Preparing trainee teachers to negotiate the tension between disciplinary excellence and inclusion

This article outlines some of the ways in which teacher educators can prepare trainee teachers to understand and respond to the perceived discrepancy between inclusion of diverse learners and the aspirations expressed in policy of promoting rigorous science education and assessment. It looks at evidence on the views of trainee teachers on the difficulties they experience in reconciling the two aims. It then suggests approaches, based on my own experience that may help to 'bridge the (apparent) gap'.

Evidence on the source of the problem

This article draws, firstly, on two studies that I carried out with two populations of trainee teachers. Both studies involved interviewing trainee science teachers who were on a one year teacher training route. All had completed at least one of their two school placements. All had undertaken the university elements that included teaching about inclusion and the policies around it, and all had been inducted into the practices of at least one placement school. The first study interviewed trainee teachers before they began their second school placement, and also scrutinised course materials to understand how ideas about inclusion and inclusive education were being taught by staff and understood by staff and students. In addition, school pupils' views were gathered from two schools which regularly worked with trainee teachers . The second study re-visited the question of how trainee science teachers viewed inclusion after a gap of five years, during which time the UK had seen the introduction of the Prevent strategy, aimed at detecting terrorist activity early on. (Essex, Alexiadou and Zwozdiak-Myers, 2018). The second study took place in a highly culturally diverse area of outer London in contrast to the first, which was situated in a far less diverse area in the north-west of England. The methodologies differed slightly in that the second study involved focus group interviews at the end of the academic year, when both placements had been undertaken In addition, the second study gathered questionnaire evidence on how the trainee teachers understood the term 'Fundamental British Values' which trainee teachers are required to uphold. Both studies revealed that science trainee teachers identified as subject specialists far more than they identified as agents of social justice through inclusion, despite policy drivers for them to do both. The perceived tension between being a good science teacher and being an inclusive teacher were reflected in the structure of the course, with inclusion addressed as a generic topic rather than within subject specialisms. The staff and students in study one commented repeatedly on the performativity pressures of Ofsted to demonstrate secure subject expertise and felt that this detracted from endeavours to focus on the teaching of diverse learners. In contrast, inclusion seemed a more nebulous notion and one that was likely to impede effective subject teaching. The findings, based on data sets, showed that there is an ongoing problem of '*the multiple and often contradictory aims of the government policy*' (Alexiadou and Essex, 2016, 2). In no way do I decry the importance of subject pedagogy based on secure knowledge, and am aware of the evidence for its importance in securing effective learning (Royal Society, 2007). However, excellent subject knowledge alone does not guarantee that teaching will

be inclusive. Nevertheless, knowing your subject well helps a teacher to make strategic decisions about how to approach the content. What is also needed is an understanding of how excellent subject knowledge can form the basis of inclusive subject pedagogy. I have actively worked to help fill the gap in recent literature in this area, since the last significant contributions were seen in the wake of the first National Curriculum for Science, published in 1988, as teachers grappled with the practical delivery of a common science curriculum for all.

Even allowing for these differences, a number of common themes emerged from the two studies. One of these was that inclusion was understood to be relevant for a range of characteristics rather than disability alone. Along with this broader understanding of inclusion, there was a persistent lack of clarity about what the term 'inclusion' really means and uncertainty about what inclusive science teaching actually looked like. The trainee teachers repeatedly said that they could not attend further to inclusion because of the relentless pressure to cover content. The consensus was that inclusion could be carried out but within limits, those limits being defined as modifications that might compromise the transmission of the required scientific knowledge. For example, one interviewee said,

Inclusion shouldn't have to include everybody … there should be a point where a person can't and shouldn't be included because it would be to the detriment to the rest of the group. (Essex, Alexiadou and Zwozdiak-Myers, 2018: 9)

Arising from the interviews, and in the light of my own experiences (an experienced ITE tutor), I suggest that there are four approaches that, in combination, can help to bridge the perceived gap between inclusion and excellent science teaching.

1. Redefining inclusion, reducing the tension

There are various views of inclusion and Göransson and Nilholm (2014) offer a helpful way to consider these:

(a) the physical placement of pupils with diverse characteristics in classrooms with their peers

(b) targeting intervention at individuals identified as being at risk of educational under-attainment in order to meet their identified needs

(c) inclusion as an approach that offers individualised support to all pupils as they need or request it

(d) inclusion as a mechanism for forging social links in communities, both the school community and the wider community beyond the school

Of these four views, policies on inclusion over the last two decades have tended to focus on the second version, which in turn is prone to promoting a 'deficit model' of diversity. The views of the trainee science teachers also reflected this model, with

much of the discussion being about doing things for a specified group of diverse learners. Sadly, it appeared that the ITE course had promoted this notion,

We had specific days in university on different groups of learners. I had never thought before about a lesson plan for each specific group. (Essex, Alexiadou and Zwozdiak-Myers, 2018: 9)

One of the problems raised by this is that certain trainees? believe that there a whole suite of different pedagogic strategies according to the diagnosis of the diverse learners. Attending to these different needs was felt to be a distraction from teaching the subject well. If, however, they could be helped to view it as something that any pupils could need, depending on their situation at that point in that lesson, and that being ready to respond to need beyond labels, it simply becomes responsive teaching. This presents much less tension because pupils not quite understanding or needing help is an expected and unremarkable part of the classroom. It also encourages teachers to anticipate likely issues and to pre-empt them in their lesson planning. Other research evidence indicates that, far from needing to be competent in multiple pedagogies, inclusive teachers need simply to be reflective, observant of their pupils, aware of how their actions shape events in the lesson and willing to implement changes as there is an indication of the need for them (European Agency for Development in Special Needs Education, 2016). These are attributes that can be captured in lesson planning and evaluation templates, also in the way that trainees are asked to describe the groups and pupils they teach. However, my experience of offering trainee teachers the opportunities to work intentionally with diverse learners, for instance through an enrichment placement at an alternative setting, in which to deploy these key attributes develops both experience and confidence on their capacity to work constructively with diverse learners. How does this sound?

However, when trainee teachers have the opportunity to work intentionally with diverse learners (for instance through an enrichment placement at an alternative setting), and where they deploy these key attributes, it can help to develop experience and confidence in their capacity to work constructively with such learners.

Exploring the culture of science as an exercise in privilege

Science has been described as occupying '*the curriculum high table'* (Millar and Osborne, 1998, p1) and this is an aspect of the subject that science specialists accept unquestioningly. Indeed, it is to confer this advantage on pupils that many are motivated to become teachers, judging from the interviews I have observed over twenty years. Likewise the economic and political importance of science has been the basis of favourable funding, such as additional funding via bursaries for shortage STEM subjects. But alongside the advantages conferred upon it has come an

increasing expectation that school science acts as preparation for future science specialists, with a greater emphasis on abstract ideas and a large body of subject content to be assimilated in readiness for 'gatekeeper' assessments, such as National 5 or GCSE exams. The notion of 'science for all' has been replaced with 'science for an elite few imposed on all'. This is far from inevitable, and science of value does not have to be difficult or elite. It is good to reflect that Lavoisier, the 'father of modern chemistry' had no knowledge of atoms or molecules, for example. Whilst we cannot, as individuals, overturn the current curriculum, we can encourage trainee teachers to be critical of its content and associated assessment takes. Incorporating work on the 'nature of science', which explores the 'why' of what we teach is rarely popular, but in my experience it is common for former trainee teachers to report, years later, that learning not to accept the curriculum unquestioningly was the most valuable aspect of their course. Developing this analytical stance to curriculum can be achieved through requiring trainee teachers to read published literature but can also take the form of asking them to design and justify their own science curriculum for a specified topic. This becomes even more eye-opening if they are asked to describe how they will then assess progress. The activity can constitute a great 'ice breaker' and also makes them aware that curriculum embodies intentions that are rarely explicit. By recognising that these tacit assumptions may be exclusionary, we encourage the trainees to adjust their delivery of the curriculum to make it more inclusive.

Understanding differentiation as both the magic key and the poisoned apple

There is considerable emphasis in the formal assessment requirements for teachers to differentiate, which is understood to be a key way to mediate between individual needs within a shared learning experience. Trainee teachers were very aware of this as a vital skill to develop and frequently expressed anxiety about it. For example,

I am not able to differentiate well for Autistic Spectrum Disorder because I haven't had much experience of it. (Essex, Alexiadou and Zwozdiak-Myers, 2018: 9)

There is no question that differentiation, whether by task, outcome or support can be a crucial way of mediating between the needs of individuals and those of the wider group. However, it may be unintentionally damaging, especially when we consider differentiation by task, because it can signal low expectations. There is a wealth of evidence of the damaging effects of low expectations and this needs to be made explicit every time we discuss ways of differentiating (Rosenthal and Jacobsen, 1968). We also know that support of the wrong kind can impede progress, in that too often it takes the form of doing the work for the pupil, such as writing answers because they cannot write fast enough. Instead we need to prepare trainee teachers to support by scaffolding, that is providing support in a form that will enable the pupil to progress to the point where they can do it independently. Other forms of scaffolding can include the provision of opportunities for; concrete engagement before engaging with abstract concepts, considering variables qualitatively before looking at quantitative data, or simply permitting pupils to repeat an activity so that they are confident that they understand what to do. As an example, when

considering the effect of temperature on rates of reaction, learners could put a spoonful of baking powder into beakers with equivalent volumes of cold tap water, hot water from a recently boiled kettle and a half-and-half mixture of hot and cold water. Strips of paper taped to the side of the container permit the three heights to be recorded without quantitative measurement and then the heights can be compared. This enables them to see the trend in the reaction rate, which increases as the water gets warmer, before starting to get into the details of measuring temperature and amount of product.

The impact of temperature on a reaction is even more evident if a small amount of washing up liquid is added to capture the gas produced. The foam produced lasts longer than the gas bubbles alone would, which aids measurement.

Photo by Pam Tait, University of Strathclyde

I often share with the trainee teachers Daloz's (1986) model of development, which says that high levels of progress are brought about by high levels of challenge in combination with corresponding support. In practice, this takes the form of thought provoking content with practical guidance, such as a writing frame, or digital assistance, such as voice to text technology. In a packed training programme, it is worth making time for the trainee teachers to analyse the demands of some exemplar lesson plans and consider how they might build strategies for scaffolding into it.

Re-conceptualising excellence

I have recently been considering the purposes of science education for all pupils. This is the list that I came up with:

- To enhance pupils' awareness and understanding of the world in which they live
- To show them one of the ways in which knowledge can be created, specifically the use of physical evidence to test and refine ideas
- To equip them with the skills to make decisions in a scientific way, for example about possible lifestyle choices
- Skills rehearsal or development, such as data processing, communication, manipulative skills, analysis, evaluation and problem-solving
- To facilitate their access to science-based jobs **and** those jobs which require the skills that science develops
- To foster personal attributes such as motivation or creativity or tenacity
- To induct pupils into important elements of modern culture, for example scientific accounts of climate change or health care
- The pleasure of succeeding in a high status subject area
- Opportunities to work socially and collaboratively
- Enjoyment, especially of practical work

I did not include the learning of more science content, as in an information rich world, this does not seem to be something that science lessons **need** to be packed with. The reason that we focus so much on content in practice is, of course, to prepare pupils for the assessments they will take, for which recall and understanding of accepted knowledge is essential. As noted earlier, the format of the exam is beyond our immediate control. However, we can ask the trainee teachers to include an objective that addresses aims beyond the acquisition of knowledge and understanding and to identify how they will recognise that the intention has been fulfilled. This, in turn, opens up a discussion about what forms excellence might take if we were to focus on some of the other purposes of science education.
For instance, instead of a pencil and paper test asking them to define sustainability, pupils' understanding of climate change and sustainability could be tested by asking them to select and justify objects for a time capsule that will be opened at a summer school on climate change in 100 years. When I did this recently, a young person with Additional Support Needs put a plastic chocolate bar wrapper into the tin. When asked to justify his choice, he explained that,
'*I don't think in a hundred years' time that people will be allowed to use plastic to wrap food in and I think that they will be shocked that we ever were.'* (Field notes, unpublished)
In my judgement he demonstrated the notion of impact over time, and how human behaviours influence the use of materials and their impact on the environment and empathy with a future generation. These are exactly the same elements as widely used definitions of sustainability and shows real understanding from someone who would have struggled to memorise a standard definition.

Conclusion

Although there is an undoubted anxiety in trainee, and indeed experienced teachers, about how to reconcile curriculum and assessment pressures with inclusion, the two are less irreconcilable than they may realise. Whilst there is no easy 'fix' to their perception, a critical engagement will enable them to make informed decisions about their professional beliefs and practice. This requires us to encourage them to reflect on why we wish to have all pupils learn science and why we advocate inclusion, along with the ways in which these two aims are enacted in school. On a time-constrained content-dense programme, subjected to high levels of external accountability, this may seem like a luxury that we can ill afford. However, if we are to help the next generation of science teachers to be both excellent subject specialists and genuinely inclusive, it is an investment that science education must make, in the interests of both our future science specialists and tomorrow's scientifically literate society.

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