

	agencies, community colleges, private and public schools)	services have remained in continuous employment in North Carolina's schools	No comparison with non participants
Odell and Ferraro 1992	Mentoring	+effect on retention	There was no control group and the groups were not matched nor was there an attempt to find similar, or matched districts to serve as the comparison. This is important since the districts in question might have already been higher-retaining districts (or at least higher than the state average.
Parker, Ndoye and Imig 2009	Mentoring	Positive effect of same subject and grade level mentors on retention	Sample included 8838 beginning teachers being mentored for 2 years. Outcome was teachers' intention to stay not actual retention
Protik et al. 2015	Cash transfer incentive	No effect – uptake was low	0 No comparison so not possible to say what the uptake would be in the absence of the incentive
Quartz 2003	Induction and ongoing professional development in Center X	Positive effect Over 5 years 70% of Center X graduates remain in classroom compared to 61% nationally based on SASS (ES = 0,69)	Comparison with national figures Participants were self-selected (bias selection) The focus of the study is on the reason why teachers stay or leave
Reynolds and Wang 2005	Professional development	Positive effect PDS graduates less likely to leave teaching (20%) than non-PDS graduates (17%) ES = 0.26	Compared PDS with non-PDS graduates High attrition/nonresponse
Reynolds, Ross and Rakow 2002	Professional development	No effect No retention differences between PDS and non-PDS route	Small sample (N = 191) Attrition 58% No data on retention presented

Robertson-Kraft 2014/2018	Teacher performance management	Quicker turnover rates in INVEST pilot schools Paperwork relating to INVEST contributed to wanting to leave	Schools are not randomly allocated High non-response No report of actual retention data (based on teacher's self-report)
Robertson-Phillips 2010	Teacher induction Beginning Teacher Support and Assessment Program	No effect on retention Retention of BTSA teachers similar to the intern programme	Compared RIMS/BTSA teachers with intern teachers Groups not randomly assigned Data based on perceptions of participants
Rothstein (2015)	Types of contract (permanent vs temporary	No impact on supply. Bonus contract is less effective than the tenure contract in increasing the number of high ability teachers (ES +0.004 and +0.033 respectively). Retention policies are effective only if there is substantial increase in salary. If budget is fixed, may need to increase class sizes to offset the higher salary of teachers	
Scott et al. (2006)	Scholarship, tuition fee remission and mentoring	+ effect on recruitment (an increase of over 100% from in 37 1st year to 80 in the 3rd year). In the 4th year 100 enrolled 80% indicated that they would stay on. (no comparison group). Retention is based on participants' self-report of intention to stay on the course, not teaching in general.	

Shen, J. 1997)	Alternative route to teaching	Successful in recruiting minority and shortage subject teachers and increasing supply of teachers in urban areas However, AC teachers tend to have lower qualifications AC less successful in attracting experience personnel from other occupations Most new college graduates opted for the AC to avoid the traditional teacher education programme AC teachers less likely to treat teaching as a lifelong career No impact on retention (retention not measured but based on participants' report of intention to stay)	Given that AC and TC teachers were not randomised there are important differences between them. Those who chose the AC route may have different motivations from those who chose the TC route. It's also possible that those who entered via the AC route were not eligible for the TC programme because of their lower academic qualifications.
Sims (2017)	Salary compensation	+ effect on recruitment and retention Increase in the total supply of teachers (recruitment deficit ES= 1.3 for science and 1.4 for maths	
Spuhler and Zetler 1993, 94 and 95	Mentoring	Positive effect on retention. In the second year 92% of mentored teachers compared to 73% of non-mentored teachers were still teaching. Effect size is 0.12. In the 3rd year all the mentored teachers continued teaching but only 70% of non-	The small sample size meant that the results could not be generalised. The comparison teachers were not matched in any way.

		mentored teachers remained in teaching (ES = 0.12)	
Stinebrickner 1998	Wages	+ impact on retention Teachers paid higher salary 9% more likely to stay on in teaching for more than 5 years than teachers paid the mean wage Attrition was 70%, hence the 1 🔒	
Tai, Liu and Fan (2006)	Alternative certification of maths and science teachers	No difference between alternative and traditionally certified teachers	Used admin data (SASSand TFS) Missing data Lapse time between SASS and TFS is only one year. Longer evaluation needed to test sustained effect
Van Overschelde, Saunders and Ash 2017	Professional development programme Texas State University teacher preparation programme	Positive effect 85% of Texas State University's graduates teaching after 5 years compared to 71% for average state retention rate (ES=0.9) Retention also higher.	Comparison institutions not randomly allocated. Did not control for teacher and institutional characteristics.
Wells 2011	Financial incentives Team performance pay	No effect in the 1st and 2nd year	Difference-in-difference approach comparing retention before, during implementation and a year later Teachers' report of retention and the district data not consistent
Zavala 2002	Alternative certification vs field-based training	CPDT (field-based training) appears to impact retention positively	Two types of teacher preparation not randomly assigned. So not sure how field-base training is compared to traditional teacher preparation.
Zhang and Zeller 2016	Alternative routes into teaching	Long-term retention rates are greater for traditional certification programme than ACP	Small sample (58 teachers were tracked over 7 years. 22 regular, 20 lateral entry and 18 NC teachers.

			Groups self-selected not randomly assigned.
Zumwalt et al. 2017	Alternative route to teaching	• Positive results for recruitment but weak evidence as not comparison group data available. • Negative results for retention of maths teachers	The evidence is weak as these measures were largely based on correlation and pre-post comparisons without any control. E.g. the increase in the proportion of qualified primary teachers coincided with the legislation that teachers should be qualified.