REFORMING TEACHER TRAINING: EXPERT PERSPECTIVES

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FOREWORD

by Jenni French, Head of Teacher Supply Programmes and Sir John Holman, Senior Advisor, the Gatsby Foundation

The Gatsby Foundation commissioned this collection of essays in order to inform the current debate about the future of initial teacher training (ITT) in England, stimulated by the Government Market Review.[1]

Gatsby has long emphasised the importance of subject specialism in secondary school teaching. Science teaching continues to suffer because there are too few specialist teachers working in schools: physics teachers are in particularly short supply. Other specialisms, such as maths and modern foreign languages, suffer from similar shortages. Over the last twenty years Gatsby has worked with Government and other partners to improve the quality and quantity of specialist teachers, particularly focussing on physics teachers. As well as commissioning research, most recently around the role of salary in recruiting and retaining teachers, our work has included piloting the first subject knowledge enhancement (SKE) course, providing support for non-specialists and providing mentoring for early-career teachers. We continue to be concerned that the supply of subject specialist teachers does not meet the needs of the country and we wanted to explore how the Government's initial teacher training (ITT) Market Review report, published in July 2021 would affect the situation.

Earlier in 2021 a panel of experts, led by Ian Bauckham, reviewed the ITT market and drew up proposals which aimed to ensure that all trainees receive consistently high-quality training, whilst ensuring that the market maintained sufficient capacity. Recommendations included changes to the ITT curriculum ensuring it is based on a Core Content Framework (CCF),[2] and an increased course length that introduces a new 'intensive' school placement, reducing the time being taught within the teacher training institution. Most controversially, it is proposed that every provider should go through a re-accreditation process.

Whilst some welcomed the changes, many parts of the ITT sector raised some significant concerns, fearing that, as they stand, the proposals would reduce the autonomy of the training institutions and ultimately force providers out of the market. In response to both the proposal and the concerns, Gatsby asked nine people who have an interest and expertise in ITT to write an essay covering their personal thoughts on some aspects of teacher training, and to reflect on the new proposals. The contributors come from a range of institutions, from academia to schools, universities and subject associations.

The contributions demonstrate that there is much to celebrate about our existing system. Our higher education institutions, the role of which is described eloquently by James de Winter of the University of Cambridge, are amongst the best in the world, and the diversity of our teacher training providers should be celebrated. Tim Oates, of Cambridge Assessment, in his essay about negotiating the curriculum, describes how recent policy reform has improved the education system in England. He goes on to welcome the role of the state in "understanding the variation in the system, highlighting and communicating best practice. This can inform both initial teacher training and continuing professional development."

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/999621/ITT_market_review_report.pdf

2 https://www.gov.uk/government/publications/initial-teacher-training-itt-core-content-framework

But how do we know what constitutes best practice? Dame Alison Peacock of the Chartered College of Teaching reminds us that "professional knowledge is constantly evolving. A framework for professional development must by its very nature be open and permeable because pedagogical knowledge is not fixed, and must always be subject to critique and nuance." She argues that the ITT system needs more time to embed the CCF and to develop more effective ways of working in partnership before changes are implemented, or we risk damaging teacher professionalism and de-stabilising the system.

Several contributors suggest that making changes could well de-stabilise the system and result in additional disruption to teacher supply in an already precarious market. Michelle Palmer from the Royal Society of Chemistry describes some of the reasons why small providers and School-Centred Initial Teacher Training establishments (SCITTs) could withdraw from the market. She explains that trainees in some parts of the country do not have access to large teacher training institutions and the loss of small providers could result in a reduction in the number of trainees. Ben Rogers from Paradigm Trust also raises the issue of the location of teacher training providers, and questions how well some of the smaller providers are equipped to deal with the subject-specific training. He reminds us that we currently do not know enough about the destination of our trainees in terms of employment in schools and that better understanding of this would help us shape policy more effectively.

Charles Tracy of the Institute of Physics, in his essay about developing subject knowledge for teaching, describes very clearly the different types of subject knowledge required for teaching, and makes the argument to put subject expertise at the heart of any new reforms, ensuring that sufficient time is provided in the curriculum. He also argues for a single, coherent system for developing teachers' subject knowledge "from the moment they start training to the time they leave the classroom." Charles stresses the importance of subject-specific mentoring, something Gatsby's own work strongly supports.

When considering the importance of subject knowledge in teacher training, it is easy to overlook primary education. Dr Alex Sinclair from St Mary's University and Ben Rogers remind us to also consider the importance of subject knowledge for primary trainees, and to ensure that all trainees wherever they are trained are able to access subject-specific support.

Hannah Stanwix, a chemistry teacher at Rosebery School and recent trainee, provides a reflection on her training which serves as a reminder to place the needs of the trainee at the heart of any reforms. She focuses particularly on the importance of educational research in her training and how she continues to use this in the classroom, and this supports James de Winter's view on the important role of Higher Education Institutions in the training of teachers.

The final article in the series is somewhat different from the others and reflects Gatsby's longstanding approach which is to make sure that policy makes the best possible use of evidence. In addition to pulling together some of the evidence around the need for reform, Dr Sam Sims of the UCL Institute of Education offers some concrete suggestions about how Government could enact its ambition to improve the quality of initial teacher education, whilst addressing the concerns raised by other

contributors. His paper lays out a plan for an independent body to take responsibility for the teacher training curriculum and set outs a timetable for enacting his vision.

In publishing this collection, we aim to highlight some of the many views held by those with a stake in ITT. The collection shows that teacher training in England is complex and consists of a plethora of routes and providers. The question at the heart of the Government review is: how can we improve the system, ensure the best provision is allowed to continue whilst ensuring all trainees have access to high-quality training? However, it seems there is no consensus over the right things to do or even if change is necessary. As is suggested by several Essay contributors, Gatsby recommends that this uncertainty is a reason to slow down and assess in detail the options and their implications before identifying the long-term solution.

NEGOTIATING THE ARGUMENTS ABOUT CURRICULUM – THE IMPLICATIONS FOR ITT STRATEGY

Tim Oates, Cambridge Assessment

The alternative conceptualisations regarding 'teacher competence' offered by Chris Winch of King's College London allow us to see the different assumptions – and combinations of them – circulating in the current arguments regarding strategy for teacher training: 'Craftsperson', 'Executive technician', 'Professional' – radically different ways of viewing the competence of teachers and their actions. There's no doubt that the current discussion of Initial Teacher Training (ITT) is heated. Part of the intensity of the debate comes from the pressing problems pent up in our system: acute and chronic shortages in key subject areas; escalating requirements and duties despite clear evidence of 'daily overload'; societal pressures which include but are not limited to the Covid-19 pandemic; a strong drive for improvement; and tight financial discipline being applied to ITT spends. It seems that England needs clear strategy on three things: a means of addressing immediate shortages, a stable approach to initial training; and robust continuing professional development. Easy to say.

However, Chris Winch suggests that there are radically different views of what teacher competence actually comprises. And as a key part of this, we both see the problem very much as a problem of knowledge.

- What knowledge is essential for professional competence and where should it come from?
- What should be the balance of 'knowledge from own experience and practice' and 'knowledge from other people' – which 'other people and sources of ideas' and who should control the content and balance of the complex curriculum required?

A historical precedent: when Sussex University refined its practice-based PGCE in the 1980s, the course designers drew heavily on research about professional practice – knowing that teachers in training require knowledge and theory to deal with the complexities of practice, that classroom experience grounds the theory and develops expertise, and that personal insights into practice drive reflection and discussion of theory and knowledge. It was seen as vital to move between short periods of practice and formal learning outside the classroom, with novices sharing experiences and reflections – all guided by evidence and the support of mentors in schools and specialists on the formal course. And care to avoid trainees being 'lost' in practice, or overwhelmed by the demands of driving practice through evidence was seen as central. It surely is good that over three decades later, all these elements are visible in the recent review of ITT. The objections appear to focus on knowledge and control. Control has long been ambiguous in teacher training – after all, Lawrence Stenhouse and then John McBeath emphasised the extent to which curriculum development and institutional development 'should' be located in schools. This shifts the locus of control towards 'knowledge from practice' and the autonomy of schools. While key elements of professional knowledge are created through practice, inefficiencies derive from schools being isolated in this process. The State rightly desires equitable access to high-quality education and

professional convergence on effective practice. We have long seen the tug-of-war and pendulum swings in ITT policy which can occur as 'professional and institutional autonomy' and 'evidence-based drive to system improvement' collide – rendered all the more complex by this not being a simple State-school relation, but a set of relations between schools, clusters of schools, ITT providers, and other agencies.

In medicine, the pressures regarding quality and cost-effectiveness of treatment (including rationing) – in all their technical and ethical complexity – led to the formation of NICE – the National Institute of Clinical Excellence. It is not without challenge or need for continuous improvement, but it has been accepted by the medical profession and by society. And the formation of this Institute, over and above the undoubted collective and specific knowledge of individual teaching hospitals and colleges, was seen as a national necessity. The ITT review reinforces the Education Endowment Foundation (EEF) as a partial analogue of NICE – a sensible proposition, which implies that the EEF should strive, as does NICE, for the highest levels of competence and probity in its scrutiny of 'knowledge about practice'.

Central to 'professional' knowledge – and it is the last category of 'craftsperson', 'executive technician' and 'professional' which Winch and I favour – is understanding of 'curriculum'. I now turn to this. Michael Eraut's definition of 'curriculum' as 'aims, content, pedagogy, assessment and evaluation' takes us beyond the reductivist idea of 'curriculum as content' and into the territory of 'intended, taught, assessed and learned' curriculum present in the theorisation of 'curriculum' in Trends in International Maths and Science Study (TIMSS). Add to this Bill Schmidt's identification of the association of 'curriculum coherence' with high performance, and the concomitant necessity of 'curriculum control', and it is clear that the ITT Review is right to include the State's interest in curriculum quality (and both equity and attainment), the need for signalling high-quality evidence from research, as well as recognising the complexity of individual professional 'formation' through practice. Schmidt's work on 'curriculum control' has been widely misunderstood, since the word 'control' suggests 'top-down State control' – but Schmidt makes very clear that systems achieve coherence through very different patterns of control – from dirigiste to highly participative approaches. In its most naive form, the frequent call to 'trust teachers' can condemn teachers and schools to working in high-effort isolation, and the State stepping back from providing supportive structures and the means of converging on effective practice.

It is worth exploring this crucial issue of the balance of interests and control through examples of deterioration and improvement in curriculum quality.

Sweden assumed that structural reform – the marketisation of education – would unleash an 'invisible hand' of improvement. Henrekson and Javervall's 2016 report (Royal Swedish Academy of Engineering Sciences) showed that this was misplaced, and as grades maintain an upward inflationary route, underlying standards – as measured by the big international surveys – have seriously declined. From 2000, the Organisation for Economic Co-operation and Development (OECD) investigated the 'autonomy' of schools, and the message many policy-makers took from the OECD data and analysis was that 'autonomous schools will increase the quality of provision' – not considering the likely possibility that high-performing systems might have reached a place where they can relax the requirements on schools. In other words, earlier policy in these systems may have put things in place which allow a reduction of central 'steering'.

England has experienced an oscillation of policy on central steering and school autonomy. The National Curriculum pulled things towards the centre, and moved from the variation of curriculum practices sanctioned by the 1944 Education Act. Relaxations of the National Curriculum in 1995 and 1999 were accompanied by a ratcheting up of accountability arrangements. Meanwhile, the 2014 National Curriculum may signal to all schools some specifics about both content and process, but does not apply to a substantial segment of the system.

So who decides what comprises 'quality in the curriculum'. We know that 'quality' resides in the day-to-day actions of teachers and pupils – the 'lived experience of learning'. What to do? With targets and accountability measures coming from the State, the implied message is 'quality is anything which improves performance against those measures'. But we know from research that there are shortcuts to improved performance which do not represent a genuine improvement in quality. And teachers – novice and experienced – continue to be faced with loud arguments about 'knowledge versus skills', 'subjects versus themes', 'theory versus application' – arguments all subject to their own weird reversals and oscillations. COVID-19 has increased the uncertainties about the role of schooling, of technology, of learning outside school – and has certainly fed fractious debates about what education should look like. It's easy to say 'well ... we should focus on the research into quality...' but arguments about quality rage in the research community as much as anywhere else.

However ... despite these challenges, and unfashionable as it is to say it, I think we are doing some things right in England. The Chief Inspector of Schools has focussed on curriculum, after decades of neglect. The inspection framework does not seek to impose models, it seeks to understand what is happening, to feed comparison of approaches, and to highlight success. And to measure that success in more than just the extent to which a school's data are improving against targets. This seems like a good role for the State – understanding the variation in the system, highlighting and communicating best practice. This can inform both initial teacher training and continuing professional development. While there continue to be active subject associations, there is a lack of well-developed processes for identifying and communicating best practice. I welcome this shift in inspection practice, not least the extent to which the revised framework has been informed by leading-edge international research on curriculum. This shift is not a pendulum swing towards school autonomy or to central control; it feels like balanced policy – the State facilitating improvement, not dictating the detail of it.

There is more which we seem to have got right. Our English 2018 PISA results bucked the trend – in particular, the maths results of 15-year-olds improved. This improvement coincides with policy action – the revision of the National Curriculum using transnational comparative research, with funding of international exchanges on curriculum approaches, and the founding of the national network of Maths Hubs to support professional development. As with the focus on curriculum in inspection, this is not a simple increase or relaxation of central control, it is a sophisticated mix of evidence-based policy and clear signalling of effective curriculum management, pedagogy and didactics.

Neither of these developments are quick or simple. But they tread a careful path between over-prescription and excessive variation. They engage with the realities of day-to-day practice, extract from this in a systematic way, and then encourage wide dissemination in the system. By clear signalling, these developments offer a means of negotiating the contested nature of 'curriculum quality'. Of considerable importance, such signalling can reduce teacher workload as well as improve outcomes.

The development of inspection and the formation of the Maths Hubs have been deliberate outcomes of State policy – from Her Majesty's Inspectorate and the Department for Education respectively. The insights on 'curriculum quality' which they yield should be central to both initial teacher training and to continuing professional development. They link research, policy, and practice. I believe that they are central to the discussions about reform of ITT, not separate or tangential to it. They preserve legitimate State interests with 'bottom up' developments in practice.

It's easy to assume that other national systems lack the same arguments and ambiguities present in our own. We tend to be sensitive to what's happening in England, and less privy to the debates elsewhere. Well, Scotland is mired in discussions of direction, following a serious decline in standards. High-performing systems in Asia are grappling with rising concerns about the pressure on young people, and US states continue to worry about the dominance and impact of testing. Curriculum quality is challenging to identify and even more challenging to implement, but by international standards, in England it feels as if we are making progress.

As outlined above, the ITT Review includes consideration of the right elements. It recommends signalling of evidence and inspection of providers as key contributors to securing coherence, the importance of which is emphasised in empirical studies of system performance. Inevitably, issues of control run through the proposed changes – and shifts in the locus of control almost inevitably ignite controversy. The Review and the practical action which comes from it needs to be judged not by the extent to which it causes frictions, but by the extent to which it contributes to resolving the persistent problems of acute teacher shortages, national provision of comprehensive professional preparation for teaching, and system-wide ongoing professional development of the existing labour force.

Tim Oates is Group Director of Assessment Research and Development at Cambridge Assessment, focusing on national and international research on assessment and measurement. In 2010 he published 'Could do better' which laid down the principles for the review of the National Curriculum in England. He was chair of the Expert Panel for Review of the National Curriculum in England. Emerging from this review, subsequent research on the quality and function of textbooks and other resources has been taken up around the world and discussed at two international summits on learning resources. Tim chairs various curriculum groups for the Department for Education in England, and has undertaken system evaluation and curriculum review in nations around the world. He has published widely on assessment and curriculum issues, and routinely provides briefings and advice to UK and other governments. He has worked with OECD on curriculum policy and, with Nuno Crato, has recently published analysis of the 2018 PISA results for England. He is Fellow of Churchill College Cambridge and in 2015 received a CBE for services to education.

THE RISK OF A SINGLE GOLDEN GOVERNMENT THREAD

Dame Alison Peacock, Chartered College of Teaching

The English Government's proposals for initial teacher education in the DfE Independent Report: *Initial teacher training (ITT) market review report*, July 2021[1] complete a suite of professional development qualification reforms that are designed to support teachers throughout their career. Documentation describing these reforms (DfE 2021) refers to the so-called 'golden thread' of professional development.[2]

On the surface, this sounds great. No longer will teachers flounder in search of career development; funded National Professional Qualifications (NPQs) will enable 'pathways' to be clearly identified. The Department for Education has secured funding to provide scholarships that will enable thousands of teachers to benefit from taught courses from October 2021 via teaching school hubs and the new Institute of Teaching (from 2023). In principle, I support this initiative; indeed colleagues from the Chartered College have contributed to the thinking that underpins the Early Career Framework and NPQs. However, the Government needs to recognise that professional knowledge is constantly evolving. A framework for professional development must by its very nature be open and permeable because pedagogical knowledge is not fixed and must always be subject to critique and nuance.

The Chartered College of Teaching works hard to establish respect for a plurality of voices. This means representing a range of views, perspectives and approaches. We believe that this call from Robin Alexander over a decade ago still holds true:

> *'Teachers should be able to give a coherent justification for their practices citing (i) evidence, (ii) pedagogical principle and (iii) educational aim, rather than offering the unsafe defence of compliance with what others expect. Anything else is educationally unsound.'* (Alexander et al, 2010)[3]

In seeking to develop this sense of confident professional knowledge and clarity of purpose, we need to ensure that the so-called 'golden thread' becomes less of a single strand and more of a complex, knotty series of threads which lead teachers to develop increasing practical contextual wisdom combined with theory. Educational research is constantly developing and we must avoid a tendency towards over-certainty about the latest trends. One example of this is the July 2021 Education Endowment Foundation (EEF) publication *Cognitive science approaches in the classroom*[4] showing the necessity of further studies that seek to understand efficacy of application beyond limited subject areas and age ranges. To make leaps in pseudo-scientific ways leads us into the territory of 'folk pedagogies' that the DfE ITT Market Review cautions against.

Teaching School Hubs have reportedly been warned by the Department for Education that they must only promote Government-approved courses. This has led to dismay in some quarters (Mansell 2021)[5] where the motivation to become a 'hub' was centred on building a community of practice across large numbers of schools, tailoring professional learning that would meet local needs and demands. Again, a single golden thread risks jeopardising collective wisdom, energy of ideas and local priorities in the name of consistency and compliance.

Centralised control of professional learning is risky. The experience of the implementation of the Literacy Hour and Numeracy Hour in primary schools should serve to remind us that a one-size-fits-no-one approach is doomed. How much better, then, to see the route from Initial Teacher Training onwards as a series of informed pathways towards building professional expertise. To achieve this, we need a rich ecology that includes universities, school-centred initial teacher training (SCITTS), education partnerships, Multi-Academy Trusts (MATs) and other collaboratives where teacher knowledge is enhanced through collaboration in learning communities where criticality is valued.

The reality is that half a million teachers in England are going to take a great deal of influencing and convincing before they believe that there is a single golden answer to all aspects of early career experience, behaviour management, mentoring and leadership. Learning is messy and gets easily tangled but we have increasingly promising knowledge and 'best-bets' that can help. Engaging with this knowledge both ethically and creatively will enable us to find a way through for every child.

My plea to Ministers would be to loosen the reins and to resist the desire for centralised ideological control. We need more time for the ITT Core Content Framework (CCF) to become embedded and to be implemented. Recent Ofsted inspections of initial teacher education have been highly critical of the lack of coherence and of curriculum development within SCITTS and HEIs. The ITT system needs time to embed learning from these inspection outcomes and to work with partnership schools to develop effective ways of working. The CCF is not exhaustive, so each provider needs time to develop its own curriculum whilst maintaining coherence across the system. This needs to happen, by the way, when schools are not focused on saving lives in a pandemic.

What of the recommendations within the DfE ITT Market Review? There are real risks of losing prestigious universities from Initial Teacher Training through insistence on re-accreditation. There are risks to the overall teacher supply through destabilising training routes and by insistence on tighter regulation via lead providers. There are risks of losing academic freedoms through placing ITT providers in a strangle-hold in the name of 'a more efficient and effective market'.

Ultimately, our professionalism is at stake. Teachers need to see themselves as lifelong learners, as developing experts with a collegiate responsibility for building professional learning communities within their schools and groups of schools. If we are to achieve the culture in schools that the ITT market review report calls for, we need to take teachers with us on the journey. We need to ensure that teachers recognise and appreciate the value of professional learning. They need to be convinced that high-quality mentoring benefits not only trainees but the mentors themselves. We need school leaders to value the importance of informed debate over received knowledge, and without doubt we need the university sector to continue to be the flag-bearer of educational research and expertise.

We aim for the profession to achieve greater respect, trust and autonomy. To achieve recognition we cannot allow teacher education to become training by numbers or professional learning to be rigidly controlled with an ideological stance. To quote Robin Alexander again (2010), he called for teachers to work from 'repertoire' instead of 'recipe'. This is why the 'golden thread' must be richly diverse, complex and knotty. Professional status and recognition is not easy to achieve but professionalism is worth the struggle and must be preserved at all costs.

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Dame Alison Peacock has spent her entire career as a teacher and most latterly as Chief Executive of the Chartered College of Teaching. She has worked in secondary, primary and advisory roles and has engaged with research into 'Learning without Limits' seeking to inspire teaching without so-called 'ability' labelling. Alison is a trustee of the Helen Hamlyn Trust and of Big Change and Deputy Lieutenant of Hertfordshire. She is an Honorary Fellow of Queens' College Cambridge and of University College London.

DEVELOPING SUBJECT KNOWLEDGE FOR TEACHING

Charles Tracy, Institute of Physics

In this article, I will argue that teachers' subject knowledge for teaching needs to be explicitly and systematically developed; this development should be done in a structured way, with dedicated time and led by tutors with specific expertise in their subject. The structured approach should be continuous from Initial Teacher Training (ITT), through early career and into a system of career-long professional learning. Furthermore, I will argue that trainee and early-career teachers should be taught and deployed in a way that enables them to focus on a single, home discipline while they develop and hone their teaching skills.

At the heart of a teacher's role is their ability to teach a subject (or subjects). Most of us will think immediately of the need for sound substantive (content) knowledge, but I would argue that teachers need to develop three distinct types of knowledge to teach well. So, by the term "subject knowledge for teaching" I mean a combination of:

- substantive knowledge: the established canon of explanations, ideas, and accepted theories within a discipline
- disciplinary knowledge: the set of ways of thinking, the practices, and the procedural knowledge that define and characterise a discipline and its practitioners
- pedagogic content knowledge (PCK): the knowledge of how to represent substantive and disciplinary knowledge to students in a way that helps them learn it.

For nearly everyone entering teaching, PCK will be a completely new concept. This is one reason why teachers need a pre-service year of training. PCK itself needs careful, systematic development. It is also a useful context for developing knowledge in the other two strands; this is important because knowledge of those strands cannot be assumed to be complete in a graduate going into teaching – even a graduate planning to teach the same subject as their degree.

So let's look at each strand in more detail and consider the development requirements, focussing to begin with on someone training to teach within a field of, or related to, their degree. Then we will look at the additional challenges of learning to teach an out-of-field subject.

Substantive knowledge is what many people would call content knowledge; things like knowing the formula to calculate the current in a resistor, remembering that Henry VIII was a Tudor king and being able to identify Cornwall on a map. It might seem fair to assume that a graduate in a discipline will arrive at teacher training with pretty good substantive knowledge to teach a discipline. Fair but risky: we cannot rely on an assumption that even a graduate in a subject has a comprehensive grasp of all of a subject's substantive knowledge. There are a number for reasons for this.

Firstly, a degree will have taken them into areas of the discipline which are very different from those taught at school, some completely new, others more advanced.

Secondly, some subject domains are so large that their degree (and experience at school) will not have covered the entire breadth of its domain. And thirdly, it will have been at least four years since any of the trainees has studied much of the content – in many cases, much longer ago than that. For these, and other reasons, it is wise to reckon on all trainees having gaps in the substantive knowledge needed for school teaching. That is to be expected and not a failing. However, it means that part of the role of ITT is to ensure that any gaps are filled.

Therefore, it is important that trainees (and their tutors) formatively assess their existing substantive knowledge and address any shortfalls. This is most effectively – and most courteously – achieved through auditing and addressing substantive knowledge in the context of developing the new strand of PCK. That development requires dedicated instruction time. Currently, specific time allocated to direct instruction of PCK within a trainee's main subject ranges from a couple of days to about fifteen across the ITT year. Even the most generous allocation is likely to fall short of what is required by most trainees. And, at the lower end, it is likely to leave them with incomplete foundations for beginning to teach.

In terms of messages for the ITT Market Review, the first is that the current amount of instruction time must be protected and, in many cases, it should be increased. The second is that we should take the opportunity of the Review to build in systems which position ITT as only the beginning of acquiring the required subject knowledge for teaching. Trainees need continued support with their PCK (as well as substantive knowledge) into their early career and beyond. Therefore, it would be advantageous to put systems and frameworks in place to ensure that professional learning in a teacher's early and whole career is continuous and consistent with their ITT year. That is, to instigate a single, coherent system for developing teacher's knowledge from the moment they start training to the time they leave the classroom.

Disciplinary knowledge can be thought of as knowledge of and capability in the approaches and practices that characterise a discipline. It includes epistemological knowledge; but goes beyond merely knowing about the discipline's practices and ways of thinking: it also includes being adept in those practices.

Disciplinary knowledge is easily overlooked in the school curriculum. And yet it is an essential part of young people's learning in a subject, partly for its own sake: disciplinary knowledge (across a range of disciplines) provides students with persistent, transferrable and valued skills; and partly because it provides them with an authentic view of the discipline beyond it being solely a bunch of facts within a specified domain and allows them to make informed choices. Disciplinary knowledge contributes to making a student's experience of the school curriculum varied and rich, with different disciplines being defined by and developing very different ways of thinking about and defining the world through their disciplinary knowledge.

Good disciplinary knowledge is an essential part of a teacher's toolkit. Most graduates will have good disciplinary knowledge within their main subject. But, in addition, they need time and support to develop a view on it, both to reflect on the meaning of knowledge within their discipline, and to learn how to explicitly model their discipline's behaviours in the way they teach their students. This enables them to bring the discipline to life in an authentic way and demonstrate what is distinct, alive and potentially appealing about their discipline. This brings us onto pedagogic content knowledge.

Pedagogic content knowledge is itself an amalgam. It is the knowledge a teacher has that enables them to represent their subject in a way which makes learning possible. Above all, it is about how to provide explanations that are accessible and sensical to students, and how to put ideas into a sequence that builds learning. It therefore includes knowledge of the curriculum, knowledge of students' likely existing conceptions, and knowledge of the context in which students are learning.

PCK is, in some ways, what distinguishes a teacher of science from a scientist; or a teacher of history from a historian. As such, it is most likely to be a completely new concept to most beginning teachers. Instruction relating to PCK is an excellent way to enable experienced ITT providers to develop trainees' (or early career teachers') substantive knowledge and develop methods of courteously filling gaps and is the focus of the best ITT.

So far, we have considered the development of a teacher within a field that is related to their degree. Teaching and teacher training is further complicated by the prevalence and expectations for teachers to teach outside of their main discipline. In the next three paragraphs, I will discuss some of the specific challenges we face with out-of-field teaching. I will consider the situation within the sciences; but it applies in other disciplines as well.

There is currently a desperate shortage of physics teachers in schools. And therefore, it is inevitable that biology and chemistry teachers will be required to teach some physics. However, that should not mean it is inevitable that a new (early-career) biology or chemistry teacher should teach physics. And neither should it be inevitable that a physics teacher, early career or otherwise, should be required to teach biology (particularly when there is a healthy supply of biology teachers to do so). A new teacher has enough on their plate to become confident in teaching within their own field – in which they feel relatively secure. Adding to this burden by expecting them to pick up, from scratch, the substantive knowledge in two new disciplines places an enormous (and avoidable) additional load on them. Furthermore, teachers are far more comfortable modelling the disciplinary knowledge within their own discipline.

Currently, a physics graduate is likely to be expected to teach biology – even during their training. They may not have studied biology since they were sixteen, and their highest qualification may be just two-thirds of a GCSE (or equivalent). They cannot be as effective as a biology graduate. Such deployment decisions are detrimental to children's learning. However, they are also detrimental to the beginning teacher – because it adds enormously to their workload and can undermine their confidence at a critical stage. Allowing them to focus solely on physics will reduce their workload in two ways: they can rely on their in-field knowledge (rather than having to start from scratch in an unfamiliar discipline); and they will have repeat lessons and can reuse lesson plans. This second point has been shown to facilitate their chances of getting good quickly within their main field.

Attrition rates amongst teachers are highest for teachers of physics and the other sciences. It is very likely that the need to teach outside their main field, especially in their early career, contributes to that high rate. We should not be sacrificing the precious resource of in-field physics teachers on the misbegotten altar of "a teacher of any science should teach all the sciences". This is equally true for biology and chemistry teachers. We should not overburden them too early with the need to learn and teach physics; this can come later. It is both more effective, less

damaging and, frankly, kinder, to allow them to pick up new a specialism once they are experienced, confident teachers within their own discipline. They can do this through specific in-service training to develop a secondary specialism.

Finally, a word about tutoring and mentoring; by which I mean, respectively, specific provision by an expert who is dedicated to teacher development and ad-hoc support and oversight from a supporter is likely to be an existing teacher. Both are important. Most teachers agree that they learned most about their subject in the first three years of teaching.

Therefore, for efficiency and effectiveness, it is essential for teachers to have access to people with expertise and knowledge in their discipline. Furthermore, that expertise should be across all three strands above. To provide the necessary instruction of those strands, trainee teachers need access to a tutor who is embedded in the landscape of teacher development, is familiar with (and preferably part of) the current thinking and for whom teacher development is the main part of their work. For this reason, we should be very concerned about the potential loss of high-quality providers based in higher education – both for the quality of teacher training they provide and the direct link they have with the world of education research. Indeed, it would be helpful for the Review to make suggestions for how we build and nurture university education departments and subject-based education researchers.

When in school, during training or in their early career, teachers need a mentor from within their specific discipline. That is, a physics trainee should have access to direct and specific support from mentors with physics expertise (not one of the other sciences) – and it would be helpful if the Review were to result in this being a requirement. Finally, in the same way that we cannot assume that a good graduate will make a good teacher, we cannot assume that a good teacher will make a good mentor or trainer simply by attribution. Therefore, mentors and tutors should not only be subject specialists, but they themselves need to be developed and trained. Supporting and developing teachers is a specific new capability and needs to be developed.

To close, the strands of knowledge that contribute to making a great teacher are essential, interwoven and complex. They require a concerted and planned effort to be developed effectively and as quickly as possible. As such, we need a system of development for subject knowledge which begins in Initial Teacher Training and continues – in a consistent and coherent way – through their professional career with support from tutors and mentors with expertise in the teacher's home discipline; and trainees should be allowed to focus on their in-field discipline as they develop their teaching ability.

Charles Tracy is Head of Education at the Institute of Physics. His main interests are in the physics curriculum, teachers' professional learning and building professional communities of teachers. He also advises on education policy, particularly relating to teacher retention and recruitment. He started teaching in Hertfordshire in 1987, where he worked as a physics teacher, head of physics, head of science and as an adviser. Charles has also worked as a consultant for the BBC and Channel 4, and has developed educational websites.

Over the years, Charles has written textbooks, overseen major national CPD projects and been involved in curriculum development. He is particularly interested in how the physics curriculum can be structured to develop rich and lasting ideas about physics and its practices.

KNOWLEDGE, TEACHING, TEACHERS, PHYSICS, UNIVERSITIES AND ME

James de Winter, University of Cambridge

The main building at my place of work is named after Donald McIntyre and rightly so. Donald was committed to understanding what it meant to be an excellent teacher and how academic researchers, universities, schools, mentors and teachers could work collaboratively to support all teachers in attaining that excellence. His 2006 paper, 'Bridging the gap between research and practice' explored the types of knowledge that educational research has generated and the knowledge around the practice of teaching, looking for ways to connect these two more effectively.

There are continuing tensions between theoretical knowledge and practical, pragmatic guidance – and these tensions can be enriching. Engagement with academic research is high on the agenda for many teachers and in current educational discourse, but there is a shift of emphasis in the national dialogue. This national movement seems disproportionately to be aimed toward the pragmatic and a single, mandated *right way*. This can only diminish teacher agency and autonomy, and pays little attention to the joyous complexity of teaching.

If I were to sum up the entire PGCE provision here at Cambridge in three words, it would be to enable teachers to make *informed professional decisions*. To do so they require the tools and knowledge to continue with this during their careers. It is usual for university-based teacher education courses to include academic components where beginning teachers are helped to find, filter, read, scrutinise and consider how to apply ideas from academic research in their own classrooms, as well as to evaluate their effectiveness. The time and space to be able to stand back from the whirlwind of a school and classroom and to be able to think deeply about your practice, what you might want to do, and why and how you will know if it worked, is part of the teacher education universities provide. Like the best teaching, it has a legacy after the lesson ends and teachers leave us with this way of thinking as part of their professional practice.

In working with our wonderful and invaluable team of school-based mentors as part of a true partnership, we can help share the academic knowledge that is part of our course as well as be informed and influenced by mentors' experiences in schools, building and maintaining the bridges that Donald McIntyre spoke of. The increasing popularity of Master's level courses in education for in-service teachers only goes to show that there is a thirst for an education in this type of professional criticality, from many who may not have experienced this as part of their initial teacher education.

Here and in other university education departments we are not just consumers and disseminators of this knowledge and the tools of scrutiny and challenge; we are also producers. As an example, much of the work that appears in the highly-regarded Education Endowment Foundation (EEF) *Improving Secondary Science* report (2018) emerged from university education departments with long histories of teacher education and subject-based research into teaching and learning. The names Driver, Millar, Harrison and Reiss are part of a roll call that all science teachers should know and should inform their thinking. All these and many others helped me find my way into the classroom, act within it, and then move to a different life as a teacher

educator, a position requiring me to learn a great deal more to do my job well. Even so, I say with love and respect that I'd not want to be just like any one of them or have only had one of their voices as my education. It is the same for me: I implore the PGCE students here not to try to *be like* me but to *learn from and with* me.

The space, opportunities and infrastructure access that my role in a university education department gives me is not an indulgence, it is part of vital contribution to a wider professional landscape. It is true that those on the Physics PGCE here at Cambridge spend many hours and days on acquiring an understanding of physics teaching which I have accumulated like a magpie over the last 20+ years. I take seriously my role as part of a wider community for all physics teachers and teaching. Through the Institute of Physics, Ogden Trust, Association of Science Education, STEM Learning and others I will, and happily do, share what I know with others.

Equally, my own research work about what it means to be a good physics teacher is not about increasing my citation index, it's about my part in developing the professional knowledge base in which I operate. It is with pride that I see some of my work make its way into other teacher education provision. I wish to contribute to this professional community, provide challenge, and in turn be challenged by it. It is only from these multiple voices that our knowledge about what it means to be a physics teacher can grow and keep pace with the world as it continually changes.

It would be a source of professional shame if my teacher education course was exactly the same now as it was even five years ago. In five years' time, I hope that this will have evolved further. Not because I am wrong now, but because I and my course need to change and improve. My role as a science teacher educator based at a university gives me the time and space to do this, a space that we all know many in schools simply do not have, particularly in physics where there is always a class without a specialist physics teacher needing attention.

Long before Newton talked of standing on the shoulders of giants, Seneca spoke of how we should respect the wisdom of what has come before, be guided by it but not constrained or afraid to move on.

> *But no new findings will ever be made if we rest content with the findings of the past. Besides, a man who follows someone else not only does not find anything, he is not even looking. "But surely you are going to walk in your predecessors footsteps?" Yes indeed, I shall use the old road, but if I find a shorter and easier one I shall open it up. The men who pioneered the old routes are leaders, not our masters. Truth lies open to everyone. There has yet to be a monopoly of truth. And there is plenty of it left for future generations too.* (Seneca, Letter 33)

I'm proud to be part of a university-based teacher education tradition that has contributed so much to the profession. Current policy direction places this tradition and the whole process of continuous challenge and scrutiny under genuine threat, to be replaced by what is on only one side of the bridge Donald McIntyre spoke of. Yes, these concerns and my motivation in writing this are about protectionism. Not about my job but protecting a world class teacher education model here and at many universities which has been developed and refined over many years by some of the finest minds in education, and one which is at risk of disappearing in the very near future.

Regardless of what some may think with the University of Cambridge as my employer and my quoting of an ancient Roman philosopher above, I do not like top tables and avoid sitting at them. However, if we as university-based educational researchers and teacher educators don't even have a space at the table, the meal will be diminished for all.

Formerly a secondary school physics teacher, James de Winter has led the secondary PGCE Physics course at the University of Cambridge for many years. He is a member of the Physics Education Research Group at the University of Uppsala, Sweden where he is researching the development of beginning and early career teachers. James also works with national physics and science education organisations including the Ogden Trust, Institute of Physics and Association for Science Education in various roles which he characterises as "being nice to physics teachers for a living".

INITIAL TEACHER EDUCATION – REFLECTIONS ON MY OWN TRAINING

Hannah Stanwix, Rosebery School

Having read the recent market review of initial teacher training, I reflected on my own experience of changing career and training to be a teacher a few years ago. I remember vividly that I started the teacher training course with a mixture of nervousness and trepidation. Would it matter that I hadn't studied chemistry for almost ten years? Surely I couldn't be expected to be in charge of students wielding Bunsen burners at any point! This was coupled with a hint of complacency. How hard could it really be to teach a group of teenagers how to balance a chemical equation? I was struck by the diversity of my fellow chemistry teacher trainees – some were recent graduates, some had just finished their doctorate studies, and some had worked in industry. Some already had teaching experience, while others – like me – were complete novices. We trained at King's College London, and had a few weeks of university lectures, seminars and interactive group sessions before heading off to our first school placements. Those first few weeks established the tone for the course – the importance of research-informed practice in teaching. The bespoke nature of my training and the focus on educational research were two key takeaways from my PGCE.

The focus on educational research and evidence-informed teaching is something I try to practise each school day. Every time you teach a lesson, it's almost like conducting a mini-research project. You plan your lesson in advance, deciding on the teaching strategies and interventions you will use. You teach your lesson, and sometimes it goes well and sometimes it doesn't. And then you evaluate and reflect, and possibly adapt your approach for the next lesson. One of the differences between a lesson and a formal research project is that the nature of teaching necessitates that this evaluation takes place quickly – perhaps in the two minutes between one class ending and the next arriving, or over a coffee in the staffroom. Each day I can go through this intervention-evaluation-adaptation cycle for five lessons, requiring a degree of flexibility plus the ability to recognise when things haven't worked and the openness to change them.

This approach, and the focus on evidence-informed teaching, is one of the learnings from my PGCE which has stayed with me and become the basis for my teaching.

School life is extremely busy and it is very easy to get lost in the doing – planning your lessons, teaching your classes, feeding back on their work – without stepping back to consider the why – what's the evidence for a particular teaching strategy; what are the best ways to give feedback. At King's we studied many different educationalists and their research – from Vygotsky and the role of social interaction in learning, to the work of Wiliam, Black, Harrison and colleagues on assessment for learning and the impact of feedback on students' learning. This evidence-based foundation didn't stop at the end of my training – I often talk with my colleagues in the staffroom or in CPD sessions about ideas or activities we have tried, whether they have worked or not, and how we might adapt them. We read education blogs, magazines and Twitter messages to stay up-to-date with current research and share with our colleagues. When observers come to watch our lessons, the conversations afterwards are often about what worked well and why, how do we know it worked and what we might tweak next time. As the famous saying goes "the definition of

insanity is doing the same thing over and over again and expecting different results" – my training taught me the importance of reflecting on my practice and making changes when needed.

I mentioned above that one of the most valuable aspects of my training was how bespoke it felt. Thinking back to my undergraduate studies, I remember how anonymous lectures often felt – only towards the end of the course did you get to know many of the lecturers better. Teacher training couldn't have felt more different. The university sessions were mostly in small groups (predominantly science trainees together, but some sessions were a mix of subjects) led by two or three tutors. The diversity of backgrounds of the cohort meant that these sessions were lively and interesting – with many different viewpoints and experiences. Before training to be a teacher I worked in educational policy, so sessions on governmental changes to education and assessment felt familiar, and I was able to help my classmates get up to speed. Whereas sessions on chemistry subject knowledge were challenging for me, and I relied on the support of my colleagues and tutors. This bespoke nature of the training was also true on both of my school placements. My school mentors were both incredible and quickly assessed my strengths and my areas for development. They allowed me autonomy and independence to develop my skills, but also provided support and guidance for the areas I found most difficult. Teacher training feels quite unique in the nature and diversity of backgrounds of the cohort – yet because of the relationships you build and the detailed feedback you receive, it feels so personalised when you are going through it.

Teaching is a job like no other – in one day you could be teaching Y7 students how to draw a line graph, helping Y12 students synthesise an organic compound, comforting a student trying to deal with a bereavement, marking a set of assessments, or calling a parent to discuss their child's progress. We strive to help our students do their best. My training taught me that to do this we must be flexible and adapt our teaching to our students. My teacher training was bespoke to me, just as I try to make my lessons responsive to the needs of my students. Reflecting on the market review of ITT and the changes suggested therein has made me wonder about the experience that future teacher trainees might have compared with mine – will it be as tailored to their needs, to their strengths and weaknesses? Will they spend their training in a diverse group, learning from the experiences of their peers? Will they have the opportunity to immerse themselves in educational research, and understand the background to different teaching strategies? In September 2021 I am mentoring a PGCE student. I hope that my mentee and all those training in the future will have the same excellent experience of teacher training as I did, and I will be as supportive and empowering as my own mentors were. Teaching is truly the best job in the world, and I am so thankful to my teacher training for getting me here.

Hannah Stanwix is a science teacher at Rosebery School, a large secondary school in Surrey. She completed her PGCE in 2017 at King's College London. Prior to training to be a teacher, Hannah worked in education policy and research. Hannah has a master's degree in Chemistry from the University of Sheffield.

IS QUALITY INITIAL TEACHER TRAINING IN SHORTAGE SUBJECTS WELL-DISTRIBUTED?

Ben Rogers, Paradigm Trust

In September 2021 almost 600 people began their training to become secondary physics specialist teachers, some 400 fewer than the Government target. But how did these people choose where to train, and where will they end up teaching? Is quality Initial Teacher Training in shortage subjects such as Physics well-distributed across England? These are questions the Government should consider as part of the ITT Market Review.

In this essay, I use anecdotal evidence and national statistical data to suggest that access to high-quality initial teacher training expertise in shortage subjects varies geographically, and that this may impact not just on where candidates apply to teach, but also on where they begin their teaching career.

As an example, Ipswich Academy opened in 2011 after years of under-performance by its predecessor. The significant investment accompanying academisation failed to improve the situation – in January 2015, Ofsted judged the new academy to be inadequate. Paradigm Trust took over its operation in September of that year. By March 2019, the Academy was judged to be "Good".

A key barrier to improvement was the recruitment of specialist teachers. Teachers in shortage subjects simply did not apply. One traditional strategy for recruiting teachers is to offer training placements, but the nearest HEI training institutions placing specialist students are more than 50 miles away: too far for placements, and further than new teachers typically move. We have good local school-based ITT providers, but their ability to draw on subject expertise is mixed.

The Paradigm Trust solution was to 'grow our own teachers'. We made the decision to recruit graduates as teaching assistants and, if we felt they would make strong teachers, we encouraged them to train with us through the salaried school-direct programme. We worked closely with a local ITT provider to ensure the programme effectively met the needs of our trainees and our schools. Early on, many of our graduate trainees did not have relevant subject degrees, and so subject knowledge enhancement (SKE) and subject pedagogy were key training requirements. (See Charles Tracy's piece, page 11.)

Our trainees required significantly more investment and support than a typical cohort. Those attracted to our locale, school and training opportunity tended not to have the academic background or experience which would have allowed them to successfully apply for more sought-after teaching posts. We were also prioritising initial teacher development at a delicate time – not only were we transforming a school which had been unsuccessful for so long, but such a transformation also entailed taking our most experienced teachers out of classrooms.

Our local ITT provider has been an excellent partner, working closely with us to ensure our trainees get the core training they need, and we have supplemented this provision with our own curriculum-specific training. We are fortunate to have in-house expertise. Do all schools have the capacity to do this?

The situation appears more capricious when you look at the provision of shortage subject specialist teacher training. My particular interest is in physics education. Around half of trainee physics teachers do not have a physics or related degree. Evidence continues to point to the fact that good subject knowledge is paramount to the high-quality teaching of specialist subjects such as secondary school physics. In larger teacher training institutions, students are likely to have access to physics subject specialists. Yet around half of trainee physics teachers are trained on school-based courses: how many of these trainees have access to vital physics-specific training which emphasises subject-specific pedagogy alongside subject knowledge?

Furthermore it is a sensible assumption that non-degree specialists would have a stronger chance of acceptance to a course conducted by a school and its consortia, than to larger HEIs with specialist tutors. In other words, trainees who would benefit the most from specialist physics teacher training may be the least likely to get it. If the Government is to make changes to Initial Teacher Training, it should consider the introduction of minimum standards to support the development of subject knowledge and pedagogy in order to ensure that all trainees have access to the same level of support.

I also have an interest in primary science education. The Wellcome Trust (2017) found that the majority of primary trainees do not have sufficient access to science subject training. The same report found that trainee teachers were also often unable to observe or teach science while on placements. (See Alex Sinclair's piece, page 22) Again, I would argue that the larger training institutions are more likely to have access to science expertise, potentially utilising their secondary science leads. If this is the case, then as for secondary physics, there are likely to be significant geographical gaps in provision.

I hypothesise that the availability of secondary physics (and primary science) expertise on teacher training courses will vary by size of provider and geography. I would therefore encourage the Government to analyse the teacher training data to see whether smaller school-based Initial Teacher Education programmes find it more challenging to recruit shortage subject specialists than the larger research-intensive institutions. This data could also be matched with the School Workforce Census to help us better understand where trainees go on to teach. Understanding where early career teachers train and begin their teaching careers and considering all the implications is vital before making the changes the ITT Review suggests. The system as it stands is far from perfect, but I would hope that any changes to initial teacher training have the empirical grounding to ensure they result in all pupils having access to well-trained and well-supported teachers.

Ben Rogers is the Director of Curriculum and Pedagogy at Paradigm Trust. He taught physics at secondary schools for eighteen years before moving to primary. He currently oversees Paradigm Trust's initial teacher training and teacher development programmes as part of his wider Trust role. Ben serves on the Education Committee of the Institute of Physics and on the editorial board of the Association for Science Education journal 'Primary Science'.

SPECIFIC SUPPORT FOR SCIENCE SPECIALISTS: PROMOTING BEST PRACTICE IN PRIMARY SCHOOLS

Dr Alex Sinclair, St Mary's University, Twickenham London

This vignette is drawn from conversations about the recent ITT Market Review with course tutors at other higher education institutions (HEIs) in England.

There is general agreement (see Sam Sims, page 27) that the Review does not provide a robust argument for the system-wide change it suggests. It highlights how well the sector has coped during the Covid-19 pandemic, and feedback from students at HEIs has been high. Student satisfaction is always paramount, considering the tuition fees and the 'value for money' expected.

The ITT Review proposes a greater emphasis on the in-school mentor-led support provided during placements. However it is not clear how this would work in practice in relation to science. There are often significant gaps in science subject expertise in primary schools, especially given the challenge of learning to teach science as a practical subject (see Charles Tracy's piece, page 11). Most primary classroom teachers and science subject leads do not have post-GCSE science qualifications, and the nature of science teaching varies. The Science Lead in a primary school has frequently not chosen this position. Curriculum design in some schools means that science can be timetabled inconsistently, or for a different time of year from the student teacher placement, and student teachers may not observe high-quality science lessons during their school placements. Whilst placement audits require that trainees teach their specialist subject, primary schools give priority to reading, writing and maths rather than science.

Extra support for science-specific mentors in primary schools would be welcomed, but the ITT Review does not show how the current system could provide capacity for this. The ITT Review recommends extra time in schools, which might mean a greater chance of experiencing science teaching, but this would be at the expense of taught sessions.

Many trainees lack confidence and are anxious about teaching science. This lack of confidence is associated with their identified lack of subject knowledge and how to make the curriculum content accessible to pupils, the practical nature of the discipline and the management of science lessons, alongside other pedagogical issues. In addition to this, many of these trainees' life and school experiences have resulted in negative connotations of science or an ambivalence about what science and a science education can offer. As HEIs we work to help student teachers overcome barriers to teaching science, but school-based ITE routes provide less time for dialogue which can support student teachers to face these deep-rooted issues and overcome their barriers.

Taught sessions across ITE programmes are designed to increase a trainee's confidence in a number of ways and are delivered by science specialist tutors. The following provides a brief overview of the ways in which this is achieved.

Developing secure science subject knowledge and the identification of common misconceptions are core foci for improving confidence. Audits are undertaken by the trainees which highlight and challenge common misconceptions. Specific sessions on subject knowledge are also timetabled. It often becomes apparent that

children's misconceptions are also held by trainees. Individual tutorials are offered for those struggling.

Practical work is carried out by trainees who have the chance to trial age-appropriate activities which can be used in school. This is one way of providing the trainees with the resources they so desperately ask for. Perhaps more importantly it affords them the opportunity to discuss and gain advice on the different ways of managing these lessons to ensure optimal learning.

Prior to trainees' placements, they watch and critique pre-recorded science lessons with the help of their tutor's expert advice. High-quality and reputable resources which will be accessible on school placement are tried out in these sessions. These include (although not restricted to) medium-term plans (sequences of lessons), examples of age-related work, concept-related activities, and links to reference material which help improve subject knowledge and identify misconceptions. Institutions also have the facility to loan out equipment to trainees in schools where it may be lacking. Tutors are frequently contacted for guidance on teaching a particular lesson or topic. In fact, this tutor's help is often extended past the point of qualification as a teacher.

The benefits of a science specialist tutor are multi-fold. Advice is often drawn from the large network of schools that they have a connection with, in conjunction with other experts in the field. Most are involved with organisations such as the Association for Science Education (ASE), Primary Science Quality Mark (PSQM) and the Primary Science Teaching Trust (PSTT) all of whom have the goal of improving the quality of science education in the primary classroom. This, and science specialist tutors' own classroom experience assists them in identifying and anticipating trainees' needs and helps them to plan and sequence the input received by trainees. This understanding of trainees' needs also ensures the quality of resources recommended. Science specialist tutors also have the expertise to help trainees navigate, critically reflect upon and build into their practice the plethora of ideas suggested from research.

An initial step in ensuring that trainees' experiences of learning to teach primary science is improved would be to address the low teaching priority that science is sometimes given in schools because of the emphasis on learning English and Maths. While both these subjects are the foundation for future learning, it seems odd that a child can transition from primary to secondary school having rarely learnt science, which will occupy so much of their secondary timetable.

Alongside this increase in profile, it would be prudent to provide the time for science-specific continuing professional development for classroom teachers. There is enough expertise already in the system from courses such as those provided by STEM Learning and subject organisations such as the ASE to facilitate this.

Alex Sinclair is the Primary Science lead at St Mary's University, Twickenham London for their primary and undergraduate ITE teaching courses. He completed his doctoral studies on the role of starting teachers in the development of a curriculum for sustainability. His interests also include how science can promote equity, diversity and inclusion. Alex is Chair of the ASE Futures Committee, a Hub Leader for the Primary Science Quality Mark and Lead Facilitator for STEM Learning. He writes regularly for the ASE's 'Primary Science' journal. His publications include 'Standing on the Shoulders of Giants' and 'Superhero Scientists'.

TEACHER SUPPLY FOR THE SCIENCES: DO WE HAVE REASON TO BE CONCERNED?

Michelle Palmer, Royal Society of Chemistry

Teachers are the most important resource in our schools, and we don't have enough specialist chemistry teachers – recruitment of chemistry trainees has been consistently below the DfE's Teacher Supply Model (TSM) target since 2015.

Supply of secondary science teachers is a complex issue and the Royal Society of Chemistry (RSC) is concerned about what a market reconfiguration could mean for science teacher training. Any changes should be analysed alongside teacher supply, particularly for shortage subjects. If the ITT Market Review recommendations are implemented, an unintended consequence may be reduced opportunities for trainees across different types of providers and regions to access training and therefore a reduced supply of teachers in our classrooms.

The RSC spent much of summer 2021 speaking with providers, and examining some of the DfE data to explore potential risk factors. Risks, for example of reducing approximately a quarter of chemistry trainees,[1] should Russell Group universities withdraw. The RSC has also identified a risk of small-sized School-Centred Initial Teacher Training (SCITTS) organisations withdrawing from teacher training.

Our analysis of DfE's ITT census data[2] on new entrants to postgraduate teaching training courses in 2020-2021 identifies 119 SCITT providers which train ten or fewer science teacher trainees. Based on our discussions with providers and other stakeholders, we are concerned that there is a risk that smaller SCITT providers may withdraw from teacher training of the sciences, reducing the provision across regions.

WHY MIGHT SCITT PROVIDERS WITHDRAW FROM SCIENCE TEACHER TRAINING?

Loss of autonomy

Autonomy might be lost through having to develop partnerships with other organisations, removing their local knowledge of context.

Additional requirements, without additional funding

Additional capacity would be required to meet the Quality Requirements (QR), although there is no additional funding. One SCITT has estimated that the extra intensive placements would cost £16,000 for a cohort of 60.

Burden of reaccreditation

Reaccreditation of SCITT providers would be a further demand on their time and resources.

Evidence of need for change

The ITT Review evidence base for proposed reform of teacher training has been questioned by many providers.

1 Russell Group, July 2021, https://russellgroup.ac.uk/news/russell-group-response-to-the-itt-market-review/

2 DfE, Initial Teacher Training Census, December 2020 Initial Teacher Training Census, Academic Year 2020/21 – Explore education statistics – GOV.UK (explore-education-statistics.service.gov.uk)

The potential risks are high. Large-scale providers including the University of Cambridge have been clear about their intention to withdraw from teacher training if the proposed changes go ahead.[3] In the Cambridge region there are about five SCITTs which train fewer than ten science teacher trainees. If those SCITTs do not run science programmes, alongside the loss of the University of Cambridge, this region may have significantly reduced options for teacher training.

One SCITT provider, training approximately ten science student teachers a year, stated that part of the draw for people to train at smaller SCITTs is that they live in the area and don't want to travel too far. Similarly, another small SCITT told us that they understand the needs of their local area and worry about the idea of forming partnerships which risk their autonomy.

During the peak of Covid-19 we saw training providers respond with strength, resilience and genuine care for their student teachers and their pupils. Providers also spent this period of the pandemic working on their curricula, focusing on the Core Content Framework (CCF) and linking to the Early Career Framework (ECF). Many felt the CCF and ECF gave them a sense of connectivity across their work and were confident that all areas were well-linked.

It is important that we have a period of time to allow these changes to embed and for providers to have a period of testing and reflection before further changes are made.

TO RE-ACCREDIT OR NOT?

A major cause for concern is the recommendation for existing providers to be re-accredited. We fear that if this recommendation is implemented, high-quality providers may withdraw, and some may be forced to do so, not because they are not high-quality providers, but because they do not have the capacity to complete the requirements within the current timeframe.

Based on the suggested timelines, providers will have five months to establish new partnerships, 'gather evidence against criteria' and submit an application for re-accreditation. Within the context of having recently adapted curricula to meet the CCF requirements, as well as weaving aspects of the ECF, all within the backdrop of a global pandemic, there is a risk that some HEIs and SCITTs may choose not to put themselves through the stress of this process, reducing the options for trainees to access local science teacher training. In England we are already under-recruiting chemistry trainees. Why would we risk reducing teacher training options?

IS NOW THE TIME FOR CHANGE?

Chemical scientists of the future will be the ones we look to for tackling the world's health, societal and environmental problems. This is why we must do everything we can to ensure that chemistry teacher trainees have access – across all regions – to the best possible teacher training, meeting their local needs, so we can ensure school students have access to the best possible chemistry education.

Providers have had a turbulent year-and-a-half responding to Covid-19. It has also been a time of significant policy change. We see value in some of the recommended changes and believe that they could increase quality if they are

3 University of Cambridge, Statement on the UK Government Initial Teacher Training (ITT) market review report, July 2021, https://www.cam.ac.uk/notices/news/statement-on-the-uk-government-initial-teacher-training-itt-market-review-report

done in collaboration with the teaching sector. But the timeframe doesn't allow for genuine engagement with the recommendations, before needing to be reaccredited. We call for recommendations to be analysed alongside teacher supply, and for a delay before any are taken forward.

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MAKING GOOD ON THE ITT MARKET REVIEW

Dr Sam Sims, UCL Centre for Education Policy and Equalising Opportunities

POLICY CONTEXT

Since the publication of the Carter Review in 2015, teacher education/training in England has been undergoing major reform.[1] Central to this has been the introduction of the 'Early Career Framework', which has two components. First, it extends the induction period by providing teachers with a funded 5% reduction in timetabled teaching in the second year of employment (in addition to the existing 10% in their first year). Second, it provides access to in-school coaching for teachers across the first two years of employment. Taken together, this effectively extends the induction period for new teachers from two years (one training year and one in-school year) to three years.

Alongside this, the Government has introduced new 'Core Content Frameworks' (CCF): minimum-entitlement, evidence-based curricula/syllabus endorsed by the Education Endowment Foundation, specifying what teachers should know and be able to do after their training year,[2] and after their first two years of employment as a teacher.[3] Ofsted inspections of Initial Teacher Training (ITT) providers already incorporate checks that they are covering this core content with all trainees.

These changes to initial teacher training have been accompanied by reforms to the National Professional Qualifications (NPQ) for more experienced educators, introducing new qualifications for specialist senior teachers (e.g. NPQ Leading Teacher Development), and reforming the existing qualifications for senior leaders, headteachers and executive heads. Each of these NPQs is also accompanied by a new Core Content Framework .[4] In sum, the system for teacher training in England – from qualification to retirement – has been overhauled within six years.

THE ITT MARKET REVIEW

In July 2021, the Government released the report from its review of how the ITT market can provide a sufficient supply of high-quality new teachers.[5] The Review cites evidence from Ofsted research, collected during visits to 75 out of 240 registered ITT providers during Spring 2021. This research found that less than half of the participating ITT providers could demonstrate they had incorporated the relevant CCF material into their ITT curricula, despite this having been a requirement since September 2020.[6] In addition, Ofsted concluded that too many ITT mentors relied on trainees to tell them what they had already learned and what they wanted to work on next. In response to these criticisms, the Market Review recommended that "providers of ITT should develop an evidence-based training curriculum as a condition of accreditation which allows trainees to understand and apply the principles of the CCF in a controlled, cumulative and logical manner."

The wording of this recommendation merits closer examination since it contains within it the main ideas and argument of the Review as a whole. First, the Review wants providers to develop an *evidence-based* curriculum, which includes the CCF in full, but and should also include additional evidence-based material chosen by providers. Second, the Review wants this curriculum to support trainees to *understand and apply* this material, through the integration of theory and practice.

This contrasts with a situation in which theory is taught in the ITT classroom and practice is done in placements – but the two remain largely disconnected. Third, the Review wants the curriculum to be *controlled and cumulative*, in that providers intentionally design the sequence in which knowledge and skills are learned so that foundational skills (e.g. basic behaviour management) are taught first and higher-order skills (e.g. facilitating class discussion) that depend on these lower-order skills are taught subsequently. Finally, the Review wants all of this to be a *condition of accreditation* such that nobody can provide ITT without first demonstrating they fulfil these criteria. To do so, the Review recommends a consolidation of ITT providers under a smaller number of 'lead providers'.

Building on the aim that trainees be able to *understand and apply* evidence, the main practical innovation proposed by the Review is to introduce a new requirement for trainees to undergo 20 days of 'intensive practice'. This differs from placements in that it involves 'approximations of practice' such as simulations or role plays, rather than teaching in real classrooms. This provides an opportunity to isolate specific skills, for mentors to provide immediate feedback integrated with the underlying theory, and for trainees to have the chance to rehearse the target skill based on this feedback. To ensure that ITT providers have the skills to provide intensive practice, each will need to have a 'lead mentor' who has completed the NPQ Leading Teacher Development, or a comparable qualification.

THE SECTOR'S RESPONSE TO THE REVIEW

The response to the Review from ITT providers has been largely negative. Higher Education Institutions (HEIs) have criticised it for undermining academic freedom by imposing a core curriculum/syllabus, and for threatening HEI-school partnerships through the process of consolidating smaller providers into networks lead by larger 'lead providers'.[7] These concerns are exacerbated by a suspicion – building on the push toward school-led ITT between 2010 and 2015 – that Government is trying to force many HEIs out of the market altogether.[8, 9] Meanwhile, many school-led ITT providers fear that the autonomy which they gained by establishing their own provision will be undermined if they are forced to consolidate into networks lead by larger 'lead providers'.[10] Both HEI- and school-led ITT providers worry that the proposed timeline and lack of new funding for the additional 20 days of intensive practice make the proposals infeasible – thus threatening the supply of new teachers.[11]

A WEAK ARGUMENT AGAINST THE ITT MARKET REVIEW PROPOSALS

In general, providers have questioned the evidential basis for embarking on the reform in the first place. Many have cited survey data showing that 70-80% of teachers rate their training positively.[12] Others have cited data from Ofsted inspections showing that almost all ITT providers are rated 'good' or 'outstanding' by the inspectorate. Reviewing this and other evidence, the All-Party Parliamentary Group for the Teaching Profession concluded in their report *If It Ain't Broke, Handle with Car***e** that "there is no evidence that there is a substantial quality problem that justifies a significant change".[13]

This argument is not convincing. Does 70-80% of teachers providing a positive evaluation of ITT suggest that it is good enough? Or does 20-30% of teachers not giving a positive evaluation suggest that ITT is not good enough? In any case, these surveys are conducted with serving teachers, which means that they under-

represent teachers whose training was insufficient to keep them in the profession. Similarly, Ofsted's ITT inspection results have never been properly validated.[14] By definition, that means that is unclear what resemblance Ofsted inspection grades bear to the true quality of the inspected courses.[15]

All this points to a more fundamental issue about evaluating the quality of existing provision. A sensible starting point for any research project is to think about the ideal data that would be required to answer the research question. In this case, we would want to collect nationwide teacher value-added data (on whatever metric) for recently qualified teachers. However, this data does not exist in England due to an agreement between Government and the unions. We therefore cannot get a good measure of the quality of ITT or indeed validate the Ofsted ITT inspection process.

In sum, nobody currently knows how good or bad ITT in general is in England. Instead of asking '*Is ITT good enough*' it might therefore be more productive to ask '*are there evidence-based ways of improving ITT*?'

EVALUATING THE EVIDENCE SUPPORTING THE PROPOSED REFORMS

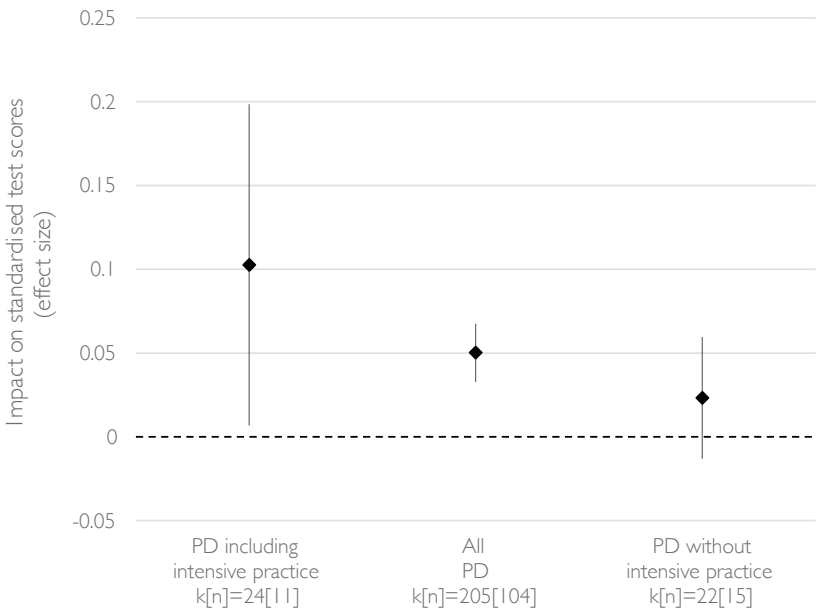
The University of Oxford's response to the Government consultation argues that the proposals made in the Review are "not based on any well-researched model of professional learning". Likewise, the UCL Institute of Education's response argued that the proposals represent a narrow "skills-based or technical approach to teacher education".[16] These objections are both poorly-informed. The proposals in the ITT Market Review actually reflect the paradigm of Practice-Based Teacher Education (PBTE), on which there has been a proliferation of research over the last fifteen years.[17] PBTE emphasises not just knowledge or just practice, but rather the "the use of that knowledge in practice".[18] Careful theoretical work and case study research has shown how it is possible to *integrate* theory and practice in a way that respects the situated and sophisticated nature of teachers' work.[19] The ITT Market Review reflects this in its recommendation that "theory and practice are integrated and interleaved at every stage" and in using concepts (decomposition, approximation) drawn from PBTE scholarship.[20]

So the Review does sit on a coherent theoretical foundation. But what about empirical evidence? Ian Mearns MP, for example, has criticised the report for citing insufficient evidence in support of its proposals.[21] I would tend to agree – indeed, the report seems to understate the empirical evidence for its proposals. For example, there is now empirical (including experimental) evidence to support the value of PBTE approaches in helping trainee teachers use: ambitious instructional practices in English literature; [22] theoretically informed classroom management practices; [23] and high-quality formative assessment.[24]

Recent research on teacher Professional Development (PD) also supports the use of intensive practice sessions. The figure below shows the results of an original analysis of a comprehensive database of 104 randomised controlled trials testing the impact of PD. The vertical axis shows the impact on pupils' standardised test scores. The leftmost plot 'PD including intensive practice' shows the average impact for all PD that includes the following components: isolating a specific skill to work on, mentors modelling that skill to the teacher, the teacher rehearsing the skill, and the mentor giving the teacher feedback based on observing their practice. The middle plot 'All PD' shows the average impact of PD. The rightmost plot 'PD without intensive practice' shows the average impact for the 15 studies which do not include *any* of the

above-listed components of intensive practice. The average impact for 'PD including intensive practice' is .10 (p=.03); the average impact of 'All PD' is .05 (p<.01); and the average impact for 'PD without intensive practice' is .02 (p=.18). This strongly suggests that incorporating an intensive practice component in early-career teacher training would results in improvements in teaching and learning.

Average impact of different types of Professional Development (PD) on pupil test scores



Notes: Results of a random effects meta-analysis using robust variance estimation. PD = professional development. k = number of effect sizes. n = number of separate experimental studies. Vertical bars represent 95% confidence intervals. 'PD without intensive practice' comprises PD which incorporates zero of the four elements of intensive practice. This analysis is based on data originally collected for a separate EEF project.[25]

SOME STRONGER CRITICISMS OF THE ITT MARKET REVIEW PROPOSALS

While the goals of the ITT Market Review are the right ones, there remain important concerns around the means of achieving them. These relate to timescales, academic freedom, and funding.

The Review proposes that all ITT providers be re-accredited during the 2021/22 academic year (AY), which would allow re-accredited providers to continue to recruit trainees during the 2022/23 AY and begin training this cohort in the 2023/24 AY.[26] This would require all 240 ITT providers to prepare the necessary paperwork within five months.[27] This timescale will be challenging for the sector, which has been working hard to maintain the trainee school placement system during the Covid-19 pandemic. The National Association of School-Based Teacher Trainers (NASBTT) and others have suggested that the same realignment could be achieved through the existing Ofsted inspection cycle.[28] However, the DfE claims that the current six-year Ofsted ITT inspection cycle would be too slow – taking three times as long as their (two-year) proposals.

The Review also recommends that incorporation of the CCF material becomes a condition of re-accreditation. The representative body for HEI ITT providers has expressed concerns that "The continued involvement of some universities in teacher education might be at risk if they are expected to slavishly follow and accept current and potentially time-limited DfE approved orthodoxies and deliver prescribed curricula." The University of Cambridge and the University of Oxford have threatened to stop providing ITT altogether.[29] This has already been picked up on in a *Telegraph* editorial, which provides some indication of how politically salient it would be.[30]

The Review's proposals for an additional 20 days of intensive practice also have implications for funding. Under existing ITT provision, providers typically pay placement schools a fee to cover their costs in hosting trainees. Finding intensive practice placement schools would likely involve similar fees/costs for providers. In addition to this, the Review introduces new minimum requirements for course length, classroom teaching experience and mentor training – all of which have cost implications.[31]

These three criticisms are important. The issue around funding is particularly fundamental as no ITT provider can continue to deliver a loss-making course. For exactly this reason, it seems very likely that that Government will announce additional funding for the reforms if they press ahead. In the next section of the paper, I set out a proposal designed to address the objections around timing and academic freedom. My goal is not to provide a philosophically pure argument derived from first principles, but rather to propose a pragmatic route forward that would be acceptable to all stakeholders, while making good on the promise of the Review to ensure that all trainee teachers can benefit from evidence-based, practice-based teacher education.

A TWO-STEP APPROACH TO RE-ACCREDITATION

During the 2021/22 academic year, the Government should establish a new independent Initial Teacher Training Council (ITTC) with responsibility for accrediting all ITT in England. This would be staffed by appointees, chosen initially by civil servants, based on their record of published academic research in competitive journals. A proportion of appointees should be chosen based on their subject-specific expertise. The ITTC would inherit the existing ITT Core Content Framework and ITT Quality Requirements but would revise and update them as the evidence base develops. Like the General Medical Council (GMC), the ITTC would accredit ITT providers against these standards. This should solve the academic freedom problem, since no universities object to the GMC defining the core curriculum/syllabus for their medicine courses. The Oxford and Cambridge PGCE courses would therefore be saved.

The Government should also announce in October of the 2021/22 AY that the largest 53 ITT partnership will need to submit materials for re-accreditation by 1 July 2022. This gives them almost nine months to submit their revised curricula and plans – twice as long as under the existing proposals and in line with what the Universities' Council for the Education of Teachers (UCET) say universities need to revise their courses.[32] The ITTC would then inform them by 1 September 2022 whether they were allowed to recruit during the 2022/23 AY. The large providers that are re-accredited would then have one year to prepare for

delivery of the realigned curriculum/ syllabus starting in September 2023. These larger providers account for 70% of all trainees, meaning the Government would achieve a 70% realignment of ITT within the same timeframe (two years) as their existing proposals, but avoiding many of the risks of a potentially chaotic market consolidation in the process.

The Government should also announce in October of the 2021/22 AY that the remaining 187 ITT partnerships will need to submit materials for re-accreditation by February 2023. This gives smaller providers almost 18 months to prepare their submissions – three times longer than under the current proposals. The ITTC would re-accredit smaller providers by September 2023 – allowing them to recruit during the 2023/24 AY and give them one year to prepare for delivery starting in September 2024/25. The smaller providers would therefore begin realigned delivery three years from now – one year later than under the government's current proposals.

MAKING GOOD ON THE ITT MARKET REVIEW

The proposals set out here will deliver on the goals of the ITT Market Review. This would be achieved within three years, which is almost as quick as the Review's proposals. However, the proposed two-step approach will give HEIs the time that UCET say they require to realign their courses, while also giving smaller providers far longer than under the Review's proposals. The two-step approach also negates the need for consolidation into provider networks, thus minimising disruption of existing partnerships and threats to supply. Likewise, by creating an independent institution to accredit against evidence-based standards, the proposed approach neutralises the risk of HEI providers pulling out of the market for reasons of academic freedom.

Creating the ITTC would also put the process of updating the CCF and Quality Requirements for ITT on a sustainable footing, allowing the document to be updated as the evidence base develops. ITT providers could then be inspected against these evolving standards by Ofsted. This would be analogous to the existing setup in which ITT providers are inspected against the Early Career Framework (ECF) – but with the standards set by an independent body of experts, rather than Ofsted themselves.

It is doubtful that any of the stakeholders in this debate would agree with all of the proposals set out here. However, this compromise would likely be accepted by almost all parties, while also making good on the promise of the ITT Market Review to provide more effective, more evidence-based, more practice-based initial teacher training.

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