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Teacher Recruitment and Retention: A Critical Review of International Evidence of Most Promising Interventions

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Abstract: Background: A raft of initiatives and reforms have been introduced in many countries to attract and recruit school teachers, many of which do not have a clear evidence base, so their effectiveness remains unclear. Prior research has been largely correlational in design. This paper describes a rigorous and comprehensive review of international evidence, synthesising the findings of some of the strongest empirical work so far. Methods: The review synthesises a total of 120 pieces of research from 13 electronic databases, Google/Google scholar and other sources. Each study is weighted by strength of evidence. Results: The strongest evidence suggests that targeted money can encourage people into teaching but does not necessarily keep them in the teaching profession. The money needs to be large enough to compensate for the disadvantages of working in certain schools and areas, and competitive enough to offset the opportunity costs of not being in more lucrative occupations, and its effect is only short-term. Conclusions: Continuing professional development (CPD) and early career support could be promising approaches for retaining teachers in the profession, but the evidence for them is weak. There is no evidence that any other approaches work, largely because of the lack of robust studies.

Keywords: teacher recruitment; teacher retention; systematic review; causal evidence; interventions

1. Introduction

This paper provides a comprehensive review of international evidence synthesising the findings of some of the strongest empirical work on improving the recruitment 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. Shortages are more severe in some subjects especially for maths and physics where there is a high demand for graduates in these fields. Compounding this is the growing pupil population. In England, teacher demand has consistently outstripped supply [1]. Reportedly, more people are leaving teaching than ever before. Only 60% of teachers remained in state schools after five years and for 'high-priority' subjects like physics and maths, this five-year retention dropped to just 50% [2].

An adequate supply of qualified teachers is important for the provision of an effective education system. A shortage of teachers can have a detrimental effect on the life chances of children [3–7]. Many countries in Europe have reported a widespread shortage of teachers [8]. Teacher supply continues to be a challenge in Australia and New Zealand and, in England and the US, the teacher

shortage is predicted to get worse as the pupil population rises. Across each of these contexts, the extent of the shortages can vary depending on geographical region, subject area, age of student and school types.

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 number of people choosing teaching as a career, with more people seeing it as an attractive option during times of economic uncertainty [9–13]. 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 [14].

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 [15–17]. While all occupations experience some degree of turnover and career change, turnover in teaching is considered high particularly in the first few years compared to many other professions, such as lawyers, engineers, architects and professors [18,19]. 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 [20]. In England, the attrition rates are similar, particularly in maths, science and languages subjects [21]. Among the secondary teachers who qualified in 2010–2012 around 66% stayed on in state-funded schools in the fifth year [2] (Table 8). Government data show that the odds of leaving are higher for newly qualified teachers (NQTs) and those with stronger academic backgrounds [22].

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. 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 [23–25].

In more recent years, some policymakers have moved beyond financial incentives for retaining teachers. A growing awareness of the often challenging working conditions associated with teaching [26,27] has led to the development of strategies to try and improve these, and in turn make teaching a more attractive profession. These include induction programmes, access to professional development, enhancing leadership skills in schools, flexible working. In England, the Early Career Framework (ECF) [28], introduced in 2020, is part of the wider Teacher Recruitment and Retention Strategies [29] to support new teachers during the induction years via high-quality mentoring and professional development, and a reduced teaching timetable.

An increasingly important issue is teachers' workload. Correlational studies indicate that teachers' perceptions of workload are strong predictors of their decision to leave teaching [30–32]. In England, a report published by the DfE [27], based on interviews with 101 former teachers, suggested workload as the most important factor influencing teachers' decision to leave the profession. A recent survey of teachers and those who have left the profession found that 'workload' and 'improving work-life' balance were the most cited reasons for exiting teaching [33]. An earlier report based on a survey of over 1000 teachers also identified workload, policy changes and accountability pressure among the top

reasons for teacher attrition [34]. The DfE launched the Workload Strategy in 2014 to understand and address 'unnecessary' tasks that teachers undertake in the course of their duty. There is no evidence available on the extent to which schools have engaged with the recommendations put forward from this consultation, but the Teacher Workload Survey carried out in 2019 showed a reduction in teachers' reported working hours since 2016. However, the majority of teachers still reported workload as a serious problem.

2. Background

2.1. Common Approaches Used to Improve Teacher Recruitment and Retention

2.1.1. 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. Identifying what a well-designed pay incentive should be is difficult because of the numerous challenges and parameters that need to be considered [35]. Some commentators have suggested that effective incentive plans must offer relatively large awards to induce behavioural changes [36,37]. A number of American studies have pointed to the level of financial incentives needed in different contexts. Goodnough and Kelly [38] 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. [39] and Hanushek et al. [40] 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. 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 be paid a 'salary supplement' to encourage their retention, particularly in the early years of their careers [41,42]. 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 [43–45]. There is very little evidence to indicate whether performance-related pay works either in improving teachers' performance or retaining them within the profession [46].

2.1.2. Alternative Routes into 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 the profession 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 (e.g., Teach First, School Centred Initial Teacher Training programme in the UK; Teach for America, the Teacher Residency Programs and Peace Corps Program in the US).

Many studies have been conducted to evaluate the effectiveness of different teacher preparation routes, but most focus on outcomes relating to teacher performance with mixed results [47,48]. Typically, these studies assess the relationship between certain attributes and qualifications of teachers and teacher performance (usually measured using students' performance as a proxy). There has been less research on the effects of teacher preparation for teacher recruitment or retention.

2.1.3. Induction Programmes and Mentoring

In recent years, there has been growing policy interest in induction and mentoring strategies. These are designed to provide additional support and development for teachers, usually in the early years of their career, with a view to retaining them within the profession [49,50]. 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, most are limited to single-group causal comparative analysis, correlating teachers' participation in these programmes with their self-reported intention to stay in teaching [51]. A systematic review on the role of mentors on retention of newly qualified teachers could not find conclusive evidence of a positive impact [52]. 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. Further high-quality research focusing on these areas is particularly needed at present in order to inform the development and implementation of new policies on induction and mentoring (see e.g., the Early Career Framework in England [28]

2.1.4. 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 [53]. 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 [54]. There are numerous professional development opportunities available to schools and teachers at present. However, there is considerable variation in the aims and quality of such programmes and teachers' access and engagement with them. Further, there is very little robust evidence which points towards an impact on retention [55,56]. A study by Allen and Sims [57] 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 [58] 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.

2.1.5. Leadership Support

Some studies have highlighted the importance of school environment factors for teacher retention, with school leadership often being viewed as influential in determining the ethos and working conditions within a school. A series of observational studies point to teachers' perceptions of administrative support and leadership as being strong predictors of teachers' intention to leave [59–61]. Johnson, Kraft and Papay [62] argue 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 [63] found 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.

2.1.6. 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. Examples from Australia and America include housing subsidies or offering rental accommodation at below-market rate for teachers willing to work in rural areas [64]. 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. 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, as Anne Podolsky at the Learning Policy Institute acknowledged [64].

2.2. Previous Reviews of the Literature

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 [65,66] or focused on particular issues or groups of teachers/schools. Przygocki [67], for example, looked specifically at teacher supply issues in Catholic schools, while Fore et al. [68] and Billingsley [69] 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 [70,71] or providing a discussion of a small number of key articles [72–74]. Borman and Dowling's [75] 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. [76] examined the individual and school characteristics linked to teacher recruitment and retention, 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 [77] 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 [78] 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.

Where attempts have been made to consider the quality of the included studies the results have been disappointing. Laurence et al.'s [79] 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 [80] reviewed recruitment strategies employed in Australia, the US, UK, Canada and New Zealand and cautioned that many of the strategies have not been formally evaluated, or where they have, evidence tended to be anecdotal and informal.

Our review exclusively includes studies that can contribute to answering causal questions on the impact of strategies or policy initiatives to improve the recruitment and retention of teachers.

3. Methods

This review summarises the evidence of initiatives in addressing teacher recruitment and retention. Knowing more about what 'works' and what does not will allow policymakers and schools to make informed and targeted decisions on strategies to use or avoid, to attract and retain teachers. Given the huge amount of research in this area, we have to be careful these decisions are supported by the best available evidence. It is therefore imperative that the trustworthiness of each research finding is evaluated. To do this we used a multi-factor method for judging the quality of evidence of each study included in the review.

The research questions are:

1. What are the most promising approaches in attracting teachers into the profession?
2. What are the most promising approaches in retaining teachers into the profession?
3. What are the 'best bets' for schools, regions, and policymakers to improve the recruitment and retention of school teachers?

In the context of this review, teachers refer to classroom teachers who deliver teaching in state-funded schools from early years to post-secondary education. We have intentionally not limited ourselves to teachers of any phase or subjects as attracting and retaining different types of teachers may require different strategies. In any case, the majority of research conducted in this area focused on teachers in state-funded schools, with a small number covering special education teachers. There was also a disproportionate number about shortage subjects, such as maths and science or languages. This is not surprising as recruiting and retaining shortage subject teachers has been a concern in most education systems across the world.

3.1. Search Strategy

To search for relevant studies, a list of search terms was developed as follows:

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.*

These were applied to 13 educational, psychological and sociological electronic databases 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
- 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

- Plus Google and Google Scholar.

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

The search terms were tested on well-known sociological, educational and psychological databases to ensure that they picked up relevant pieces of literature, and 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.

To determine the causal evidence of policies and initiatives on teacher recruitment and retention, we included only studies using experimental (e.g., randomised control studies) or quasi-experimental designs (e.g., regression discontinuity, matched comparison, difference-in-difference, longitudinal time-series analysis and instrumental variables) and large-scale longitudinal studies, or similar.

The scoping review and previous reviews of literature suggested that there were few robust experimental evaluations of policy initiatives or approaches for teacher recruitment and retention. The decision was therefore made to include any empirical studies with at least some type of comparative design, but would have low ratings for trustworthiness in terms of causal claims.

The search was limited to studies published or reported in the English language. We intentionally did not set any date limits, to keep the search open. To avoid publication bias, the search included any material published or unpublished that mentions both substantive and causal terms.

A total of 6731 potentially relevant records were identified from titles alone. 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 were specifically related to the effects of induction and mentoring on teacher retention. All were exported to EndNote (a reference manager) for screening.

3.2. Screening

In any review, a broad search of the databases will invariably pick up huge numbers of irrelevant materials. This is even more so in our case as we intentionally kept the search as broad and comprehensive as necessary to ensure that we did not miss potentially relevant materials. A large majority of records were not relevant but contained some of the keywords. To remove these, we eyeballed the entries looking at the title and abstracts and removed those that were clearly not relevant to the topic. We then screened for duplicates using the EndNote function. Some studies were presented in different forms, or for different audiences, e.g., as a working paper or a report as well as journal articles. These were treated as one study.

In the next stage of screening the full reports were skim-read by one researcher. Any studies thought not to meet the inclusion criteria were then reviewed by other members of the research team for consensus. Four members of the team independently reviewed 10 randomly selected reports to agree on their inclusion or exclusion. The full texts of the included studies were screened by applying pre-defined inclusion and exclusion criteria as presented below.

3.3. Inclusion Criteria

Inclusion and exclusion criteria were determined prior to completing the searches and were applied after the initial screenings. Studies were included if they were:

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

3.4. Exclusion Criteria

Studies were excluded if they were:

1. Not relevant to the research questions
2. Not primary research
3. Not reported in English
4. Not a report of research
5. Descriptions of programmes or initiatives with no evaluation of strategies or approaches used in teacher recruitment and retention
6. Not about strategies or approaches to improve recruitment or retention of teachers (e.g., observational or correlational studies of factors influencing recruitment and retention)
7. Studies that had no clear evaluation of outcomes
8. Studies with non-tangible or measurable outcomes (e.g., surveys about teachers' attitude or beliefs or perceptions
9. Ethnographic studies, narrative case studies, opinion pieces
10. Outcome is not teacher recruitment or retention
11. Focus only on specific groups of teachers, e.g., special education teachers or ethnic minority teachers
12. Not relevant to the context of English speaking developed countries
13. Recruitment and retention of school leaders, teaching assistants or school administrators
14. Anecdotal accounts from schools about successful strategies
15. Surveys collecting ideas about the best way or most effective ways to attract and retain teachers

The PRISMA diagram (Figure 1) tracks the number of studies included and excluded at each stage of the review process.

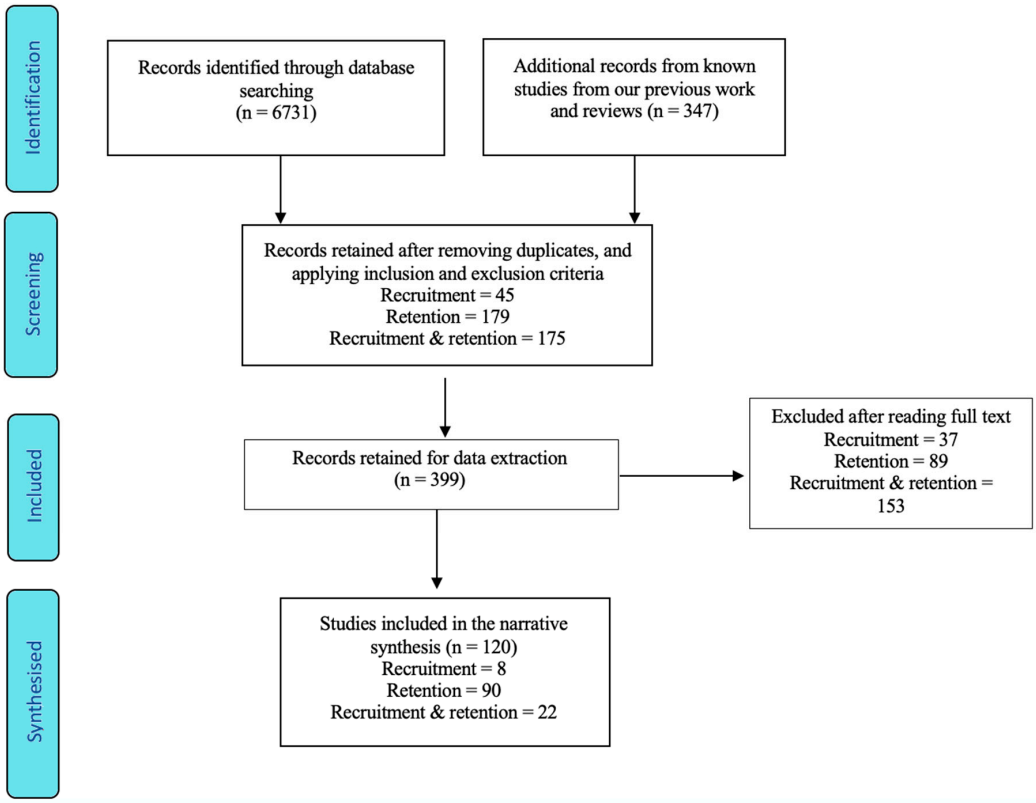

Figure 1. PRISMA Diagram of included/excluded studies

The majority of the studies that were excluded were because they were not relevant to the topic (i.e., not about teacher recruitment and retention), not about impact evaluation, recruitment and retention were not the outcomes, or were simply reports about best practices.

3.5. Data Extraction

The included studies were assembled and considered for synthesis. Key information from each of the included studies was extracted and summarised using a template (Appendix A). Such information included the research design, sample size, group allocation, outcome measures, missing data, methods of analysis and the results.

We then judged the research evidence and reliability of the finding for each piece of included study using the "Gorard Sieve" [81]. This uses five criteria to assess the trustworthiness of the research (see Appendix B): the design (whether it includes a fair counterfactual), scale of study (size of smallest cell, as small studies can be volatile and vulnerable to threats to validity), scale of missing data (missing data can bias the findings), quality of data obtained (data obtained from standardized test instruments or administrative data are considered more robust than data collected from participants' self-report or from instruments aligned with the intervention) and other threats to validity (e.g., conflicts of interest). All such factors are important [82] for ensuring that the evidence that informs policy and practice can be relied upon. Each study was then given a padlock rating ranging from 0 (no weight can be placed on the study) to 4🔒 (the most robust that could be expected in reality). This is an indication of how secure the findings are. We use the term "quality" to refer to the security of the findings and not necessarily the quality of the research. The ratings take no account of whether the intervention was deemed successful or not, or whether the report author claimed the intervention was effective. To ensure inter-rater reliability, four members of the team reviewed and rated a sample of five papers. Team members were in constant consultations with each other throughout the process to ensure consistency.

We did not compute the average effect sizes for each of the approaches as the study designs were so varied that averaging effect sizes across different studies which use different scales (e.g., odds ratios, hazard risks, mean effect sizes and r-coefficients) 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. This is an umbrella term which encompasses differential salary compensation, bonus incentive scheme, pension enhancement, scholarship and bursaries and tuition fee waivers. These strategies are not identical, or even similar in some cases, therefore averaging the effect sizes across the different strategies may not reflect the impact of each particular strategy. It is also the case in this review that there were often only one or two studies for each type of financial incentive that meet our causal criteria. It was therefore not possible or desirable to average the effect size for each type of programme [83].

The key matter is whether the effect is positive or not. The size of the effect can be misleading as studies with small samples, those without control groups, used non-randomised controls and those that are based on teachers'/pupils' self-reports of outcomes invariably show huge effect sizes [83]. To overcome these problems, we examined the substantive and methodological features of each study using the "sieve". Therefore, rather than reporting effect sizes, we present the direction of effect (positive, negative or no change) and the strength of the evidence (i.e., how secure is the finding).

3.6. Synthesising the Evidence

To facilitate the synthesis, we sorted the research reports by outcomes according to whether they were about recruitment, retention or both. A broad classification of incentives/initiatives was created. These include financial incentives (e.g., signing bonuses, wage uplifts, scholarships and loans), and other non-financial incentives (e.g., alternative routes into teaching, staff development, mentoring & induction and workload reduction) or a combination.

Approaches with the most highly rated studies showing positive effects are considered the most promising. Likewise, approaches rated highly (i.e., 2🔒 and above) showing negative or no effects are considered least promising given the existing evidence. All outcomes, whether positive or negative are considered. It is just as important to identify approaches that do not have evidence of effectiveness as it is to identify those that do work. It has to be made clear that approaches with no evidence of impact does not mean that they are not effective, but rather that the existing evidence is such that its effectiveness cannot be determined.

4. Results

The 120 included studies reported 157 individual outcomes relevant to recruitment and retention (Table 1). We discuss the approaches for improving recruitment and retention separately. However, a number of studies report on both recruitment and retention and these are included in both sections where appropriate. Studies receiving a 0🔒 or 1🔒 rating are not discussed in any further detail as their limited design or methodological quality means that they offer little in terms of indicating promising (or otherwise) approaches. Appendix C summarises the weaker studies (rated 0🔒 and 1🔒). These are mainly studies with very weak design. They either had very small samples, non-randomly allocated comparison groups, had no clear comparators, high attrition or based on models that made a number of unrealistic assumptions. All this makes it difficult to attribute the effect to the policy initiative or intervention. Therefore, including them in the discussion will add little to the overall finding.

Table 1. Number of studies with each security rating: all included studies.

Security Rating	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

4.1. Approaches to Attracting Teachers

Fourteen studies that focus on approaches relating to recruitment are rated 2🔒 and above (Table 2). All but two involve some kind of financial incentives (Table 3). This is perhaps because large-scale administrative/panel data relating to financial incentives are more readily available and accessible, and efficient to examine for researchers.

Table 2. Security ratings of studies on recruitment.

Security Rating	Positive Outcome	Unclear/Mixed Outcome	Neutral or Negative Outcome
3🔒		Rosen (2012)	
2🔒	Boyd et al. (2012) DeFeo, Hirschberg & Hill (2016) Dolan, Metcalfe & Navarro-Martinez (2012) Falch (2017) Fitzgerald (1986) Glazerman et al. (2013) Hough and Loeb (2013) Steele et al. (2010) Zarkin (1985)	Fulbeck & Richards (2015)	Bueno & Sass (2016) Gorard et al. (2020) Kraft et al. (2020)

Table 3. Security ratings of studies on financial incentives in teacher recruitment.

Security Rating	Positive Outcome	Unclear/Mixed Outcome	Neutral or Negative Outcome
3🔒	-	1	-
2🔒	8 + 1	1	2

4.1.1. Financial Incentives

The strongest study (3🔒) shows mixed outcomes, but otherwise the results from the 2🔒 studies are predominantly positive (Table 3). This suggests that there is promising, but far from definitive evidence that financial incentives may be an effective strategy in attracting teachers into the profession and to specific regions, subjects or hard-to-staff schools.

The only study rated 3🔒 on recruitment [84] evaluated the impact of financial incentives on recruitment and retention of shortage subject teachers. The results were mixed. The study utilised an instrumental variables model using data from the School and Staffing Survey from 1999/2000 to 2007/2008 which contained data from 106,930 public school teachers in 6540 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. 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.

There were eight studies rated 2🔒 showing positive effects. These were not rated higher because of some limitations in the research design. These studies suggest that financial incentives, such as higher wages, stipends and bonuses can entice teachers to teach in challenging schools. DeFeo et al. [85] estimated that higher salaries are needed to attract more qualified teachers to teach in hard-to-staff schools. They 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. Their analysis suggests that to compensate for factors that might make a community or school more or less attractive, salary differential would have to be between 0.85 and 2.01 with hard-to-staff schools having higher differentials. The differentials include costs of living among other working and living conditions that affect teachers staying or leaving communities. 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 would have to be the salary differences on the teacher's actual salary and not the state salary schedule as some districts were already paying teachers more than was stipulated in the state salary schedule. Otherwise even with compensatory bonus, teachers' salaries could be the same or even below what they were already getting.

Fitzgerald [86] evaluated the impact of the High Priority Location Stipend Program in Miami, Florida. The stipends varied between $500 and $2000 annually depending on the position of the staff and the number of years they worked in the high priority areas. Over three years, vacancies in treatment schools fell substantially from the base year while teacher and vacancies in the control schools went up (effect size 1.3). 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. 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. [87] 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 [88] used a difference-in-difference approach, comparing the recruitment and retention of 1611 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. [89] 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 $5000 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 [90]. This was an experiment with 1574 undergraduates (but data for 1496 was analysed) to test whether financial incentives would attract high ability students into teaching. Instead of asking students 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 [91] 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 2034 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 [92] 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 an increase in salaries.

One 2🔒study showed mixed outcome—successful for some schools only. Fulbeck and Richards [93] explored the effects of ProComp, a performance-based financial incentive, on teacher mobility in Denver, CO, USA. Teachers were awarded an additional $24,000 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.

Another 2🔒 studies found no impact of financial incentives on teacher recruitment. Bueno and Sass [94] 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. [95] compared three groups of 4469 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.

4.1.2. Alternative Routes into Teaching

Only one study that looked at the impact of an alternative teacher preparation programme for teachers (Table 4) was rated 2🔒, and so is discussed here.

Table 4. Number of studies with each security rating: Alternative routes and teacher supply.

Security Rating	Positive Outcome	Unclear/Mixed Outcome	Neutral or Negative Outcome
3🔒	-	-	-
2🔒	1	-	-

Boyd et al. [96] compared the qualifications and retention of the Maths Immersion Program (MIP), 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.

4.1.3. Teacher Accountability

There is only one study that examined teacher accountability on the supply and quality of teachers (Table 5). High stakes teacher evaluation reforms were introduced across the different states in the US at different times. Kraft et al. [97] took advantage of this differential timing 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 comparing teacher supply (the number of licenses granted) and teacher quality (measured 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.

Table 5. Number of studies with each security rating: Teacher accountability and teacher supply.

Security Rating	Positive Outcome	Unclear/Mixed Outcome	Neutral or Negative Outcome
3🔒	-	-	-
2🔒		-	1

In summary, the most promising approach appears to be financial incentives. While substantial increases in salary may be linked to better recruitment in general, and perhaps in hard-to-staff areas and schools as well, studies that take the background of teachers or potential teachers into account suggest that salaries are not as important [95]. There is also the suggestion that monetary inducements, like bonuses and bursaries, may attract teachers in high demand subjects, but the evidence indicates that such incentives disproportionately attract those already interested in teaching, and are more successful in getting trainees into desirable schools rather than hard-to-staff ones.

The evidence for the different routes into teaching is not strong as there is only one medium-quality piece on this. There are no robust studies at all on most of the other approaches.

4.2. Approaches to Retaining Teachers

The evidence on teacher retention is more mixed than for recruitment (Table 6). There are no 4🔒 studies and the eight studies with a 3🔒 rating, all had unclear, neutral or negative outcomes. 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 6. Security rating of studies on retention.

Security Rating	Positive Outcome	Unclear/Mixed Outcome	Neutral or Negative Outcome
3🔒		Rosen (2012) Shifrer et al. (2017) Springer et al. (2016)	Clotfelter et al. (2007, 2008) Fryer (2013) Glazerman et al. (2010) Helms-Lorenz et al. (2016) Steele et al. (2010)
2🔒	Allen & Sims (2017) Bueno & Sass (2016) Cohen (2005) De Angelis et al. (2013) De Jong & Campoli (2018) Falch (2011) Feng & Sass (2015, 2018) Fitzgerald (1986) Glazerman & Seifullah (2012) Glazerman et al. (2013) Ingersoll & Smith (2004) Koedel & Xiang (2017) Latham & Vogt (2007) Murnane & Olsen (1990) Papay et al. (2012) Ronfeldt & McQueen (2017) Speidel (2005) Springer & Taylor (2016) Springer et al. (2010)	Booker & Glazerman (2009) Choi (2015) Fuchsman et al. (2020) Fulbeck (2011) Fulbeck (2014) Shirrell (2014) Silva et al. (2014/2015) Weisbender (1989)	Anders et al. (2019) Boyd et al. (2012) Dee & Wyckoff (2015) Hendricks (2014) Hough & Loeb (2013) Jones 2013

4.2.1. Financial Incentives

The evidence on financial incentives for retention is less clear than for recruitment. All of the stronger studies (3🔒) do not suggest clear benefits (Table 7).

Table 7. Number of studies with security rating: Financial incentives and retention.

Security Rating	Positive Outcome	Unclear/Mixed Outcome	Neutral or Negative Outcome
3🔒	-	3	3
2🔒	9	4	4

The large study by Rosen [84], discussed more fully in the recruitment section above, for example, found no clear evidence that districts offering incentives had higher teacher retention, at least after the first year.

Shifrer, Turley and Heard [98], another 3🔓, 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 3363 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. 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 [99] evaluated the US$5000 retention bonus program for effective teachers in Tennessee's Priority Schools (high poverty, high minority schools). The study showed that the bonus incentive increased the retention of teachers in tested subjects and grades, but not the retention of Level 5 (Diploma in Education and Training) teachers. This was a quasi-experimental study using a regression discontinuity design exploiting the sharp cut-off 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.

Three moderately high evidence studies (3🔒) found no effect of financial incentives on teacher retention. Steele et al. [89] 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 $5000 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.

Using a difference-in-difference-in-difference approach, Clotfelter et al. [100,101] compared hazard rates before and after the implementation of the bonus programme; eligible and ineligible teachers in the same schools using a hybrid of a randomized experiment and a regression discontinuity design. This is the North Carolina bonus incentive aimed at retaining qualified teachers in targeted subjects in high poverty or academically challenging schools. Under this scheme teachers were eligible for an annual bonus of $1800 if they taught in an eligible school, and will continue to receive the bonus as long as they stayed in the same school and taught the same subjects. Overall, the results suggest that the bonus incentive did not reduce turnover rates. However, it is not clear whether this is because the $1800 bonus was not large enough or is it because there was a flaw in the design and implementation of the program as 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. 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. However, this reflects a pattern already in place even before the programme was introduced. Including the school fixed effects in the regression the effect was negative.

In a cluster randomised control trial, Fryer [102] examined a school-wide performance bonus scheme that provided performance bonuses to school staff based on their schools' progress report. Using both an intention-to-treat (ITT) and treatment-of-the-treated analyses, the results showed that the teacher performance bonus program had no effect on teacher retention. Some reasons suggested for the nil effect included incentives not being large enough, incentive scheme was too complex and group-based incentives may not be effective. Participating schools were given a lump sum incentive on $3000 per full union teacher. Schools could decide to award a subset of teachers with the highest value-added or divide among teachers by lottery. The majority of schools opted for group incentives. Data on students and teachers from 396 high-need public elementary, middle, and high schools from 2007–2008 through 2009–2010 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. Retention outcomes in schools that were offered participation in the program—even if they ultimately declined to participate—were compared with the outcomes in schools that were not offered the opportunity to participate.

Nine studies rated 2🔒 reported positive outcomes of financial incentives on teacher retention, but the effects were either short-lived or involved some kind of a tie-in. Bueno and Sass [95] found

that salary compensation only had a short-term effect on the retention of teachers. They compared teachers who were eligible with those who were not. The attrition rate for bonus recipients was lower than non-recipients, but only in the first five years when they were 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 [103] used a natural experiment taking advantage of changes in the wage system in Norway over a nine-year period (1993/94–2002/03) to look at whether giving teachers a higher salary would make them more likely to stay in teaching. Over that time, teachers in schools with high teacher vacancies were eligible to receive a wage premium of between 7.5% and 12%. In total, there were 161 treatment schools. Of these 104 received wage premium for less than four years. The difference-in-difference analysis comparing the turnover rates before and after wage premium was introduced showed that 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. The wage effect was 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. There was no impact on the retention of younger teachers, and female teachers were less responsive to wage increases than older and male teachers.

Another incentive scheme is the Florida Critical Shortage programme is a state-wide programme to increase the supply of teachers in shortage subjects. Feng and Sass [104,105] evaluated the effects of two components of the scheme. 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 was a one-off retention bonus for teachers teaching certain subjects and grade levels. Retention bonus was capped at $1200 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 Florida by 25%., but no effect on retention in the school they were currently teaching.

Fitzgerald [86] also found that the impact of financial incentives is short-lived. The effect of the High Priority Location Stipend Program was observed only in the first year after implementation. 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.

Pension enhancements have also been used in states in the US to encourage teachers to stay until their retirement. Koedel and Xiang [106] examined one such scheme in St Louis, Mississippi using the six-year administrative panel data covering the school years 1994–1995 through 1999–2000. They compared the likelihood of eligible teachers (i.e., those retiring after June 1999) with those not eligible using a difference-in-difference analysis. This resulted in a 60% increase in pension wealth for the eligible teachers, and had the effect of delaying the retirement only of teachers who were a year close to retirement, but not for other groups.

Glazerman et al.'s [87] analysis of the Talent Transfer Initiative, described in the section on recruitment, was also linked to increased retention. But this is because a condition of the incentive

is that teachers agree to move or stay in the low-performing school Retention in the first year was 93% (70% in the comparator group), but dropped to 60% after two years (compared to 51% in the comparator group). This suggests that the effect of the incentive was not long lasting and loses its effect once the payment stopped.

Murnane and Olsen [107] examined the career histories of 13,890 North Carolina teachers to estimate the impact of salaries on teachers' longevity in teaching. 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 a $1000 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. [108] evaluated the District Awards for Teaching Excellence (D.A.T.E), a state-funded incentive pay award in Texas. All districts in the state were eligible to receive grants, but participation was voluntary. The average award for teachers ranged from $1361 in districts with district-wide plans to £3344 in districts with select school plans. The study showed that the likelihood of leaving increased for teachers who did not receive the award, but the probability of leaving fell sharply for those who did receive the award. The size of the award also matters. In districts with relatively small maximum awards, turnover increased, but turnover fell as the awards increased until it exceeds $6000 beyond which it makes no difference. However, not all districts and not all schools were eligible for participation, and it is not clear what the eligibility criteria were. Districts and schools that received the award may be systematically different to those not eligible for the award. The factors that exclude them for eligibility may be relevant to teacher turnover.

In a pilot study, Springer and Taylor [109] 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. Schools 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 $3000 and $10,000. Using a combination of data from different sources the author analysed teacher turnover for six academic years. The results showed that turnover was higher among beginning teachers 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, suggesting the short-term effects of such incentive award.

A further four 2🔒 studies showed unclear or mixed outcomes. Booker and Glazerman [110] evaluated the Missouri Career Ladder (CL) Program to test the effect of pay increases on teachers at different stages of their career. Based on their performance-level eligible teachers received supplementary pay for taking 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 £1500 for Stage 1, £3000 for Stage 2 and £5000 for Stage 3. The authors compared the retention rates of teachers in districts offering the Career Ladder incentive with similar teachers in non-Career Ladder districts. There was no difference in retention rates between CL and non-CL districts after controlling for observable differences such as wealth, size and population density in regression models. Using instrumental variables 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 authors estimated 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. 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.

In another study Fulbeck [111] used 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 was 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 3900 and 4200 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 schools (ES = 0.05). The findings, however, are really difficult to interpret as the graphs seem to contradict the findings reported. Also the incentive came in at the time of the economic recession, which may have affected individual's propensity to move.

Using multinomial hierarchical regression modelling of data taken over a year, Fulbeck [112] estimated 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 not out of schools within the district. This relates only to those who volunteered to participate in ProComp and received the $5000+ 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 [113] reported positive effects of the Quality Compensation program (Q Comp) on teacher retention but only in schools that have implemented the scheme for five years—6.3 percentage points higher compared to schools with less than five years of implementation. There was no benefit for charter schools (retention rates 10.5 percentage points lower than other schools). Q Comp is an alternative teacher compensation program (ACPs) under which teachers' pay was 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 analysing data for 12,708 teachers and 1734 schools over 8 years. Teacher retention was calculated by comparing the list of teachers in two subsequent years.

Four other 2🔒 indicated that financial incentives did not improve retention of teachers. A 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. [43] 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 [114] reported a performance incentive programme (IMPACT) aimed at retaining effective teachers in the District of Columbia. IMPACT 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. Employing a regression discontinuity design, they compared the retention and performance outcomes of 4000 low-performing teachers whose ratings placed them near the threshold at risk of 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. The high stakes incentive programme was successful in removing teachers at the threshold of being labelled minimally effective, but did not improve the retention of high-performing teachers.

Hendricks [115] compared the attrition of teachers in districts which award teachers via pay for year of experiences, with districts that do not. The study found no relationship between teacher pay and turnover. Districts differ in terms of labour and market outcomes so those districts that award pay increases by years of experience may already be experiencing high attrition of more senior teachers.

Hough and Loeb [88], described under recruitment, 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.

4.2.2. Teacher Development and Support

Previous studies have suggested that teacher development, which includes mentoring for inexperienced teachers and induction for early career teachers can help support and retain teachers in the profession. Our review found mixed results with the strongest studies showing no obvious benefit of teacher induction, while the weaker studies are largely positive about mentoring and induction (Table 8).

Table 8. Number of studies with security rating: Teacher support and retention.

Security Rating	Positive Outcome	Unclear/Mixed Outcome	Neutral or Negative Outcome
3🔒	-	-	2
2🔒	10	1	-

Although 10 studies of moderate quality 2🔒 suggested positive effects, the two strongest studies rated 3🔒, using randomized control designs, showed that mentoring and induction did not make a difference to teacher retention.

For example, Glazerman et al.'s [56] evaluation of a comprehensive teacher induction programme in Princeton, New Jersey (US) found no impact on retention of teachers who received either one or two years of comprehensive induction within school, district or teaching profession over the first four years of the teachers' careers. This was one of the strongest studies using a randomised control design involving 1009 teachers in 418 schools. The mentoring programme consists of a year-long curriculum for beginning teachers that focuses on effective teaching. Mentees also had the opportunity to observe experienced 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 h of professional development.

Another randomised control evaluation of an induction programme for beginning teachers in the Netherlands also showed no clear effect on teacher retention [116]. It involved 71 schools with 338 beginning secondary education teachers who were randomly allocated to receive 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 conditions 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 that it was the lack of certification and the low teaching skills that most explained teachers leaving the profession.

The 2🔒 studies mostly reported positive outcomes. Allen and Sims [57] 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 [117] 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 3172 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 [118] 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 [119] 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 = −0.52). 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 [23] 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 2600 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 there was no consistent pattern.

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 [120]. 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 3235 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, they were 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 [121] 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 (defined as having elements of field placement, onsite coursework and professional development) were more likely to stay in teaching for longer (about 0.25 of SD more than those who did not). It is important to note that the PDS group were self-selected and hence were likely to be different to those that were in the non-PDS group.

Papay et al. [122] 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 [123] 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 used propensity score matching of demographic characteristics to link 1600 teachers receiving extensive induction (i.e., 4 to 6 induction supports) with 1130 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, but only 2340 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 analyses 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 was 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 [124] evaluated a teacher development programme, known as the Skills, Tips, and Routines for Teacher Success (STARTS), in the Volusia County Schools (Florida) designed for teachers of students with special needs. The study utilized data on the employment histories of 771 new special needs teachers for school years 1998/99 to 2003/2004. 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.

Further, one 2🔒 showed mixed outcome. Weisbender [125] evaluated the California Mentor Teacher Program which was developed to retain experienced teachers and to assist new teachers in the transition into teaching. Under this scheme, highly talented classroom teachers (mentors) were given the incentive to 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 effect on retention for 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. [98] noted, it may be the case the high performing teachers can find jobs more easily and are therefore more mobile.

4.2.3. Alternative Routes to Teaching

There is no clear evidence that offering alternative routes into teaching is beneficial in retaining teachers. Two studies rated 2🔒 that examined alternative routes into teaching showed no clear advantages of any alternative pathways in retaining teachers (Table 9).

Table 9. Number of studies with security rating: Alternative routes and retention.

Security Rating	Positive Outcome	Unclear/Mixed Outcome	Neutral or Negative Outcome
3🔒	-	-	-
2🔒	-	1	1

Silva et al. [126] evaluated 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. 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). Teachers who moved schools were more likely to move to higher performing schools with a smaller proportion of ethnic minority children.

The second study by Boyd et al. [96] 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.

4.2.4. Teacher Accountability

One commonly cited reasons for teachers leaving the profession is high stakes tests and accountability pressures [127–129]. However, our review found that removing or reducing teacher accountability does not seem to have a clear benefit on retention, although the evidence base is particularly weak here (Table 10).

Table 10. Number of studies with security rating: Accountability and retention.

Security Rating	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 [129] 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. 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 using a difference-in-difference approach. 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 teachers with 0–4 years of experience leaving the profession when testing requirements were relaxed 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.

Shirrell [130] estimated the impact of accountability under the No Child Left Behind Act (NCLB) where 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. Using the minimum subgroup size threshold of 40 for a regression discontinuity analysis, Shirrell compared schools on either side of the threshold before and after NCLB. A difference-in-difference analysis was also used to compare teachers of different ethnic sub-groups. The study found that Black teachers in schools that were held accountable for the performance of Black student subgroup were less likely to leave than Black teachers in schools not accountable for the Black subgroup's performance. There was no difference in attrition for the White subgroup. 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. Shirrell also surveyed student teachers before they began teaching and after. The results showed that challenging working conditions generally do not predict changes in student teachers' career plans, although poor working conditions in training schools are associated with decreases in the lengths of time they plan to teach during their careers. Overall, there was no evidence that working conditions and accountability had any effect on attrition of ethnic minority primary school teachers.

Jones [131] 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. Teachers in performance pay districts earned a salary that was $2825 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 the most important reason for teachers' decision to leave. 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. Because the sample consisted of only 64 teachers caution is urged in interpreting this result. Also, implementation of performance pay incentive 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. In summary, the evidence on retention is not clear.

5. Discussion

5.1. The Evidence on Recruitment and Retention to the Teaching Profession

In summary, financial incentives seem promising for attracting new teachers into teaching, and in increasing the number of teachers in challenging schools with a high proportion of poor or disadvantaged children. However, the effect is stronger for high performing schools and schools with lower proportions of disadvantaged children. The evidence suggests that for financial incentives to work, they have to be large enough to compensate for the challenges of working in less desirable schools and 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 graduates from these subjects tend to 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 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.

As for retention, financial incentives do not seem as be as effective. Although many studies do show positive results, the more robust studies which control for context suggest that teachers only stay while the incentive is available. Such short-term results are not useful in solving the chronic shortage of teachers. In fact, the evidence suggests that the use of discriminatory incentives may even worsen overall retention. Eligibility for an incentive, or a small incentive, seems to make little difference. Where incentives are used, they need to be substantial.

In many cases, monetary incentives work only because teachers are required to commit to teach for a specified period or certain subjects in specified schools or areas as part of the contract agreement. These incentives often entail a penalty for breaking the contract, raising questions about the value of such an approach and the potential for a kind of enforced retention where teachers feel 'tied-in' to a role that they no longer wish to do.

In recent months, in England, the government have announced pay increases for teachers across the board [132,133]. These are not specific incentives nor attached to particular individuals, subjects or regions as we have examined in the section above. However, the plans do indicate that teachers new to the profession will receive a higher increase than those who are more experienced. The link between teacher pay and recruitment/retention is still fairly unclear but it will be important to examine whether these reforms do appear to have any impact on the number or type of graduates entering teaching, or the number of teachers choosing to continuing working in schools.

5.2. Beyond Financial Incentives—Implications for Policy, Practice and Research

Financial incentives have been used for decades to try and encourage increased numbers of graduates to enter the teaching profession. Despite the evidence that they can have some positive impacts, there is nothing to suggest that they are likely to 'solve' the recruitment challenges that countries such as England and the US currently face on a longer term basis. Economists have argued that the use of monetary incentives needs to consider how they interact with intrinsic and social motivations and what happens when they are withdrawn [134].

Thus, it is important that policymakers and school leaders look to alternative or additional approaches too. Relying primarily upon financial inducements is unlikely to be an effective and sustainable strategy for recruitment and retention, and arguably it is not desirable either. It is not clear, for example, whether the extrinsic motivation offered by financial incentives, leads to the best or most-suited graduates entering teaching.

While monetary incentives may be potentially useful as a way to increase the supply of shortage subject teachers and to attract teachers to challenging schools or areas, we question, for example, whether they are necessarily the best approach to improving recruitment as it is quite clear that the attraction is not lasting. Where prospective or qualified teachers are asked to report the factors that influence their likelihood for entering or staying in teaching, or that might encourage those in the profession to leave, money rarely features highly [27,32,33,94]. Instead there are other factors which may offer more promise for recruitment and retention if addressed.

Support in schools for teachers in the early stages of their careers and continuing professional development for established teachers appear to offer potential benefits for retention but are also arguably important in their own right. The evidence for mentoring and professional development is uniformly positive for mentees but the studies that we have to make these judgements are unfortunately not of the strongest quality. The stronger studies do not show consistent positive effects [23,119]. There is also little evidence on the effectiveness of specific induction programmes for retaining new teachers. The few studies that have looked at this area are either methodologically fairly weak and/or report mixed or unclear findings. The stronger studies find little or no impact. A consistent issue though is the multi-faceted nature of these interventions which makes it difficult to identify, accurately measure and understand the elements of the induction programmes. It is not always clear whether it is the induction alone or a combination of other factors that makes a difference. Some of these studies also use 'intention' to stay in the profession as an outcome rather than actual attrition figures. These are issues which need to be factored into future design and evaluation of induction programmes.

In England, the government has recently introduced the Early Career Framework (ECF) with a view to providing teachers with a strong induction programme, including early professional support, mentoring and a reduced teaching timetable [28]. The potentially promising findings on some of these areas in this review are therefore welcome news, but given the relative weakness of the studies, it is not clear to what extent the ECF is an evidence-informed initiative, or how confident we can be in its outcomes. 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.

Our review also tentatively points to the importance of improving school cultures and ethos for recruitment and retention. While we found very few rigorous studies that evaluated interventions related to areas such as accountability, teacher stress, working conditions, behaviour, workload or levels of support from teachers/leaders, some of the correlational and survey-based studies indicate that these could be valuable areas to explore further. As we note above, there are likely myriad other reasons for improving some of these wider factors too, including pupil/teacher performance and wellbeing. These could well be enough to justify the trialling of interventions that seek to achieve such aims, with a view to also understanding their impact on recruitment and retention. While we acknowledge that measuring and evaluating some of these school-level approaches at scale is arguably

more complex than the evaluation of government-administered financial incentives, we would contend that such evaluations are vital and should form an integral part of any new policy initiative.

Many of the interventions also seemingly address the symptoms rather than the cause of teacher shortages. As See and Gorard [14] have shown, government policies that aim to improve the quality of teachers has led to a reduction in the number accepted into teacher training. Manipulating the number of teachers that can be trained in higher education institutions and reducing school funding all have ramifications on the number of teachers in schools. A more coherent and long-term approach to policies is therefore needed.

5.3. Strengths and Limitations of the Review

This review systematically and rigorously synthesised approaches and interventions used for improving the recruitment and retention of teachers. It is the only comprehensive single-study review that we know of which includes robust appraisal of the research design and methods used within each study. This quality-appraisal is key to the claims that we are able to make in terms of the most effective approaches and the strength or amount of evidence available to support them. While our review focuses on the inclusion of studies using experimental or quasi-experimental designs, we have also sought to acknowledge where evidence from other types of study might be helpful for understanding particular issues or highlighting where there are potential evidence gaps. Finally, although our review had broad parameters, included over 7000 studies at the outset and a process of careful and rigorous screening, the criteria that we applied do mean that it is of course possible that relevant and potentially useful studies have been missed or excluded.

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Appendix A

Template used for extracting data from each included study

Overview

Brief Description of the Intervention

- Aim and type of intervention: e.g., financial incentives (performance-related pay, scholarships, bursaries, housing benefits, pension scheme)
- Phase: Primary/secondary/general
- Country:
- How the intervention works: There must be enough information to enable identification of key features of a successful intervention, if it works.

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.

Appendix B

A 'sieve for judging the trustworthiness of causal research studies (Gorard, 2017)

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

Appendix C

The table summarises pieces that were reviewed and rated below 2. These tended to be small-scale, have considerable attrition, no clear comparator, and/or rely on reports of intention to stay or leave.

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)	The study design was unable to test whether recipients of the Noyce programme would have gained teacher certification in STEM subjects and go on to teach in high needs areas in the absence of the programme

Study	Strategy	Impact	Evidence
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)	It is a correlational analysis and the states being compared are not the same, there are confounding factors that are not accounted for.
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
Brown &Wynn 2009	Role of principal	Positive effect of principal awareness of issues affecting teachers on retention	Not an impact evaluation
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 ended up teaching in HTSS (84% no comparison) than traditionally certified teachers + on retention ES = 0.1	Comparisons were made with national average and traditionally certified teachers. The 2 groups of people are therefore likely to be different. Paraprofessionals and emergency-certified teachers, for example, were already working in the schools. It is therefore, hardly surprising that they were more likely to stay in the school or district where they were trained. There was also no comparison of before and after data.
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)	The very small non-random sample, and exclusion of teachers who did not have TVAAS results meant that the sample might be biased. Comparisons were made with volunteers and non-volunteers
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.

Study	Strategy	Impact	Evidence
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. ACP had the highest retention rates likely because of their selective process.	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.
Croffut 2015	Mentoring and Induction	No effect Turnover rate of beginning teachers in the district decreased by 1 percentage point between 2012–2014 and 2014–2015. 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	The groups were no randomly selected and as the authors reported, this may be reflective of the kind of pre-service students who would sign up for the more intensive one-year programme. No actual retention data presented.
Elmore 2003	Mentoring	No difference in retention rates although retention of teachers using MTC continued to increase over 2 years while those using peer mentors continued to decrease	No pure control 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

Study	Strategy	Impact	Evidence
Fowler 2003	Massachussets Signing Bonus	- No effect on recruiting to high need districts (no comparator, so cannot calculate ES)	There was no comparison group. It was simply an analysis of the data on bonus recipients and their outcomes.
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)	Lowers 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	Not focused on recruitment and retention specifically
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	Not relevant to English context (funding reform in Brazil). The analyses are correlational and did not take into account other confounding factors
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

Study	Strategy	Impact	Evidence
Hansen et al., 2016	Alternative certification (Teach for America)	Effects are mixed. Clustering has a positive effect on retention of teachers in 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	This study can only establish correlation but not causality. It also cannot determine the direction of 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.

Study	Strategy	Impact	Evidence
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 = 7294) 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 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)	Comparisons were not made with similar teachers Scholarship recipients were high-flying graduates who applied and were therefore self-selected. 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)	It is correlational in design, it is not able to control for other confounding factors such as the economic and political differences in the districts

Study	Strategy	Impact	Evidence
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 left 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

Study	Strategy	Impact	Evidence
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 agencies, community colleges, private and public schools)	Positive effect Large percentage of participants who have received Consortium services have remained in continuous employment in North Carolina's schools	Weak causal evidence Focus on participants in the Consortium programmes 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.
Ogunyemi 2013	Mentoring	Some claims about perceived impact of mentoring on retention	Self-report, no comparison group and high attrition
Oliver 2016	Mentoring	Suggests that the use of social media platform increases retention of induction year maths teachers	Ethnographic accounts based on participant observations and field notes—not a study which aims to find causal/correlational outcomes linked to retention
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
Partridge 2008	Mentoring	No effect of mentoring on participants' intention to stay	Survey based on 71 teachers (only 12 were assigned a mentor). The data was delimited to information provided by a portion of elementary teachers in one public school district so might not reflect the opinion of all members of the included population. Responses were subject to the validity of self-perceptions regarding mentoring.
Perry 2008	Induction	Minority teachers	Small sample (n = 22). No clear data presented to make judgements about the validity of the findings
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 left X	Positive effect Over 5 years 70% of left 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
Randall 2009	Mentoring	The teachers reported that the mentors had no effect on their decision to remain in the classroom.	Not impact evaluation.

Study	Strategy	Impact	Evidence
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
Ridgely 2016	Induction	Compare two models of induction. Suggests that dual-role induction was more effective in keeping teachers thana site-based induction.	Comparison was between 2 types of induction programme. No counterfactual. So cannot rule out other differences between the 2 districts who could have explained the different retention rates. There was also a huge disparity in numbers between the two districts being compared.
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	The models are based on a number of caveats which are not possible in reality. It assumes that teacher performance assessment is unbiased and that new teachers are recruited from the same population as current teachers ignoring the fact that there are potentially high ability teachers who would not consider teaching at all.
Rogers 2015	Induction	Found no link between induction programme and retention	Online survey, very low response (34%), no clear comparator. Evidence based on school leaders' and administrators' report. No actual retention data
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.	There is no comparison group, so it is not possible to attribute the increase in the number of students enrolled on the teacher certification course solely to the MASS programme. The retention rate is the retention on the programme and is based on students' report of their intention rather than actual staying on

Study	Strategy	Impact	Evidence
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.
Shepherd 2009		Claimed that the Induction program had a positive effect, but given the data presented, it is not possible to know if this can be attributed to the program.	Data gathered from stakeholders through surveys, focus group discussions and interviews. No causal/correlational evidence clearly presented. Poor reporting of samples.
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	The model made a number of assumptions, e.g., Teachers missing in the School Workforce are taken to have left teaching, the reduction in probability of leaving the profession is evenly spread across each year of the policy, Increased pay does not incentivize more people to train in each cohort
Spuhler and Zetler 1993–1995	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-mentored teachers remained in teaching (ES = 0.12)	The small sample size meant that the results could not be generalised. The comparison teachers were not matched in any way.
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	The data is poor with only 30% of teachers being tracked. We are therefore not sure how different the results would be if data for all the teachers were available. Those that did not respond are likely to be different to those who did. Also the survey asked teachers to recall their teaching experience. This can be subjective depending on their experience at the time of the survey and may not accurately reflect what actually happened.
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

Study	Strategy	Impact	Evidence
Toterdell, Heilbronn, Bubb and Jones 2002	Induction	Focused on the positive experience of NQTs	Not impact evaluation. Limited focus on retention or attempts to measure this in a coherent way. Looks at perceptions of new programme and some implementation but little in the way of actual outcomes.
Troutt 2014	Professional Learning Communities (PLCs)	Claims PLCs improve retention	No pre- post comparison. Made conclusions based on comparison of a high retention and low retention school. The schools may be systematically different in terms of pupil intake, location etc, which could have influenced retention. Therefore, not possible to attribute success to the programme. Used school-level rather than individual teacher retention Poor reporting.
Uttley 2006	Mentoring	Suggests positive effect	Evidence based on survey of teachers' perceptions about the effectiveness of the programme, collected at one time point. Non response was 45%.
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
Wilkinson 2009	Induction for alternative certification programme students		Comparisons were made with 7 different cohorts of students, who were lumped together as one despite possible differences in contexts/backgrounds. Evidence based on survey collecting respondents' report of satisfaction with the programme and correlation analysis of their responses with their intention to stay
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.

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