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All-attainment secondary mathematics teaching in England: how some teachers make it work

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Candidate Declaration

I hereby declare that:

1. I have not been enrolled for another award of the University, or other academic or professional organisation, whilst undertaking my research degree.

2. None of the material contained in the thesis has been used in any other submission for an academic award.

3. I am aware of and understand the University's policy on plagiarism and certify that this thesis is my own work. The use of all published or other sources of material consulted have been properly and fully acknowledged.

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5. The word count of the thesis is 65980.

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Abstract

The research on which this thesis is based is focussed on the grouping of students in secondary school mathematics by a conception of their "ability". Focussing particularly on mathematics education I argue that this practice is unjust, as previous research shows, and that a socially just education system should treat all of its students, including working-class students, equitably.

This research focusses on a small group of teachers who do not accept this "common-sense" "ability" thinking but who instead believe that all students should have access to all of the curriculum and that all are capable of learning without limits. During 2016 I carried out in-depth interviews with these teachers in Brierley Grove, an inner London comprehensive with a largely working class intake, Shortvalley, a comprehensive on the south coast and a rural comprehensive in Cambridgeshire.

This research is the only current in-depth study of mathematics teachers who are committed to all-attainment teaching and, as such, the findings of this research represent an original contribution to knowledge.

My research identified three major themes:

- what sustains the teachers;

- how they introduce, develop and maintain all-attainment; and

- how they make all-attainment work in the classroom.

Drawing together the findings I present two interrelated models of the knowledge and understandings the research has generated. The first attempts to explain how the teachers are situated with regards to their teaching. The second, encompassed within the first, illustrates how the teachers through all-attainment mathematics are attempting to enable the students not only to develop and succeed mathematically but to become agentic so that they are not restricted in the life choices they have.

I discuss the implications of the study for those connected in a variety of ways to the teaching and learning of secondary school mathematics in all-attainment groups and make recommendations for further research.

Dedication

to Hilary and Hannah

Acknowledgements

I wish to thank my father, Harry Jackson, a lifelong trade unionist and socialist, who was responsible for awakening the idea of social justice within me. My father, along with my mother, Eileen, believed in the power of education and wanted all of their children to have the education opportunities they never had. They never stopped believing in me or my siblings despite the setbacks we invariably underwent from time to time. They inspired me to want the same opportunities for all children.

I wish to thank all of the teachers who took part in my research including those teachers whose interviews I didn't use in my thesis. They all welcomed me into their schools and their classrooms and were extremely generous with their time. Thank you - Pete, Philippa, Akhila, Fred, Chandra, Jean, Sarah, Bob, Samira, Mick, Adara.

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Backstory

Growing up working-class[1] in Northern Ireland: schooling not education

Northern Ireland: A sectarian state

I was born and grew up in Omagh, a large town in the west of Northern Ireland in 1957. The late sixties and seventies was a time of much civil unrest, somewhat euphemistically known as "The Troubles[2]". The origins of the '"Troubles" were intimately connected with the nature of the state. Created in 1920, Northern Ireland was deliberately set up on sectarian lines. It was designed to have 'a Protestant Parliament and [be] a Protestant State' (Craig, 1934). Only six counties of the nine counties of the ancient province of Ulster, were included in the new statelet, ensuring a large Protestant majority. Including the five westernmost counties would have meant that a Protestant majority could not be ensured in the longer term. Hence, Northern Ireland included only two of the westernmost counties, Fermanagh and Tyrone.

From the beginning Catholics were treated as second class citizens, a situation reinforced through various forms of anti-Catholic discrimination, most blatantly in the east in the Belfast shipyards. Gerrymandering at council level meant that even towns which had a large Catholic majority returned a Protestant council. In addition, unemployment levels in the west[3] ensured a steady stream of emigrants searching for work in England or further afield.

Due to the sectarian nature of the state, working-class Catholics and Protestants tended to live very different lives. Catholics and Protestants largely lived in different housing estates in different areas of the town (important for gerrymandering purposes). They drank in different pubs, went to different schools, frequently played different sports, attended different cultural events and attended different churches so that they rarely had occasion to meet.

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[1] Class is used here as it is in the vernacular. As understood in common parlance the working-class, are those in the lower strata of society while the middle-class occupy the strata above.

[2] The "Troubles" lasted for another two decades until the mid-90s, during which I first lived in Scotland and then England.

[3] In my county, Tyrone, unemployment rarely fell below twenty percent in the four main towns when I was growing up.

Unsurprisingly in the big towns and cities education was a sectarian affair: Catholics attended Catholic schools and Protestants attended state schools which were de facto Protestant schools. This arrangement by and large suited both the Catholic

Photo 1 Omagh

Photo 2 Blue, white and red kerbstones

Church hierarchy and the Northern Irish state. Eventually, in the early eighties integrated schools organised by parents slowly began to appear. However, even now only around 5% of children attend integrated schools.

This was the situation in Omagh where I lived until I left for university in 1976 at the age of nineteen.

About me: jumping through the hoops

I was the second of six children. My parents were practising Catholics although my father was a convert and an Anglican by birth. He had been born in the East End of London and was posted to an Irish regiment for his National Service. At that time, most Catholics followed the teachings of the Catholic church and six children was not unusual, indeed, it was quite probably the average size for a Catholic family with families of ten or twelve children not uncommon. In any case, contraception was not easily available.

Experience of schooling - parents, relatives, my primary school and the 11 plus[4]

Neither of my parents had much of an education, leaving school as they both did at 14. Indeed, expectations of working-class children at the schools they attended were such that

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[4] In Northern Ireland, the 11 plus was an IQ test taken by all students towards the end of the autumn term in the final year of primary school to determine the school the student would attend post-primary. Students

Photo 3 Dad in army uniform

Photo 4 Me – early primary school

neither of them learned much while at school other than how to read and write and do basic arithmetic. With good reason my mother had little regard for many of the people who had taught her. As children she used to tell us how the teachers in the primary school she attended in Omagh had favoured the middle-classes. The school was run by nuns who were, on the whole, disdainful of working-class children. The important children, the daughters of the relatively small Catholic middle-class, occupied the seats at the front of the class. My parents, despite their personal experiences, were passionate about education, something they had in common with many other working-class parents, and were determined to ensure the same fate did not befall their children.

My mother's experience in the 1930s was reflected by that of her younger brother. He was born in the mid-1940s. He did well at primary school but as was the experience of other working-class children his teacher decided he wasn't a suitable candidate to sit the 11 plus. When my mother learned of this, displaying a remarkable degree of agency for a poorly educated shirt factory worker, she demanded that he be let sit the 11 plus.   The school acceded to her intervention and he subsequently "passed".

By the mid-1960s the school policy had changed. Perhaps it had finally dawned on the Catholic middle-class that restricting entry to the middle-class was self-defeating in the

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who did well were selected for the grammar school while those who did not do well were selected for the secondary moderns. Only about a fifth of students were expected to attend grammar schools, the other four-fifths attended the secondary modern schools.

end as a larger Catholic middle-class was actually in their longer-term interests. However, much more likely than this was the limited increase in the prosperity of the Catholic population required an expanded middle-class. Hence, by the late sixties, all children sat the 11 plus and it had become common for many Catholic working-class boys to pass.

Hence my schooling was determined by a number of key influences: religion, gender, family and the 11 plus. In the 1960s and 70s the Catholic schools in Omagh were single sex as was the custom in Northern Ireland. Both the large Catholic primary school for boys that I attended and the secondary school I subsequently attended were run by the Christian Brothers, a religious order of lay brothers founded in Ireland in the early nineteenth century. As Brother Garvey, the head of the order, was reported as saying when apologising for previous conduct in schools run by the Christian Brothers, students were subject to '"a harsh and at times cruel" regime' (Stanford, 1997, np). Thus, corporal punishment was very much a feature of my years of schooling although being a very high attainer I was subjected to very much less of it than many boys. Tests and examinations were particular focuses for corporal punishment:

> Boys were prepared for passing exams by a combination of relentless study and remorseless use of the strap, an 8in-long leather baton which thrashed young hands ... with all the regularity of the chiming of the angelus bell. (Stanford, 1997, np)

This was particularly true in my last year of primary school when all children had to take the 11 plus but was a feature throughout my schooling sometimes in a particularly barbaric fashion.

As noted above, the result of the 11 plus determined whether you were "selected" for a grammar school or a secondary modern school.   The reality, of course, was that those children who were "selected" for the secondary modern school were regarded as failures as was evident from the differential allocation of resources to the different types of schools. These inequities commenced with the letters sent to parents informing them of the outcome of the 'selection' procedure: those selected for the grammar school received a large envelope while those selected for the secondary modern received a small envelope thereby
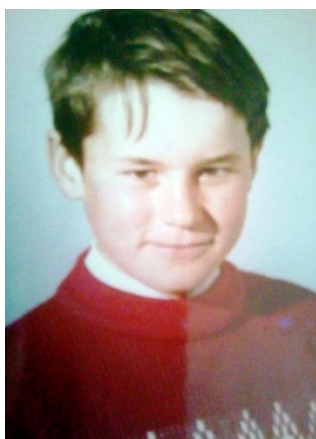
Photo 5 Me - last year of primary school

making public, via the postal service, the fate of all the children who had sat the 11 plus that year. The secondary modern schools were known to be grossly underfunded when compared with the grammar schools.

In my experience preparation for the 11 plus largely consisted of the daily practice of at least one past paper, supplemented by books of similar questions, for several months before the actual 11 plus tests. This was combined with liberal doses of the strap for failure to attain correct answers. Indeed, I remember well at the start of the process, my class being told by our Christian Brother teacher that we would get the strap for every wrong answer, which proved to be something of an empty threat as even the more successful of us rarely achieved one hundred correct answers out of one hundred and many students achieved much less. Nevertheless, several students regularly received doses of the strap. Those of us who "passed" the 11 plus subsequently attended the medium sized Catholic grammar school for boys that served the town and surrounding district.

Photo 6 Secondary school

This, then, at the time, was the natural state of things: some children were destined for the grammar school and some for the secondary modern; but there was a let-out clause for those with money - you could get to the grammar school if you could pay. Even at the time this did seem to me to be slightly unfair. After all what was the point of having a test if you could just buy your way in? Apart from this feeling I wasn't aware then of any dissenting voices.

Despite the fact that there were good teachers and poor teachers in both types of school it was known and tacitly accepted by the community that you got a second-rate education at the secondary moderns when compared to the grammar schools because of the massive difference in the level of funding. Nevertheless, despite the huge disadvantages it was still possible to achieve if you were educated in the secondary moderns. Of my five siblings three others attended grammar schools and two attended the secondary moderns. Both of my siblings who went to the secondary moderns at the start of secondary school subsequently transferred to grammar school in the sixth form. All six of us went on to university.

Pedagogy and the grammar school

My experience of learning at school was extremely traditional and overwhelmingly based on a single pedagogical model, that of transmission. In mathematics the teacher would do one or two problems on the blackboard and then we would work our way through questions in a textbook. The teacher would correct the work at some point later, sometimes

working through a particularly difficult question on the blackboard. In the transmission model of teaching:

> the teacher's role is to prepare and transmit information to learners. The learners' role is to receive, store, and act upon this information. (Tishman, Jay and Perkins, 1993, p 149)

As a very high attainer the transmission mode seemed to work well for me. Transmission was used almost to the exclusion of all other modes in the important academic subjects, the one curriculum area in which there was sometimes an exception being science where from time to time we would do experiments. Transmission did not feature much in art but, being a grammar school, we did not engage in the more vocational subjects like metalwork and woodwork and most definitely not domestic science. However, at no time can I remember ever being asked to think, critically or otherwise, during my time at grammar school.

Although I did very well at grammar school gaining the academic qualifications needed to continue my education in the sixth form and later at university other working-class children did not do as well. My older brother, who preceded me to the grammar school by two years, had to sit a test in his third year which did not lead to an academic qualification. Although he was doing reasonably well at school my parents worried that he might fail the examination so they arranged for him to have additional mathematics lessons after school. Why were my parents so worried? My brother was a middle to high attainer and not in danger of even remotely failing. A possible explanation, which resonates with the literature on grammar schools and the working-classes at that time, is that there remained an undercurrent in the school that said that the working-classes weren't really welcome, that they shouldn't be there, and that had been conveyed subtly to my parents. Or perhaps not quite so subtly as there was a continual attrition of the working-class students every year up to and including O-Levels[5]. In effect there was a not particularly well disguised enthusiasm for ejecting those elements of the working-classes who had managed to get in but were tiresomely troublesome, so much so that by

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[5] GCE O-levels were subject specific examinations taken at age 16 in the years leading up to 1988. GCE A-level is a subject specific examination taken at the end of two years study following success at the lower level examination.

the end of compulsory schooling fewer than half of the original cohort continued into the sixth form, most of whom were determinedly middle-class.

Problematising my schooling

Attending grammar school and being taught by teachers using a transmission model worked for me (as it hadn't worked for many of my working-class contemporaries) in the sense that I achieved academically and got to university. Subsequently, however, I felt dissatisfied as the end result of my schooling had been just that, schooling not education. My schooling had achieved a good result for the school - I left with four A levels, three of them at the highest grade - but I had no cultural capital or indeed any other sort of capital, economic or social. The path of my schooling was almost predetermined although I was a polymath - I followed the scientific route which interested me but certainly was not where my passion lay which was history but which I abandoned early on. I was a high attainer but without agency, something which was to influence me later when I became a teacher.

The teachers who taught me never appeared to problematise what they were doing. I suspect they taught that way as it was the way they had been taught (Ball, 1988). It obtained results (for some of the pupils at least) and so they continued teaching in that way. Why, when their teaching methods were obviously failing many of their pupils, as evidenced by the high dropout rate of working-class students in the early years of grammar school and the low numbers continuing into the sixth form, was this not a problem for these teachers?

After school

Despite my experience of schooling I loved learning and, in some ways, I had even quite liked school. However, when I left, the last thing I wanted to be was a teacher. I had enjoyed the experience of learning and the friendship but ranged against that was the brutish, bullying, unedifying culture that prevailed among some of the teachers. My work had frequently lacked challenge and had required me to do little in the way of developing my critical faculties.

It could be argued that it was the end result of my schooling that was important in that it gave me, a working-class child, the opportunity to access higher education, something denied to many others. While this is an argument which seemingly has some currency

when taken at face value and is one frequently trotted out in defence of grammar schools, it is one comprehensively refuted by Elliott (2009):

> The argument that, in the past, selective education provided poor children with a ladder of opportunity compared with comprehensives today is ... dubious. ... In reality, only a very small number went to grammar schools and many who did ended up with no, or few, qualifications.
>
> A 1950s Ministry of Education study found that fewer than 0.3 per cent of pupils leaving with two A-levels were from the unskilled working class. Even among the top grammar school streams, a third from the poorest backgrounds left without an O-level. Many poorer children left even before taking public examinations. (Elliott, 2009, np)

This argument is also used in defending other inequitable educational practices - it relies for its veracity on the acceptance of the existing status quo and brooks no alternative.

On finishing school, I went to Edinburgh University to study chemical engineering. I chose this on the basis of some careers advice I had been given at the start of my second year in the Sixth Form. Before consulting the careers advisor, I had considered geology, as my favourite subject was chemistry and I thought geology might be related in some way to chemistry. The careers advisor steered me in a completely different direction and I decided to study chemical engineering despite knowing nothing about it.

The basic thrust of his advice was to pick something with good job prospects. Chemical engineering sounded as if it was related to chemistry, and chemical engineers could earn a lot of money, so his advice was to choose that. However, this advice was extremely poor as in reality chemical engineering has little relation to chemistry. I cannot help but wonder, with the benefit of hindsight, if he would have advised a student from a middle-class background to choose a degree simply on the basis of its potential earning capacity. As it was, I had no particular aptitude for engineering, theoretical or otherwise, and only discovered in my second year the mismatch between chemical engineering and chemistry.

Compounding my error, I was encouraged to go into the second year at Edinburgh University as I had very good A-Levels. This, for me, was a major mistake. I struggled in the first year. I applied myself to the learning, but I didn't enjoy much of it. Indeed, mathematics, which I had never found difficult previously, I nearly failed in the autumn

term. I did marginally better at the end of the year. I passed the engineering modules but found them dry and of little interest. However, I persevered and did much better in the

Photo 7 Students Union - Teviot Row

Edinburgh University

second year. In fact, I thought I might do a PhD and was encouraged in this by the engineering staff.

At the end of my second year I had an ordinary degree. At the end of the third year I failed my exams. At the time I was devastated. Looking back many years later I realised that I had possibly had some sort of breakdown in the months running up to my finals as my behaviour was at times not very rational. However, I didn't have the social capital to admit to this type of problem so it never even occurred to me that my environment had in any way contributed to my failure.

On leaving university I worked in a pub for five months before eventually getting an office job with the Post Office in London which quickly morphed into British Telecom. I also joined the Labour Party. Working for British Telecom was financially quite rewarding but not very taxing mentally. By the time I started my fourth year the Conservative government was in the process of privatising most of the large state-run companies including British Telecom and we were in the middle of the miners' strike. After the shock of failing my degree I had needed some stability which the job with British Telecom provided. However, weighing everything up I decided that there had to be more to

life than working in an office, so I decided to leave. Having been away from school for some time I was able to re-evaluate my thinking with respect to teaching. I realised I did not have to teach the way I had been taught and the children I taught did not have to be schooled, they could be educated. Thus, five years after finishing my first degree I returned to study to become a teacher.

Being an educator

I was fortunate in applying to Chelsea College in London where the PGCE was progressive and where I encountered several like-minded people who were also interested in social justice. Following my PGCE, I secured a teaching post in a "challenging"[6] East End school where the mathematics teaching was based around SMILE[7]. In doing so I joined a community of like-minded people, many of who believed like me that social justice was important in teaching and that it was important to try to improve the life chances of the students where possible. My thinking was perhaps a bit naïve back then as I thought I could help all of the children I would be teaching to better things than was currently their lot in life.

From the mid-eighties to the mid-nineties I taught in several "challenging" secondary schools in London as my commitment to social justice meant I had no desire to teach in schools in leafy suburbs. Furthermore, I always chose to teach in mathematics departments that organised the children into all-attainment groups. As a London teacher that was not a difficult thing as many schools taught all-attainment mathematics lessons at that time. However, when I decided to move out of London this became almost impossible as all-attainment teaching was much rarer. In the end I decided to apply to become a head of mathematics so that I could decide on the organisation of the mathematics curriculum. I eventually succeeded in this aim and became head of a mathematics department in Yorkshire.

Although I was successful in changing the teaching groups and methods used in the mathematics department, I was unsuccessful in persuading my colleagues to change

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[6] A "challenging" school is one where many of the students exhibit difficult behaviours.
[7] Secondary Mathematics Individualised Learning Experience – a mathematics curriculum devised and controlled by practising mathematics teachers which had its origins in London.

their thinking on "ability[8]" grouping. However, I did succeed in changing the way that the children thought about mathematics. When I left that school the children didn't hate mathematics as was evidenced by the comment of a careers advisor who said that the school that I worked in was the only secondary school in the authority where the

Photo 8 My first school - SMILE classroom

children never told him they hated mathematics. However, in the end, apart from the brief period when I was head of department, the thinking of the teachers and the school Senior Management Team about "ability" grouping hadn't changed. When I left, the school reintroduced "ability" grouping in mathematics.

On leaving the school I returned to higher education enrolling on a part-time Masters degree at Sheffield Hallam University. Almost simultaneously, I began supply[9] teaching and working part-time in teacher education at Sheffield Hallam University, something which I continued for six years. Subsequently this became full-time and I continued working in teacher education until I retired.

During my time there I worked in the Mathematics Education Group. The ethos of this group was very much to encourage the teacher education students to think about the social justice aspects of mathematics teaching and how working for social justice could be

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[8] The common-sense view of "ability" in England is that it is fixed and unchanging. The quotes indicate a rejection of this common-sense view and a belief that learning can be without limits.

[9] Supply teachers are engaged by schools to teach classes where the regular teacher is absent.

incorporated into the ethos of teaching mathematics. Perhaps not surprisingly virtually all of the students training to become mathematics teachers had been among the best in their schools at mathematics. Virtually without exception they had been in the top set[10] and thus had no experience, and in most cases, no comprehension of what it was like to be "no good" at mathematics or to be in a set lower than the top set, especially the bottom set. We saw it as part of our job to educate our students about "ability" grouping and to help them understand why it is a social justice issue. To this end we encouraged our students to read the work of people like Boaler, Povey and Marks.

As I point out in my thesis the organisation of mathematics teaching in secondary schools has always been heavily dominated by "ability" grouping and all-attainment teaching has always been very much a minor activity. Indeed, all-attainment has become even more marginal over the period since I started teaching such that it is now a struggle to find any mathematics departments organising their students in this way. Given this it was virtually a certainty that none of the students had experienced all-attainment teaching in mathematics in their own schools and that when they went out on teaching practice, they rarely experienced it as it was practically non-existent in South Yorkshire.

After I had been working full-time at Sheffield Hallam University for several years, I decided that I wanted to find out more about those teachers who were still teaching in all-attainment groups in mathematics. After some preliminary research I decided to commence a doctorate looking at "ability" grouping.

I have tried to write reflexively throughout my thesis, and it is my hope that through reading my backstory the reader will have a glimpse of the world as I see it and will better understand where I am coming from and the important influences on my writing.

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[10] The most common form of "ability" grouping in England is to distribute the children into groups called sets according to their current perceived "ability", usually determined by some sort of test.

Chapter 1: Introduction

Context

Mathematics qualifications act as an important filter in gaining access to increased life chances both in the United Kingdom and the wider world (Martin, Gholson and Leonard 2010; Stinson, 2004; Woodrow, 2001; Noyes, 2009). However, "ability" grouping in mathematics in schools, which is almost universal in England nowadays, limits access to mathematics for many children and, as such, is a social justice issue. As a mathematics teacher educator and a former mathematics teacher I have always been interested in social justice in mathematics education. Hence, for my doctoral research I decided to focus on those teachers who do not group children in mathematics by currently perceived "ability" in order to understand better the teachers who make choices "against the grain" (Cochran-Smith, 1991).

In this introduction I will talk briefly about the context of my research, social justice and mathematics, about what I set out to achieve including the gap in knowledge and about the structure of the thesis.

Social justice and mathematics[11]

Social justice is a contested concept. One of the main thinkers on social justice in the last hundred years is John Rawls whose major work, A Theory of Justice (1999), is based on the concept of justice as fairness. Others argue that a theory of justice must say something about the choices on offer; whatever freedom we have must enable us to pursue whatever we are able to choose reflecting the various human positions and interests (Bird-Pollan, 2010; Gray, 2009).

Schools, because they are a particular locus of power (Apple, 1995), are a focus for social justice issues. The educational discourse in Britain is not impervious to neoliberalism which frames social justice in such a way that the problems of society are individually located and, simultaneously, many of the existing problems are blamed on social democratic state support mechanisms, for example, local authorities in the case of schooling (Centre for Social

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[11] Much of the writing in this section is reworked from my third Ed.D. assignment and from Jackson, 2017b

Justice, 2013). Reay (2012), drawing on speeches by the then Secretary of State for Education, suggests that:

> *the vision of a socially just education system that is currently dominant is the dystopian vision of the Right in which the economic ends of education are transcendent and competitive individualism is seen to be a virtue. (p 589)*

Gutiérrez (2002) in the USA highlights an additional issue but one that is pertinent also in England. Talking about attitudes to mathematics, she states that there is an underlying belief in the USA (and England) which threatens equity in that most people, unlike citizens of other countries, think "ability" is innate and no amount of hard work or state intervention can change that. In addition she argues that mathematics teaching in England, and indeed in much of the world, is inherently conservative and reflects a western view of the world (Gutiérrez, 2002).

I argue for a conception of social justice in mathematics education that is best expressed by Reay (2012) writing about Tawney:

> In Tawney's terms a socially just educational system is one in which a nation secures educationally for all children "what a wise parent would desire for his own children" (p 590).

In contrast to the neoliberal view of social justice and education Reay, drawing on Tawney, says a socially just education is communitarian and is not about increasing social mobility but is an end in itself enabling people to be who they are rather than someone they should aspire to be. It rejects the special privileges of the upper and middle-classes as 'the liberty of the working-classes depend[s] on the restraint of the middle and upper classes (Reay, p 589). It rejects the neoliberal language of choice as the choices for the working-classes are those left by the upper and middle-classes. Reay thinks that the current orthodoxy should be turned on its head and, rather than working-class families needing to change, the current attitudes and values of the middle and upper classes are the ones that need to change:

> *A socially just education system is one premised on the maxim that a good education is the democratic right of all rather than a prize to be competitively fought over. (2012, p 594/595)*

Given the premise that a good education is the democratic right of all (Reay, 2012, p 594), I shall argue that allocating students to "ability" groups is problematic at best and even, according to Slavin (1990), an affront to ideas of democracy (p 474).

What I set out to achieve through this research

As a classroom teacher, between 1985 to 2000, I was privileged always to be able to teach mixed "ability" groups in mathematics. However, towards the end of this time, this started to become more problematic as central government intervened more directly in classroom teaching. Intentionally or not, government legislation on teaching, starting with the introduction of the National Curriculum (NC) by the Conservative government in 1988, had the effect over several years of curtailing the amount of all-attainment teaching in schools. The New Labour government which replaced the Conservatives in 1997 was decidedly pro "ability" grouping. Without recourse to any educational research, it pronounced in its education white paper:

> *Secondary schools would be expected to set pupils according to ability, particularly in science, maths and languages. Mixed ability teaching was to be used 'only where it is appropriate and can be seen to be effective'. (DfEE 1997a; p 37 cited in Gillard, 2018)*

Thus, a government, nominally committed to issues of social justice, was effectively maintaining the status quo at best but, in reality, eliminating and indeed reversing educational structures which, as I will demonstrate, potentially benefited all students including working-class students.

By the time I commenced this doctoral study all-attainment teaching in mathematics had largely disappeared in English secondary schools. However, as I demonstrate in chapter 3, the literature overwhelmingly supports the view that all-attainment teaching and equity are inextricably linked. In addition, anecdotally through my chairing of the Association of Teachers of Mathematics (ATM) working group on all-attainment, I regularly met with teachers who were interested in all-attainment but who could not visualise it working in the current climate (circa 2011). Prior to starting my doctorate I had also conducted a study in Broadbent School (a pseudonym), where all-attainment teaching had been tried over a period of several years and finally rejected, (Jackson and Povey, 2017). Moreover, I was aware that all-attainment teaching in mathematics was still happening in isolated schools around the country. I wanted to know more about this phenomenon, who the teachers involved were and how it was that they still managed to do it given that the accepted common-sense meant grouping students by perceived "ability".

Over the course of my studies I have developed a thorough-going knowledge of my field having searched through numerous journals, read many hundreds of articles and books, talked to a variety of colleagues and attended several mathematics education conferences, at some of which I have submitted and presented papers.

The preface to this thesis is my Backstory. In it I give a brief account of my educational history so that those reading this thesis can understand something of who I am and what the forces have been that shape my particular standpoint (Rouse, 2009).

A thorough review of existing literature demonstrates that this is the only current in-depth study of such mathematics teachers and as such the findings about what sustains these teachers represent an original contribution to knowledge. The aim of this small-scale qualitative study is to suggest patterns and characteristics: any generalisability will come from recognition by and resonance with the reader.

Unsurprisingly my research question changed several times as my research developed (discussed in chapter 5). The research question I ended up answering is:

How is it possible to introduce, maintain and extend all-attainment teaching in mathematics in English secondary schools in the current education environment?

>   a. Who are the teachers who achieve this and what sustains them?
>   b. How do they introduce, develop and maintain all-attainment while convincing others?
>   c. How do they make all-attainment work in the classroom?

The thesis chapters

The rest of the thesis is conventional in format and consists of nine chapters, of which this, the introduction, sets out what this study seeks to achieve, identifies a gap in existing knowledge and contextualises and justifies the research. Further the introduction outlines the structure of the thesis giving a brief precis of the content of each chapter.

Chapters 2 and 3 are both literature reviews. The chapters review both quantitative and qualitative research including reviews of research, primarily since the start of the eighties. Where judged relevant, research studies from earlier periods are also included. The research was initially conducted using Google Scholar and the British Education Index database,

following which relevant articles were analysed systematically for further pertinent references which were also examined and followed up.

Chapter 2 outlines the introduction of mass schooling in England arguing that since its origins mass schooling has been designed to enhance the performance of the middle-classes while locating working-class students as incompetent and inadequate, initially through assumptions around intelligence but, when this became politically and educationally unacceptable, changing into assumptions about fixed "ability".

In chapter 3 I examine the role of "ability" grouping in mathematics in English secondary schooling with special emphasis on class. I explore reports of its effects on overall attainment and personal and social outcomes. I argue that grouping students by "ability" is not neutral: it is a social construct predicated on class-based assumptions effectively privileging the middle-classes and consequently consigning working-class students to a second-class education.

In chapter 4 I discuss the methodology and research design I chose for my research. Methodologies are underpinned by philosophies and my main influence is that of critical theory, but I also draw on ideas postulated by Gramsci and Gadamer. Hence my research sits within the paradigm of critical research and it will principally use an emancipatory methodology. My research design is heavily influenced by my methodology. I explain how I located the interviewees through opportunistic sampling, as mathematics teachers teaching all-attainment are now quite rare, and why my method of choice was semi-structured interviews.

Chapter 5 talks about the process of collecting, processing and analysing the data[12]. I also give some brief background information on the schools involved. I discuss the evolution of my research question. I describe the transcription process and how I started the process of analysing my data through developing portraits for each participant. From these I developed a concise thematic analysis, identifying three major categories each of which encompassed several themes.

Chapters 6, 7 and 8 present the three strands I determined in the thematic analysis.

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[12] All proper names of schools and teachers are pseudonyms

In chapter 6 I discuss the teachers' relationship with mathematics. I discuss briefly what it is that sustains them in their continuing belief in all-attainment and in their continued commitment to it. I discuss the factors that sustain this motivation including their love of mathematics, their interest in either curriculum development or research in mathematics teaching or more usually in both and their appreciation of the consequences of "ability" grouping on their students.

Chapter 7 reports on the second theme - introducing, developing and maintaining all-attainment teaching while at the same time convincing others. Although the teachers had different experiences some common patterns emerged including the need for support, the need to convince others and to support their professional development.

Chapter 8 focuses on the classroom. I report on assessment and how it affects the senior leadership teams' behaviour around mathematics. I also examine the teachers' approach to teaching, particularly their emphasis on conceptual understanding, collaboration and the development of critical skills. Finally, I examine how the teachers implement all-attainment in the classroom.

In chapter 9 I draw everything together, presenting what I believe I have achieved through this research including my contribution to knowledge. Initially I discuss the purpose of my research, I then briefly represent the findings before moving to a discussion in which I draw together the findings and present two models of the knowledge and understandings the research has generated.

This is followed by the implications of the study for those connected in a variety of ways to the teaching and learning of secondary school mathematics in all-attainment groups. This includes teachers currently teaching all-attainment, those teachers considering adopting all-attainment, teaching assistants supporting all-attainment groups, headteachers, teacher educators in higher education and parents. Finally I consider the limitations of the study and offer my suggestions for further research.

Chapter 2: Class, schooling and the legitimation of inequality

Introduction

> *One of the best established findings of educational research is that students' social class and their attainment at school are linked. This is a worldwide phenomenon. Students from more prestigious social class backgrounds or higher-income families tend to obtain higher marks and examination grades, and are then more likely to stay on in any education system that celebrates qualifications over equity. (Gorard, 2018, p 25)*

Why does education, 'increasingly positioned as the new panacea for the masses', lead to the majority of working-class students feeling 'a sense of educational worthlessness?' (Reay, 2006, p 296/297). To answer this question, we must first understand that the education system, which 'both mirrors and reproduces the hierarchical class relationships in wider society' (Reay, 2017, p 1), currently works in favour of the middle-classes and is underpinned by their values (Zevenbergen, 2001). Indeed:

> *Nick Davies (Guardian Unlimited, 12 July 2000) argue[s] that education policy since 1944 is a "triumph for class politics, for the power of the British middle-class to corner what is best for its children". (cited in Ball, 2017, p 101)*

This chapter is concerned with class, schooling and the legitimation of inequality. I consider first the educational consensus in England following the Second World War. Following this, I argue that neoliberalism has shaped education during the last four decades. In both periods I draw out the ways in which the dominant thinking has been productive of inequality.

Education for … society or the individual? Post-war mass schooling: educating the workers

The advent of mass schooling had its origins in the nineteenth century. Although initially education in England was provided by charities and churches the need to educate children to at least a basic level in order to prepare them to play a productive part in the workforce meant that the state gradually became more involved with schooling (Gillard, 2018). However, a belief that "intelligence" is fixed, hereditary and class based meant that the education received by most children was limited (see chapter 3 for more detail).

The introduction of elementary schools for the working-class in the latter half of the nineteenth century which catered for children from 5 – 13 provided a basic education focussed on the "3Rs". This education was limited and of an inferior nature and was

intended to inculcate into the working-class objectives other than those of learning: namely, for example, the need to obey authority, punctuality and obedience (Gillard, 2009). Indeed Reay (2017), drawing on Green (1990), says that:

> *From the conception of state-supported working-class education the system was designed to provide an inferior education, producing different educational opportunities appropriate to one's station in life. It was always about self-protection on the part of the upper and middle classes. They wanted to prevent any challenges to their own privileged positions. (p 30)*

The Hadow report (Board of Education, 1926) recommended the division of schooling into primary and secondary phases with primary schooling finishing at age 11. However, this did not come about until the 1944 Education Act, introduced twenty years in the future towards the end of the Second World War, and, even then, it was not fully implemented until the mid-60s (Gillard, 2009).

Jones (2016), drawing on Clarke and Newman (1997), frames the 1944 Education (Butler) Act, in Gramscian terms as a "policy settlement"[13,] which endured in the main into the 70s (although the selective secondary education system instigated by this Act began to be partially replaced in the 1960s by comprehensive schooling which better reflected the universal provisions of the welfare state). However, Ball (2017) states that:

> *it was a shaky, messy and unstable settlement and one that rested on a continuation of the entrenched, historic social divisions and class competition that had defined English education policy from the outset. (p 81)*

It was not until the 1944 Education Act that universal free secondary education was introduced for all children up to the age of 15 as of right for the first time. The Act recommended the introduction of three types of state school: primary, secondary and further while leaving the issue of the private sector untouched[14] (Gillard, 2011). According to Gillard the new primary schools were 'a battleground for a number of competing forces' (Gillard, 2009, p 148). In general, those who believed in the development of the child lost out to those who saw primary school as a sorting mechanism in preparation for entry to

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[13] According to Jones (2016, p 5) policy settlements are arrangements in which 'conflicting demands have been reconciled at any given time … reflecting prevailing economic, political and social circumstances … However, John Clarke and Janet Newman, state they are not just reflections of prevailing circumstances but "limited and conditional reconciliations of different interests" … They are fairly long lasting sets of arrangement, but they are not static. They have inbuilt tensions and limits. They are shaped by conflict as well as by agreement. They do not last for ever'.

[14] We see the inequity this produced continuing today (Kynaston & Green, 2019).

secondary school. The eleven plus examination, originally introduced after the Second World War, and based on the hereditarian perspectives of Sir Cyril Burt, was used as the selection tool at age 11 to determine who was suitable for grammar school and who was suitable for the secondary modern (Gillard, 2009, p 148). It usually consisted of an intelligence test (now discredited) and tests in English and mathematics.

The primary curriculum was focused on the selection procedures for entry to secondary school with children largely being streamed in preparation for this. Jones (2016) reports that Jackson (1964) found that nearly three quarters of large primary schools streamed children from age 7 with nearly half streaming[15] their infant classes:

> Most teachers supported streaming with the proportion of supporters rising among those who taught lower streams … The primary school tended to operate on the basis that ability was fixed, and that children would rarely make enough progress to get out of the group to which they had been first assigned. (Jones, 2016, p 54)

As previously stated, the grouping of children by "ability" has been an ongoing issue in England since Francis Galton first claimed in the nineteenth century that intelligence is hereditary (Syed, 2011).

Unfortunately, the provision of free universal secondary education for all caused the reformers to lose focus on the 'legislative provisions for inequality' (Jones, 2016, p 17) included in the Act. Children selected for the grammar schools received an academic education and access to university and middle-class jobs while those selected for the secondary moderns could look forward in the main to working-class jobs:

> Eighty per cent of children were educated in Britain's non-selective secondary modern schools during the 1950s. The vast majority of them were the children of manual workers. These schools were the poor relations of grammar schools. Many were, in fact, the old elementary schools renamed. (Todd, 2014, p 218)

In secondary education the 1944 Act followed through from the Spens Report (1938) which had outlined a tripartite system of grammar schools, technical high schools and modern schools and the report of the Norwood Committee (1943) which had decided that these schools corresponded to three different types of individual:

- those who can follow an argument and reason logically;

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[15] Streaming is the practice of putting children into the same "ability" group for all subjects.

- those interested in applied art or applied science; and

- those who could deal more easily with concrete things rather than ideas.

Hence in the secondary education system the Act was interpreted as requiring grammar schools for the academically able, technical schools for the vocationally minded and secondary moderns for everyone else including the majority of working-class children. The tripartite system was based on the notion of intelligence being fixed and was implemented by civil servants who had views which were more hierarchical than Norwood's and which were derived from Plato (Jones, 2016). This notion still persists in England as evidenced by the continuing existence of selection at age 11 in some areas and continued attempts at selection in other areas by other less visible and more "acceptable" means:

> *Patten [the Education Secretary, 1992-1994] was as keen as John Major to undermine the comprehensive system, but he realised that public support for comprehensive schools was a problem - one which even Thatcher had been unable to solve. There had been widespread parental opposition to the reintroduction of selection in the wake of the 1979 Education Act …*
> *A new strategy was needed. Patten's solution was to convert 'selection' into 'specialisation' …*
> *(Gillard, 2018,. np)*

The introduction of mass schooling did not bring a new egalitarian age into being as it did not create equality of opportunity:

> *Instead, government policy created a highly selective schooling system that reserved the best places for a few. Ultimately, both Labour and Conservative governments put the demands of employers before the aspirations of working-class parents and children, and created an education system that channelled most young people into the factories on which peacetime "prosperity" relied. (Todd, 2014, p 216)*

Unsurprisingly the tripartite system did not meet with universal approval. The schools were not based on what:

> *teachers, parents or children had requested. Instead they were shaped by the kinds of workers that the government thought the post-war economy would need. (Todd, 2014, p 218)*

Many in the Labour Party favoured a comprehensive education system where all children went to the same school. Indeed 'the Labour Party [in England] had been committed to "multilateralism", a form of comprehensive education, since 1939' (Jones, 2016, p 24). Nevertheless, proposals by some LEAs to introduce comprehensive schools were rejected by the Atlee government. Instead successive post-war governments engineered schooling to provide for the perceived needs of the economy which required thousands for routine clerical and assembly line work (Todd, 2014). Meanwhile, changes in occupational

structures as much as the demands for higher levels of education drove the expansion of secondary education while 'other evidence suggest[ed] that it fuelled parental discontent with the restricted opportunities offered by the tripartite system' (Jones, 2016, p 38). Indeed, when the school leaving age was raised from 14 to 15:

> *it would have been possible for some students in secondary-modern schools, … who had previously left at 14, to enter the School Certificate [except that] the opportunity was quickly closed down by government Circular 103, which forbade schools, other than grammar schools, to enter students for the School Certificate examination before the age of 17. (Stobart, 2008, p 27)*

As Stobart says:

> *being excluded from examinations is not neutral. The message is that such students are not good enough to take the examination – an ideal way to continue social stratification. (ibid)*

Although class bias in the 11 plus and private tuition for the examination boosted middle-class success (Todd, 2014), the tri-partite system was unsustainable in the longer term as the expansion of the middle-classes meant many middle-class children were excluded from the benefits of an academic education (Benn and Chitty, 1996). Tellingly, despite working-class hardship, those working-class children who did succeed in passing the eleven plus:

> *were likely to find themselves in the bottom streams of the least popular grammar schools: something that social investigators found had little to do with exam results. (Todd, 2014, p 228/9)*

Moreover, Jones (2016), drawing on Jackson and Marsden (1962), asserts that selection was an ongoing process, not a one-off event, and that working-class children were forced either to conform to the values of middle-class life or leave the grammar school:

> *… the "wastage" of working-class talent was not in this view so much a result of deficiencies in parenting or community life as a low-level form of class warfare, and those students who retained a loyalty to family, and neighbour life against the demands of the school were its casualties. (Jones, 2016, p 49)*

Indeed, according to Reay (2017, p 35), in the 1960s only 0.3% of children who came from an unskilled background gained two or more A-Levels while in the 1950s only a third of children from similar backgrounds gained more than three O-Levels.

Underfunded compared to the grammar schools, the secondary moderns were seen as second rate. The nearly three-quarters of working-class pupils who attended them were left with a sense of failure and a feeling that they were somehow less "intelligent". However, as

ever, the secondary moderns with higher numbers of middle-class pupils were better funded, better staffed and had better buildings (Reay, 2017, p 38).

Despite the growing discontentment of the middle-classes, caused at least in part by the exclusion of many of their children from grammar schools[16], the Conservatives continued their obsession with grammar schools in the 1950s. This meant that the resulting impetus towards comprehensive education across England was left largely to the incoming Labour government of 1964. Although the 1964 Labour government did not introduce compulsory legislation on the removal of selection, most Local Education Authorities (LEAs)[17] abandoned the inequity of grammar schools and secondary moderns, replacing them with comprehensive schools. However, comprehensivisation nationally was never followed through to completion as it was resisted by some LEAs with the Conservative government, elected in 1979, giving LEAs back the right to select pupils at 11[18]. In any case there remained a tendency within the education department not to believe in high-level mass education, seeing only the need for 'the creation of a type of schooling that would convey the "fundamentals of our social and political order'' ' (Jones, 2016, p 82). Similarly, the continued existence of private schools means comprehensivisation can never be successfully completed (Jones, 2003).

In the late 50s the leadership of the Labour Party had:

> a central belief in ability and differentiation [which helped] explain why Labour's presentation
> of the need for change took a traditional form. (Jones, 2016, p 56)

Labour policy consisted of an 'extension of the grammar school tradition' to many more children via the abolition of the eleven plus and the creation of comprehensive schools (Jones, 2016). Hence the new comprehensives were comprehensive by intake but not comprehensive by organisation: significantly, many schools never embraced what might be

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[16] The failure of those sections of the middle-classes to gain a grammar school place also meant their subsequent opportunities for certification were restricted as a result.
[17] Local Education Authorities were the councils responsible for all schooling in England from the early 20th century until the start of the 21st century. Many state schools are now outside such local control.
[18] Currently there are 163 grammar schools in England. This is about 5% of secondary schools. This means, of course, that there must be around 5-600 other secondary schools which are not fully comprehensive. This would seem to suggest that up to 25% of children are affected by selection at age 11.

termed a comprehensive pedagogy. Indeed, many schools which went comprehensive in the 60s did so by adopting a meritocratic viewpoint, a model which:

> *assumes that the schools operate in a cultural vacuum and once given access to the school that the pupils will automatically achieve their "full potential". It ignores the factors of class and culture conflict and discontinuity that have been shown to be important in limiting the levels of achievement that children attain. (Ball, 1981)*

Many of the new comprehensives effectively incorporated the previous external organisation of schooling into their internal structures with streaming and setting very much the rule (Ball 1981). Indeed, a survey by the London County Council (LCC) in 1961 declared that none of its comprehensive schools based its organisation 'upon the impracticable assumption that teaching groups covering the whole range of ability are suitable or desirable' (LCC, 1961, p 32, quoted in Benn and Chitty, 1996, p 249)[19].

As a result of the abolition of the eleven plus and the Plowden Report (1967), primary schools focussed more on "child-centred education" and practices such as streaming became much less common than had previously been the case (Gillard, 2009; Jones, 2016). It is worth noting that, if as Gillard (2009) maintains, the recommendations contained in the Hadow reports (Board of Education, 1931; 1933):

> *had been implemented there would have been little need for Plowden, which reiterated much of what Hadow had said forty years previously. Yet Plowden was still seen as dangerously progressive by many, especially the hacks of the tabloid press and the writers of the "Black Papers". (Gillard, 2009, p 152)*

Hadow had also noted that there were two quite opposing tendencies in the education of older children, one of which emphasised the needs of the child while the other emphasised the needs of society and the workforce. He argued for a balance between the two, a theme also present in Plowden (Gillard, 2009). Likewise, Jones (2016) says that Plowden's significance was not only in the classroom but also in its 'endorsement of educational aims that did not derive exclusively from a project centred on economic growth' (p 89). The changes in primary schooling meant there was some follow through into secondary

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[19] In the succeeding years, change if anything has been for the worse. The increasing influence of neoliberalism since the mid-70s, which I will deal with in more detail later in this chapter, has meant 'more polarisation and less-balanced intakes' (Reay, 2017, p 42) so that instead of secondary moderns and grammar schools being in different buildings they are now in the same (Reay, 2017, p 42). One example, Crown Woods, colour codes its students into different "ability" streams and puts them into one of three different "mini-schools" (Guardian, 2011).

schooling and mixed "ability"[20] teaching (as it was called) became much more common in some subjects.

However, in 1976, James Callaghan, responding to concerns about economic performance, framed by the authors of the "Black Papers"[21] and exploited by the tabloids in terms of the "crisis" in education, opened the door to greater government intervention in education. Over the next 40 years it was deemed necessary by governments that 'education policy should be guided by economic imperative; students should be prepared for the "world of work'' ' (Jones, 2016, p 75). According to Kenway (1994, cited in Jones, 2016) education policy had become 'economised' … [in that it was] organised around … 'hard and irreducible economic facts' (Department of Education and Science 1977, p 24, cited in Jones, 2016, p 100). Problems to do with schooling were reconceptualised by the tabloids as to do with falling "standards" not as due to:

> *intractable problems of social inequality but because the ideologies of progressive educators*
> *and the political commitments of a section of the teaching force were driving them away from*
> *common-sense and traditional understandings of schooling's purposes and procedures.*
> *(Jones, 2016, p 103)*

Post 1976: the era of neoliberalism

In the years between 1945 and 1979 British governments had, in general, either a social democratic or, not too dissimilar, a one-nation conservative outlook. However, since the mid-seventies, particularly in the UK and the USA, neoliberalism has been the dominant governmental discourse. After the election of the Conservative government, led by Margaret Thatcher, in 1979, neoliberal ideas and values were more widely introduced into British politics and British society.

Neoliberalism is a political ideology that seeks to reduce and limit the role of government in all areas including in the public sector, believing that markets result in greater efficiency and 'inequality is a result of individuals' inadequacy' (Hursh, 2005, p 4). Moreover:

> within policy, education is now regarded primarily from an economic point of view … [with] …
> a single, overriding emphasis … on … economic competitiveness and an increasing neglect …
> of the broader social purposes of education. (Ball, 2017*,* p 13*)*

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[20] A form of grouping where children are not grouped by "ability".
[21] The Black Papers were a series of five papers attacking the perceived shortcomings of progressive education including the move away from competition, selection and "ability" grouping. See Critical Quarterly (https://onlinelibrary.wiley.com/journal/14678705) for an overview sympathetic to the Black Paper authors.

Accordingly, 'since the 1970s education policy has been about "radical" change' (Ball, 2017, p 11) such that all previous assumptions about what education is for have undergone a process of 'rethinking, or reimagining' (ibid.) including the role and function of teachers.

Neoliberalism has appropriated the desire to want to "get on" translating it into "aspiration", a device that disguises the social and economic barriers that hinder the working-class from doing so, shifting the responsibility for 'people's opportunity to succeed or fail from the state onto individuals while replacing 'political concepts such as class, democracy, exploitation, solidarity, justice, dignity and rights' (Tyler et al., 2015 p 6). Thus students, lacking an alternative, come to accept as natural the unequal way that society is structured. This process, termed the legitimation of inequality by Bowles and Gintis (1976), leads those at both the top and bottom of society 'to see themselves as largely responsible for their own places in it' (Oakes, 1982, p 197). Reay (2006) sees class as:

> *everywhere and nowhere, denied yet continually enacted … while the privileged, for the most part, continue to … ignore its relevance to lived experience. (p 290)*

The Conservative proponents of neoliberalism introduced ideas into the mainstream that had once been considered as extreme. Consequently, the decade following the election of the Thatcher government was 'one of confrontation and manufactured crisis' (np) and resulted in the Education Reform Act 1988 (Gillard, 2009), enabling neoliberalism to be more fully enacted.

The Education Reform Act 1988 introduced two key neoliberal concepts into schooling: "choice" and "accountability". In neoliberalism "choice" is important in that it enables a "market" to be created and the "players" in this market can then be held "accountable". These markets are not free markets but are 'social constructions … [requiring] … considerable regulation and involvement by the state' (Sayer, 1995 cited in Ball 2017, p 54). However, Ball (2017) drawing on the research of Burgess et al. (2006), into the social outcomes of choice says their results indicate that more "choice" leads to more segregation in class and ethnic terms. Thus, the

> *exercise of "choice" [gives] privileged groups the opportunity to pursue educational advantage through the deployment of their social and educational capital. (Jones, 2016, p 121)*

Furthermore, as Gorard and Siddiqui (2019) conclude, for the 'poverty gap in education' (p 2) to be decreased differences between schools need to be lessened and, indeed, states should not increase choice as 'schools are largely defined by who attends them' (p12).

Also, in neoliberalism the education system has to be "accountable", it has to be capable of being measured in order to be judged as satisfactory or not. There were several mechanisms in the Act that enabled these aims to be fulfilled. The first was the introduction of a national curriculum for England as this was a necessary prerequisite for comparing schools. Although its introduction was a necessary condition it was not sufficient. For this other changes needed to be introduced. Schooling was divided into four keystages. These, combined with testing at the end of each keystage, enabled comparisons to be made between schools and, indeed, between teachers. The final strand was the introduction in 1992 of the Office for Standards in Education (OfSTED), a new school inspection system replacing Her Majesty's Inspectorate. These changes have enabled successive governments to justify their actions in the name of school improvement, while teachers have, of necessity, been forced to focus on the requirements of a punitive inspection regime. O'Neill and Adams (2012), cited in Ball (2017, p 59), say that:

> Official "targets", outcomes and priorities have very little to do with a genuinely child-centred education. … The interests being served by this sterile vision of learning are governments, not those of children, families and communities.

There have been a number of predictable consequences as a result of the introduction of this testing regime which have directly influenced what goes on in schools. These are:

- Schools are now ranked in terms of pupil outcomes.

- Schools have become more focused on the tests as they are being judged on the outcomes of these tests. Over time this has led to more teaching to the test. (Berliner, 2011, p 292/293)

- OfSTED has become very influential and schools are judged to be successful according to their criteria.

- The focus on teaching to the test and the OfSTED inspection regime affects the pedagogy teachers feel able to use in their classrooms with teachers more averse to using pedagogical practices seen as risky. Jones (2016), drawing on Reay (1998), reports that the introduction of the national curriculum affected 'the strategic

activity of teachers … their capacity to initiate, shape and popularise curricular

practice' (p 141).

The continuing focus on "standards"

> *and raising achievement for all did not necessarily entail reducing inequality of achievement and social outcomes, and using test and exam performance as indicators of success meant a tacit abandonment of broader curriculum reform in favour of "limited and culturally specific" understandings of educational value. (Jones, 2016, p 145)*

In addition, there is an increased focus on success in mathematics as a key performance

indicator in the success or otherwise of schools leading to increased pressure on

mathematics teachers and their departments.

The election of the New Labour government in 1997 resulted in little change as they

accepted most of the Conservative education legislation and agenda. Continuing on from the

Callaghan government, they accepted the analysis that education was responsible for the

failure of the economy and there had been too much emphasis on the failure of the eleven

plus resulting in too much unstreamed teaching which did not pay sufficient attention to the

need 'to differentiate among students' (Jones, 2016, p 162). Indeed, they critiqued the

supposed

> *"one size fits all" of comprehensive education … [speaking] … in praise of specialisation, selection, streaming and setting by ability … [echoing] … Conservative voices. "Specialisation", so central to post-1997 policy, had a long history in the right's attempts to devise a system which was selective, yet not based on rigid and unpopular tripartite divisions. (Jones, 2016, p 162)*

Moreover, schools had nothing to learn from working-class culture: instead failure and

> *inequalities were a result of bad choices made by the disadvantaged … and working-class people should learn to adapt completely to the new norms of education. (Jones, 2016, p 172)*

These were ideas, Jones (2016) claims, that were rejected by radicals in the 60s. Indeed, the

differences in student performance are largely accounted for by socioeconomic factors and

not by schooling (Ball, 2017; Gorard, 2018). When New Labour left office in 2010 its

education legacy was a highly differentiated schooling system where ideas of "ability"

remained a central influence.

The incoming Coalition government continued the New Labour strategy of taking schools out

of Local Authority control through its policy of either voluntary or forced academisation.

This represented over half of secondary schools by September 2013. The schools forced into academisation were those judged to be underperforming, which were most likely to be those schools with largely working-class intakes, despite this underperformance being, as Gorard found, 'largely explained by the differences in their student intakes' (2018, p 83).

In addition, academic "standards" would be maintained as examination results would return to the norm referencing that had operated before the introduction of GCSEs so that the numbers obtaining each grade would remain the same. Indeed, much of the Coalition government's reforms

> were to a significant extent about reinventing the past … They were about unpicking comprehensive and progressive education and reinstalling the virtues of a post-1944 system – things like grammar schooling … a traditional curriculum. (Ball, 2017, p 17)

The Coalition government (2010 - 2015) had little to say about ability grouping making a virtue of schools' autonomy in such matters: 'As long as schools provide a good education we will not mandate specific approaches' (Dracup, 2014, n.p.). However, in September; 2012 the chief inspector, Michael Wilshaw, appeared to argue that

> mixed ability settings require mixed ability teaching, and that effective mixed ability teaching is a difficult skill to master … teaching a narrower range of ability is comparatively easier … OfSTED will look askance at schools that adopt mixed ability teaching on ideological grounds, that cannot justify it in terms of their learners' achievement, or where the quality of teaching is insufficient to support it. (Dracup, 2014, np)

This despite the fact, as I will show in the next chapter, that research has consistently shown that all-attainment teaching raises achievement across the attainment spectrum including that of the highest attainers.

Further to Wilshaw's comments, Dracup says the government reiterated their original position several months later while OfSTED restated their position in June 2013 when they published 'The Most Able Students' (OfSTED, 2013). Again, according to Dracup (2014):

> Schools are likely to be pulled up if their mixed ability settings are insufficiently challenging for high attainers, but will also be challenged if their sets are holding back low attainers or if teaching within sets is insufficiently differentiated. (np)

The position of the Coalition government remained, in theory, that schools as autonomous institutions were free to decide on "ability" grouping despite being under constant pressure from OfSTED, to structure lessons around pre-determined "differential" outcomes. Hence,

the government could enforce compliance while declaiming responsibility for the actions of their agency.

With respect to all-attainment teaching it would be difficult to overstate the effects in England set in train by the Education Reform Act 1988 and reinforced by subsequent Conservative and New Labour legislation. On being returned to government in 1997, New Labour continued with the broad thrust of the previous Conservative government's neoliberal education policies, retreating from the pursuit of greater equality in education preferring 'the redistribution of opportunity' which was also the thrust of Coalition/Conservative policies (Lister, 2000 cited in Ball, 2017, p 210). Contrast the individualistic philosophy of Tony Blair (23 Jan 2006):

> *"I know what I wanted for my own children, and that is what I expect other parents to want and our job should be to help them get it". (cited in Ball, 2017, p 198)*

with that of an earlier Labour supporting educational philosopher, R. H. Tawney (1964, p 146):

> *A socially just educational system is one in which a nation secures educationally for all children "what a wise parent would desire for his own children". (cited in Reay, 2012)*

It is the case that the increasing influence of neoliberal ideas in education over the last thirty years has led to a societal shift in educational values. Instead of education being seen as a shared good for the benefit of all, education is portrayed at a national level as a tool to improve the performance of the economy while at an individual level it is seen as a means of personal advancement where you progress as a result of your own effort. A direct consequence is that the middle-classes look to maximise the 'the social advantages of education for their children' at the expense of limiting 'opportunities available to working-class children' (Nunn, 2007, p 73 cited in Ball, 2017, p 207). This is despite the introduction of the National Curriculum, via the Education Reform Act 1988, which purportedly made the education system fairer by offering the same experience to all pupils and continuing "concerns" about the underachievement of the working-classes. While the purpose of the reforms was supposedly to improve the education of the working-classes, the effect is Orwellian, in that the opposite is achieved and any ideas of social justice in education are abandoned (Reay, 2017).

One example of one of New Labour's education reforms was the introduction of the National Strategy (Moser, 1999). The implementation of the National Numeracy Strategy (one arm of the National Strategy) at Keystage 3 (through the Framework[22] for teaching mathematics) with its emphasis on whole class teaching, a three-part lesson structure and its consequent interpretation by teachers, mediated through the government inspection agency OfSTED, created a climate in schools that was inimical to all-attainment (mixed "ability") teaching in mathematics. This is important because, as I will show in the following chapter, research into grouping children by perceived "ability" shows overwhelmingly that it does not raise attainment and has devasting negative effects on some of the pupils who experience it, many of whom are working-class.

When the Education Reform Act 1988 was introduced all-attainment teaching accounted for about 20% of mathematics teaching in England (Ruthven 1987) predominantly in the early years of secondary school. However, the real shift away from this already markedly low level of all-attainment teaching in mathematics followed from the opposition to mixed "ability" teaching by New Labour. According to Ball (2017, p 8):

> *Policies are very specific and practical regimes of truth and value, and the ways in which policies are spoken and spoken about, their vocabularies, are part of the creation of their conditions of acceptance and enactment. … Educational problems are not just "there", they are identified and defined by particular actors with specific interests. … they provide ways of thinking and talking about policies that make them sound reasonable and sensible.*

In opposition, New Labour had advocated the obvious and "common-sense" virtues of teaching in sets (Carvel, 1996, p 7). However, as I will demonstrate in the following chapter, this directly advantages the middle-classes as, by the start of secondary school, children from middle-class families are, on average, three terms ahead of children from poorer families on free school meals (Ball, 2017) and thus, largely destined for the top sets:

> *Resource differences … and investments made or not within families become translated into individual "ability" differences or indicators of different sorts of "abilities". … In all of this, the conditions of acquisition … and accumulation of symbolic capitals, are obscured, their properties simply seen as "legitimate competence" or merit. Social class differences are thus reproduced within the relations and dynamics of the education market. (Ball, 2017, p 208)*

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[22] The Framework for KS3 extended the primary Framework into the first three years in secondary schools.

Today, all-attainment teaching in mathematics, which reflects Tawney's philosophy in that it benefits all children, has almost disappeared from the teaching of mathematics in English secondary schools. And neoliberal thinking is hegemonic.

Chapter 3: Class, "ability" groups and mathematics in English secondary schools: a review of the literature

Introduction

Given the perceived importance of mathematics by children, parents, industry and the government (DES, 1982; Smith, 2004; Huckstep, 2007; OfSTED, 2012; OECD, 2014) it might appear self-evident that mathematics teaching in England would be organised in order to enable all children to achieve in mathematics. However, currently this is not the case and there is a long tail of underachievement in mathematics. Only the top 60% (approximately) (OfSTED, 2012, p 12) of school children in England currently achieve a grade considered to be a "pass"[23] at the end of compulsory schooling and it is clear that there are barriers to mathematical achievement for the other 40% of students in schools. Gillborn and Youdell (2000) found that working-class students are significantly overrepresented in this 40% while Reay (2006) states that they are frequently positioned as inadequate learners with inadequate cultural backgrounds. More recent data suggests this has remained the case. Reay (2017, p 57) reports that the attainment gap at GCSE (in terms of 5 "pass" grades including mathematics and English) between what Reay describes as disadvantaged students (those on free school meals in receipt of pupil premium) that is, in the main, working-class, remained consistent at 27% over the years 2011/2014 with a peak of 41% achieving 5 GCSE grade A* - Cs compared to 68% for other pupils. Moreover, Demie and Lewis (2011) state that only 30% of white boys on free school meals gained five such GCSEs including mathematics in 2008, while Wigmore writing in 2016 stated that only 24% had achieved this. Indeed, this is not just an English phenomenon. As Valero et al., (2015) reported at the 12th International Congress on Mathematics Education:

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[23] A "pass" is equivalent to grades A[*] to C. OFqual claims that GCSEs were never criterion referenced but that they are 'compensatory' qualifications (OFqual blog, 2017). Further they also claim they are not norm referenced. However, the new mathematics GCSE introduced in 2015 continues the use of Comparable Outcomes introduced in the last phase of the Labour Government (1997- 2010) (Cooke, 2014; Pearson, 2017). As Mannion (2017) says:

> *I think it is clear that the way in which we grade GCSE exams is fundamentally norm-referenced, or more precisely cohort-referenced in nature. (np)*

It would appear that the pass rate for the mathematics GCSE is now fixed at around 60% and no substantial improvement is considered possible. If working-class students are to improve their current performance it will have to be at the expense of the middle-classes.

> *It is known that socioeconomic factors have an influence on mathematical achievement …*
> *"the better off you – and your family – are, the more likely you will do well in school, including*
> *mathematics". (p 286)*

This matters, not least because, intentionally or otherwise, achievement in mathematics is used as a filter restricting access to many vocations and academic institutions (Martin, Gholson and Leonard, 2010; Noyes, 2009; Stinson, 2004; Woodrow, 2001). The literature review below indicates that one potential barrier to achievement in mathematics is the practice in English schools of putting students into "ability" groupings which is used to 'fix failure in the working-classes while simultaneously fixing them in devalued educational spaces', making some students 'feel stupid' (Reay, 2006, p 298).

In common with several other countries (for example, Albania, Ireland, New Zealand, Australia, Israel, Kazakhstan, Singapore, the Russian Federation and Malaysia), in the United Kingdom 95% of students attend schools where students are grouped by "ability" across at least some classes. This contrasts with, for example, Greece, Austria, the Czech Republic, Norway and Slovenia where fewer than 50% of students attend such schools (OECD, 2013). According to the OECD (2013) only about 35% of students in Finland, one of the highest performing jurisdictions in the PISA test, are in schools where there is no grouping by "ability"; however, Räty, Komulainen and Hirva (2012) appear to contradict these figures for Finland stating that there has been some debate about readopting "ability" grouping in compulsory schooling thus suggesting that it is currently absent. And in some countries, for example, Sweden, the practice of grouping by "ability" is illegal (Gates and Noyes, 2014, p 43).   In England it is now very rare to find a secondary school where the pupils are not in "ability" groupings for mathematics. In addition, there is evidence that children in primary schools are increasingly being put into "ability" groupings (Hallam, Ireson and Davies, 2004; Drummond and Yarker, 2013). Bradbury (2019), drawing on Drummond and Yarker (2013), states that the misleading view that "intelligence" is normally distributed,

> *provides the basis for practices such as organising children into streams, sets and, most*
> *commonly in primary education, ability groups based on tables. (p 42)*

This is despite the very substantial research evidence reported in this chapter showing that this is undesirable for students

"Ability" grouping is a social justice issue because it always disadvantages somebody; and in England, amongst others, it disadvantages working-class children. Research on "ability"

grouping indicates that it has little, if any effect, on attainment averaged overall but has long term detrimental effects in terms of personal and social outcomes (Nunes et al., 2009; Boaler, 2005). Moreover, the social effects of "ability" grouping 'exact a social price, as "ability" levels largely overlap with socioeconomic differences' (Cahan, Linchevski, Ygra, and Danziger, 1996, p 30) as highlighted by the underperformance pointed out by Gorard (2018) and Ball (2017) (in the previous chapter). This works to the advantage of the middle-class and to the detriment of the working-class. One consequence of this, unintended or otherwise, is that middle-class children have minimal contact with working-class children. Indeed, the existing research makes it plain that the social effects of "ability" grouping are found to be overwhelmingly negative (Boaler, 1997).

Following up her research at a later date, Boaler found that the long-term effect of being placed in "ability" groups was damaging to children's development and continued into adulthood, resulting in more limited horizons and stunting life opportunities (Boaler, 2005). The reality for working-class children in England is that there has been no substantial change in over 100 years in terms of the structural disadvantages they suffer from "ability" grouping. As Slavin argues, "ability" grouping can be seen as an affront to basic ideas of democracy (1990): it is inequitable; and it needs to be challenged if we are truly to attempt to achieve a more just school system.

The purpose of this chapter is to examine the role of "ability" grouping in English secondary schooling and, in particular, the role of "ability" grouping in mathematics with reference to class. It explores the available research on "ability" grouping and includes reports on overall attainment and personal and social outcomes. In the main, it focusses on research and reviews of research undertaken since the start of the eighties although important and relevant research studies from earlier periods are also included. It includes both quantitative and qualitative studies. It was initially conducted using Google Scholar and the British Education Index database. The references of relevant articles were then scrutinised systematically for further pertinent references which were similarly scrutinised and followed up. It has been continually reviewed and updated throughout the period of doctoral study.

Some "ability" grouping practices

In England most children in secondary schools are currently grouped by "ability" as, indeed, are some children in primary schools. "Ability" grouping, as defined by Slavin (1990), is

> *any school or classroom organization plan that is intended to reduce the heterogeneity of instructional groups; in between-class "ability" grouping the heterogeneity of each class for a given subject is reduced, and in within-class "ability" grouping the heterogeneity of groups within the class (e.g., reading groups) is reduced. (p 471)*

Several different methods have either been used in the past or are currently used in grouping children by "ability". These methods have different names and are slightly different in different countries. However, grouping students by "ability" within a school tends, in practice, to be concentrated on England and English-speaking countries. In the countries where grouping children by "ability" is an accepted practice, there are several ways that this is achieved. Figure 1 shows the different types of grouping for England, the USA and others[24].

Description of "ability" grouping	England	USA and others
Children are in same group for all subjects	streaming	explicit tracking
Children are grouped within class	in-class grouping	in-class grouping
Children are grouped on a subject by subject basis	Setting*	regrouping/implicit tracking
Children are grouped in 2-3 groups each of which includes a number of classes	banding	tracking
* Setting: children are allocated to a group or set suitable for their particular "ability" level for each individual subject.		
Banding is sometimes combined with setting.		

Figure 1 Table of types of "ability" grouping

In England children in secondary school are now typically put into groups called sets whereas in the past, at least in primary school, children were most likely to be put into streams. Streaming tended to be the "ability" grouping practice used in primary schools in England

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[24] In much of the rest of Europe classes tend to be heterogeneous although in some countries children move to different types of schools, often at 13+, according to their previous attainment and their preferences.

between the end of the Second World War and the middle of the 1960s. Streaming fell out of favour in the 1960s (Jackson, 1964) partly as a result of the change to comprehensive education in secondary schools and the influential Plowden Report (1967) which challenged the practice of streaming, arguing for a more child centred approach. Most children in primary schools are now either set for mathematics or sit in groups of similar "ability" thereby inhibiting the potential cognitive gains and cognitive development made through the cognitive conflict which underpins collaborative group work and is enhanced by differences in "ability" (Baines, 2003). Barclay (2018), in her doctoral study of three primary classrooms, found that when lower attainers worked in all-attainment pairs, as well as gaining from the pairing, they also made a direct contribution to progressing the task for both pupils in the pair.

As explained in the previous chapter, setting is now the norm for grouping by "ability" in England in secondary schools. Taylor et al., (2017), recruiting schools for an all-attainment trial, found it 'impossible to recruit the required number of schools' (p 334), managing to recruit only 17 across the whole country in contrast to their target for London of 20.   When the children are organised into sets in secondary school, cognitive gains are inhibited. If all of the students are roughly of the same previous attainment level discussion is not as rich: low attainers do not have access to all of the perspectives and high attainers rarely share their thinking (Kutnick, Blatchford and Baines, 2005, p 368).

Class and "ability"

On arrival in secondary school many middle-class children are already academically more advanced than working-class children as their education-conscious middle-class parents will have endeavoured to ensure their children have secured a place in the best performing junior schools (Lacey, 1970, p 35). Hence many working-class children start school at a disadvantage compared to many of their middle-class peers as they are less well equipped with the tools necessary to do well in school. In addition, teachers' beliefs frequently lead to lower expectations of working-class children (Zevenbergen, 2003). Working class students tend to lack the social and cultural capital that the middle-classes possess (Jorgensen, Gates, and Roper, 2014): this difference in capital legitimates the failure of working-class students, with middle-class students' success being seen as the result of hard work or natural "ability" rather than class-based inequalities (Bourdieu, 1992).

One important effect of grouping by "ability" is that middle-class children have minimal contact with working-class children and the ethos in the higher sets constructs acceptable behaviour in ways appropriate to them (Ireson, Clark and Hallam, 2002). Students who lack the social knowledge for what is seen to be appropriate behaviour by teachers (Zevenbergen, 2003) will tend to populate the lowest sets. Those who do succeed in making it into the higher "ability" groups soon discover that to succeed in school they must conform to the accepted middle-class behaviour norms; failure to do so causes a descent into the lower attaining groups. One pattern of response to this is that of rebelling against a system that predisposes them to do badly, committing themselves to behaviour patterns which means that their work will stay poor (Lacey, 1970, p 58). Thus, there is a self-correcting mechanism for dealing with working-class children who do not conform.

Underlying the issue of "ability" are issues of power and culture and hence whose ways of knowing are dominant. "Ability" grouping is not a neutral disembodied organisational practice. Common-sense conceptions of "ability" and "intelligence" are at the heart of schooling and the "ability" discourse is part of an ideological battle defining children with lower socio-economic status as being expendable (Oakes, Stuart Wells, Jones, and Datnow, 1997): attainment grouping serves purposes in schools other than that of teaching and learning. Schooling is designed to reproduce the current social, political and economic systems rather than to provide a meritocratic route to success in adult life (Bowles and Ginnis, 1976; Oakes, 2005). Further the performativity regimes (Ball, 2003) imposed on schooling have created a climate whereby failing to conform to prevailing discourses carries huge risks to schools and to individual teachers. "Ability" grouping measured by some form of assessment is seen as risk free and, in those subjects seen as having hierarchies of knowledge, of which the two most prominent are mathematics and modern foreign languages, is virtually unquestioned. Hence in English secondary schools today mathematics and modern foreign languages are most prone to "ability" grouping (Hallam and Ireson, 2003). As Taylor et al., (2017) point out a vicious circle has developed,

> *The perception of mixed-attainment teaching as risky and difficult means that few schools*
> *take up the challenge - for mathematics in particular. This may make it even more difficult*
> *for schools to adopt mixed-attainment practices. (p 13)*

As mentioned in the previous chapter, and as the Best practice in grouping study (2014-2018) found, the number of schools organising their students in all-attainment groups in mathematics is very small.

Contemporary English society assumes that middle-class values are superior to working-class values and hence the working-classes need to "aspire" to join the middle-classes (McKenzie, 2015). Indeed, one of the supposed problems with the working-classes, reflected in their children, is that they are said to lack aspiration (Jones, 2011). The values that working-class children bring to school are neither recognised nor valued by schools while the "abilities" they bring to school are ignored at best and indeed are thought to be detrimental to a good education (Delpit, 2006). This feeds into the informal judgements about intellectual "worth" noted above. It is argued that one role of schools is to prepare children for their working lives (Bowles and Ginnis, 1976; Gilborn and Youdell, 2000) and working-class children are largely destined for working-class jobs (Willis, 1977). Although some higher attaining working-class children are able to progress out of the working-class into the middle-class, the majority remain in the working-class.

Those working-class children who overcome their initial disadvantages in mathematics may find themselves further disadvantaged at a later stage as they may not understand the mechanisms required to succeed in the curriculum; they may not have the cultural capital to "play the game", that is involved in the learning of mathematics (Bourdieu and Passeron, 1990). In a system where working-class children have learnt to "play the game" by one set of rules and succeed according to these rules, it can be difficult to understand when there is a shift in the rules so that the game is played differently as Lubienski (2000, 2002) found with high attaining working-class children in the US when introducing new ways of working including discussion and open-ended problem-solving. Jorgensen (2016), drawing on the work of Cooper and Dunne (2000), highlights similar problems.

In an attempt to overcome these problems, Wright (2019) is currently working with a school in London that is gradually moving away from setting to all-attainment. He is using a participatory action research approach involving two teachers as co-researchers. Together they are focusing on strategies that make clear to the students what the teachers' intentions are in using progressive approaches:

> *Research methods employed during the project include the joint design of student surveys*
> *and interviews (to be implemented by the teachers themselves), carrying out peer*
> *observations, and making use of video-stimulated reflection to evaluate lessons. (p 3)*

They have found that engagement has increased, and appropriate responses are being obtained from a wider range of students. The researchers anticipate that this research will lead to approaches that will help to shrink the attainment gap between the different socio-economic classes.

Student attainment, "intelligence" and the idea of "ability"

English education in terms of policy and practice takes for granted the hereditarian assumptions proposed by IQists[25], assumptions which may have their roots in the claims by Francis Galton in the 19th century (Syed, 2011). Galton, who was Darwin's half-cousin, is 'easily the most important Victorian scientist most people have never heard of' (Das, 2019, p 64). He thought that in order for the British Empire to continue its success it was necessary to breed better white people through a process he called "eugenics". It was he who first claimed that intelligence is hereditary in the 19th century (Syed, 2011). By doing so, he promulgated the now discredited notion that intelligence is a fixed and generalised intellectual capacity related to differences in class. Moreover, intelligence tests, originally conceived by the French psychologist, Alfred Binet, as a means of identifying pupils with special educational needs in order to support them, were adapted by US and British psychologists

> *to generate group tests which could allow the classification of large groups into their relative*
> *ability levels. These uses included … selection for schooling. (Stobart, 2008, p 24).*

In addition, the use intelligence testing was put to in Britain and the US, unlike France, was based on the 'assumption of fixed and innate mental abilities that education could not change' (ibid). Stobart (2008) says:

> *These were social assumptions (rather than scientific findings) which provided continuity with*
> *nineteenth-century thinking about class and racial superiority, and which legitimised beliefs*
> *about the natural superiority of upper-class Anglo-Saxon males. (p 24)*

These ideas, about intelligence and intelligence testing, concurring with hegemonic beliefs about class, underpinned the "common-sense" views espoused in English society and

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[25] IQism is a term coined by Bowles and Gintis in 1976 for those who support intelligence and hereditary principles.

'matched the social views of its leading "scientific' exponents" (p 33). This reification of intelligence leads to the situation where:

> *Social position [is] … a consequence of inherited intelligence with society's leaders well endowed, and the poor being poor because of limited intelligence. … [and] … a widespread assumption that we are born with fixed quotas of intelligence. (p 53)*

Thus many ideas that are clearly fictions and that would be dismissed out of hand in other contexts, (for example, tests are always fair and test what they purport to test; that everyone has an equal chance in the test; and that intelligence, and by implication "ability", is an innate capacity), have been accepted as common-sense. Viewing "ability" as innate has been a long-established presumption, held to be true by the general population and by many teachers (Marks, 2016) with "ability" currently used as a proxy for intelligence (Wilkinson and Penney, 2014). Policy makers at national level, through the discourse of "ability", behave as if they accept the principles of IQism; and in schools, managers are encouraged to identify and target currently high attainers to ensure that they are enabled to be successful (Gillborn and Youdell, 2000). This belief, that individuals are born with a fixed amount of "ability" which remains constant throughout their life and nothing they do will change that, leads to a particular view of how schools should be structured and the grouping of children according to their "ability" which is easily measurable and unchanging seems natural (Francis et al., 2017a). Despite what we know about the social effects of "ability" grouping, it is portrayed as more effective as children are placed in groups that are appropriate for their "ability" (Slavin, 1990). On the face of it this seems like a reasonable and "common-sense"[26] practice.

Not unsurprisingly the common-sense view that "ability" is fixed and that only some students can be high achievers discourages many students as Boaler, Wiliam and Brown (2000a) found in their four-year longitudinal study. Using questionnaires, interviews and

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26 Gramscian, "common-sense" ways of seeing

> *represent a hegemonic way of thinking that reflects the interests of the dominant class. (Bambery, 2006, p 45) This class portrays their way of seeing schooling as "common-sense" and "natural". Hence teachers within the school system accept as a given the idea that the "common-sense" way to organise teaching is by putting children into "ability" groupings. See chapter 4 below for a discussion of Gramsci's ideas and their relevance to the thesis.*

classroom observation they researched how students' attitudes and achievements were influenced by "ability" grouping practices, discovering that there was

> *restriction of opportunity to learn for students in lower sets, and students in top sets … [were] required to learn at a pace which was, for many students, incompatible with understanding. The same teachers employed a more restricted range of teaching approaches with 'homogeneous' groups than with mixed-ability groups which impacted upon the students' experiences in profound and largely negative ways. Almost all of the students interviewed from 'setted groups' were unhappy with their placement. (p 631)*

Perhaps because of this, teachers frequently attempt to disguise "ability" grouping. However, despite their best efforts students know which groups are which (Marks, 2013). Because "ability" grouping can lead to fixed mindsets, students in "ability" groupings are more afraid of failure and less open to challenge thus limiting their intellectual growth (Boaler, 2013). Thus, for most children this approach is damaging academically and socially. It is damaging nationally and is contrary to the stated aim of raising overall attainment.

Dweck (2000) shows that a belief in growth mindsets, that progress is in large part down to effort and is not restricted to those with "ability", enables students to make more progress and achieve higher. Mindset research suggests that:

- "ability" and IQ scores grow with effort and practice;
- when students believe that everybody's "ability" can grow, their achievement improves significantly;
- when teachers believe that everybody's "ability" can grow, and they give all students opportunities to achieve at high levels, students achieve at high levels; and
- "ability" grouping practices communicate damaging fixed mindset beliefs to students (Boaler, 2013).

In addition, the message students receive from their experience of setting in mathematics is that success depends more upon working quickly, being competitive and conforming to the norms of the class rather than understanding the work (Boaler, 1997). Thus, those who are most advantaged from "ability" grouping are those who can quickly integrate and absorb material (Wilkinson and Penney, 2013).

Grouping students heterogeneously is supported by a very large body of research which indicates that it improves educational outcomes (e.g. Boaler, 1997; Boylan and Povey, 2009;

Oakes, 1985; OECD, 2013; Povey, 2010; Rubin and Nogera, 2004; Tresidder and Watson, 2013). Despite this the current climate is unfavourable to all-attainment teaching. Indeed, it is often viewed as inimical to good teaching (Carvel, 1996, p 7). The pressure on schools to conform to this view coupled with the tendency of teachers to replicate how they have been taught ensures that "ability" grouping is almost universal in mathematics classrooms in England (in contrast, as we saw above, to much of the rest of the world).

"Ability" grouping sends a clear message that only some can do mathematics and that this is due to some type of "natural ability" (Marks, 2016), a message many children receive as early as age four (Dixon, 2002, p 1). Furthermore more recent research found that over a third of children are grouped by "ability" as young as two in nursery (Bradbury and Roberts-Holmes, 2017). It is undoubtedly the case that with the increase in setting in primary schools many receive this message before starting secondary school. Early research reviews (e.g. Kulik and Kulik, 1982; Slavin 1987, 1990, 1993; Sukhnandan and Lee, 1998) found that studies on "ability" grouping produced few conclusive or consistent findings. Both Slavin (1987, 1990 and 1993) and Kulik and Kulik (1982, 1992) report that "ability" grouping has little effect on attainment across the "ability" spectrum while Steenbergen-Hu, Makel and Olszewski-Kubilius (2016) report that it has little effect in between-class grouping. Recent research (OECD, 2013) indicates that in jurisdictions where students are highly stratified, as in the case of setting, there is a wider range of achievement than when they are taught in heterogeneous groups. Indeed, as Gorard and Siddiqui (2018, p 921) report, if children are split up by "ability" at a young age there appears to be no benefit for any group of students. Hoffer (1992) reports that 'the conditions under which ["ability"] grouping benefits all students (or at least helps some and does not hurt any) do not generally exist' (1992, p 223).

Comparisons between countries may be misleading due to structural differences in the organisation of schooling and the curriculum rather than differing pedagogies and beliefs about "ability" grouping. Nevertheless, research carried out in England and in the USA does show significant similarities: in the USA students in high tracks gain more than students in lower tracks (Slavin, 1990; Gamoran, 1994) while in England there is a consistent tendency for children of all "ability" levels who are placed in lower sets to attain less than if they had been in heterogeneous groups (Bartholomew, 2001). Some research in England shows that grouping by "ability" in secondary schools in England enables students in the highest

attaining groups to increase their attainment while students in the lowest "ability" groups attain less than they would have if they had been in heterogeneous groups. Although students achieve differentially depending on the group they are placed in, Ireson, Hallam and Hurley (2005) found that students with intermediate levels of attainment were placed in several different sets. Students attaining at similar levels at Key Stage 2 achieved higher levels in the Key Stage 3 tests if they were placed in higher groups and pupils who attained the same levels at Key Stage 3 and who were placed in different sets achieved higher GCSE grades if they were in higher sets. What all these studies show is that there is a consistent tendency for children of all "ability" levels who are placed in higher sets to attain more and for those who are placed in lower sets to attain less (Bartholomew, 2001; Ireson et al., 2002, 2005). Alongside this, however, it should be noted that Boaler (1997) in her research on "ability" grouping found that overall achievement is reduced for all students in "ability" groups through a number of different processes including lowering attainment for some of the highest attaining students.

In contrast to almost all of the research on "ability" grouping, Kulik and Kulik (1982) reported that there were small but significant benefits on achievement in examinations from the practice of tracking and that students in "ability" groups developed more positive attitudes than those not in "ability" groups. However, these results were predicated on programmes for "gifted" or high "ability" students with a different enriched curriculum, something which Slavin points out in his review in 1987. Slavin (1990) also says there are such enormous differences between the groups being compared that research comparisons between them are statistically invalid. Also, in the USA, Argys, Rees and Brewer (1996) argue that getting rid of "ability" grouping (detracking - reversing tracking) improves the attainment of those in the lower tracks but reduces the attainment of those in higher tracks. However, a study in New York found that removing "ability" grouping (tracking) while offering all attainers a high track curriculum benefited all student groups. The results of the lowest attainers improved as did the results of the highest attainers (Burris, Heubert and Levin, 2006). In sum, a consensus is emerging that, whilst not necessarily raising the level of outcome for higher attainers, mixed-attainment teaching does not significantly suppress it.

Ireson, Hallam and Hurley (2005) in England reported that the effect of setting on the attainment of higher and lower level students at GCSE is negligible. At the time when they

carried out their research they argued that although the GCSE examination in England had a degree of differentiation because of the tiering system there was not the same degree of curriculum differentiation as in the US system and although it is unlikely all students would have followed the same curriculum, the curriculum would not have been so different as that experienced in the US by students in different tracks (Ireson, Hallam and Hurley, 2005). Because of this they argue that their findings are akin to those of the findings of Slavin (1990). Moreover, recent research from the OECD (2013) indicates that where students are highly stratified as in the case of tracking there is a wider range of achievement.

One of the problems with trying to analyse the effects of "ability" grouping on attainment is that it can be difficult to separate the effects of other factors, e.g. curriculum, quality of teaching, from the effects of "ability" grouping. This problem is addressed in some of the smaller scale studies (for example, Boaler's two studies (1997, 2008) and Rachel Marks' (2016)) through the richness of the detail. These in-depth studies place the reader in a position where they can judge the relative effects of different factors affecting attainment. The less common larger scale studies, e.g. the Best Practice in Grouping Study (2014 – 2018) use comparative data between matched schools in similar contexts to help isolate the single factor of "ability" grouping from the complex cluster of factors affecting any educational setting.

Some other possible reasons for the difference in attainment are the tendency for teachers assigned to high "ability" groups to be both more competent and more highly motivated to improve the level of performance of their students so, whatever the curriculum, they do a better job of teaching it. Students respond to their peers as well as to their teachers and the curriculum. Thus, if a given student is surrounded by high (or low) "ability" peers, his or her performance will be affected by them (Kerckhoff, 1986). Furthermore, when set by perceived "ability", lower attainers are deprived of role models of more successful learners (Hornby and Witte, 2014). They also find it more difficult to acquire "basic" knowledge in sets compared to non-setted groups (Fuligni, Eccles and Barber, 1995) while high level content may only be made available to high attainers (Cahan et al., 1996; Porter and Associates, 1994).

Allocation of children to "ability" groups

Few concerns are raised in schools about the nature of "ability" itself and, unsurprisingly, few doubts about how it is determined and what measures should be used in allocating students to groups for example by testing or predicted grades by teachers (Wilkinson and Penney, 2014). "Ability" is not the same across all subjects and students are placed in the wrong groups because of inaccurate data (Hornby and Witte, 2014). The available evidence shows once children are placed in an "ability" group it is rare for them to change (Wilkinson and Penney, 2014), particularly in the later years of secondary school (Taylor et al., 2019) despite part of the rationale surrounding "ability" grouping being that if a child is placed in the wrong "ability" group then s/he can easily be changed into the correct group. A number of researchers (Boaler et al., 2000; Ireson et al., 2005; Macqueen 2012; Wilkinson and Penney, 2014) have pointed out that the reality is rather different and once a child is placed in a particular "ability" group it is very difficult to change that group because of differences in the content of the curriculum and the pace of teaching. Indeed, Wilkinson and Penney (2014) found that the most likely movement in setting is downwards. Even where a school's ethos supports all-attainment teaching, elements of "ability" grouping can still creep into some subject areas (Alpert and Bechar, 2008). Marks (2013) found this also to be the case in primary schools.

In almost all instances the methods used to allocate children to "ability" groups are claimed to be objective in that the children are allocated to "ability" groups on the basis of their prior performance, the process being portrayed as one which is highly refined with children being accurately allocated to their particular grouping. However, "ability" groups are not homogeneous and there is considerable overlap between them (Boaler, 1997). In addition, Taylor et al., (2019), exploring the reasons why students are allocated to particular groups, found that equity of allocation of students to "ability" groups was reduced through a number of mechanisms:

> *While some schools used minimal additional evidence … some approaches were highly complex … [risking] reducing equity by introducing opportunities for biased judgements to influence the process. (p 11)*

While, as previous research had shown

> *setting is constrained by practical and financial factors [which] influence equity of allocation. (p 12)*

Of particular concern is that in primary school the month the children are born in has a large effect on the perception of the child's "ability": if a child is born in the spring/summer this is a good predictor for being in the bottom set; in particular, children born in August are more than twice as likely to be placed in the bottom group than children born in September. Being born in the autumn or winter is a good predictor of being in the top set, children born in September being twice as likely to be in the top group (Campbell, 2014; Hallam and Parsons, 2013). This can have a significant effect on the teachers' expectations and thus on the child's performance confirming that the older children are more able, leading to self-fulfilling prophesies and possible long-term damage to the child as this construction can continue all the way through their school career.

In English secondary schools although prior attainment or perceived "ability" is found to be the main predictor of set, it is a relatively poor predictor (Muijs and Dunne, 2010). In reality schools have multiple reasons for allocating children to particular groups and children are allocated to sets on the flimsiest of evidence. Good predictors for children being in bottom sets are: poor cognitive "ability" scores; having behaviour problems; being a boy; or being in a one parent family. On the other hand the children who are more likely to be assigned to higher sets include: children with higher SES; children whose parents own their own home; children who have high cognitive "ability" scores; children with low SEN. (Bartholomew, 2003; Hallam and Parsons, 2013; Ireson et al., 2002; Muijs and Dunne, 2010). Further reasons for allocating children to sets are also not to do with perceived "ability". Being mindful of disruptive students and poor behaviour which might be seen as linked to social class, motivation, balancing numbers, appeasing pushy middle-class parents or providing good role models for other students have also been found to be factors in allocating children to sets (Macqueen, 2012; Muijs and Dunne, 2010; Wilkinson and Penney, 2014). Additional factors such as gender mix, size of classrooms, availability of teachers may also all come into play in allocating students to sets (Hallam and Parsons, 2013; Ireson, Clark and Hallam, 2002). However, more worryingly Boaler, Wiliam and Brown found that working-class students tended 'to be placed in a lower group than would be expected on the basis of their attainment alone' (2000, p 130) and that this was a result of the school's desire not to 'alienate the most powerful (and highly valued) constituencies of parents' (p 130), a pattern which is also found in schools in the USA when tracking is examined. Middle class parents

can be particularly adept at using their social capital in getting schools to address the perceived needs of their children including getting them into high attaining groups (Francis et al., 2017a). Perhaps not unsurprisingly recent work by Archer et al., (2018) found that middle-class white students are more likely to be in top-sets while working-class black students are more likely to populate the bottom-sets. Indeed, Taylor et al., (2019), drawing on the same study conclude that "ability" grouping will always be "socially based" and hence inequitable.

"Ability": beliefs and practices of teachers

In Britain research by Barker Lunn (1970) showed that many teachers are philosophically opposed to mixed "ability" and that even where children are in mixed "ability" groupings the teachers practise in-class grouping (Marks, 2016). In a similar vein, Abraham (2008) questions whether comprehensive schools are truly comprehensive as even teachers in schools with many mixed "ability" classes may not transmit support for mixed "ability" teaching. Teachers give a variety of reasons in support of "ability grouping" (Hallam and Ireson, 2003; Oakes, 2005; Sukhnandan and Lee, 1998). Oakes suggests that people unquestioningly continue the practice of "ability" grouping because it is seen as being part of the "natural" order of schools (2005, p 191). Summing up the arguments for "ability" grouping she suggests that there are four unexamined assumptions these beliefs rest on:

1. students learn better in groups of those who are academically similar;
2. slower students develop more positive attitudes about themselves and school when they are not in day-to-day classroom contact with those who are much "brighter";
3. track placements are part of a meritocratic system with assignments "earned" by students and accorded through fair and accurate means; and
4. teaching is easier when students are grouped homogenously, and teaching is better when there are no slower students to lower the common denominator (see p 194).

Likewise, Lacey (1970) reports that the teachers gave the following reasons as justification for the introduction of streaming in Hightown Grammar: it would make the teaching,

> *more efficient and … facilitate the learning process for all … [working in] the best interests of the individual pupil, even when relegating him to the bottom stream. [If he remained in the same group he would] either hold them up [higher attaining pupils] or … become demoralised, and fall further behind. … He would be able to proceed at a more suitable pace. (pp 74–75)*

Thus, despite being in different countries and experiencing radically different schooling systems, the discourse in England is remarkably similar and is framed in terms of what is perceived to be better for the students.

In both the US and Britain, support among teachers for the practice of "ability" grouping is overwhelming as teachers believe it has positive effects. They believe it has many personal benefits for themselves as grouping students by "ability" is perceived to make teaching and classroom management easier with less variation among the children they have to teach and with the curriculum being more suited to students' needs. For example, Taylor et al. (2017) report from their pilot study that teachers had a 'fearful perception that all-attainment groups are harder work to teach than sets' (p 338) and that this view predominated. Most secondary school teachers believe setting enables the higher attainers to make the most progress and also that any negative effects due to peer pressure are largely mitigated (Hallam and Ireson, 2003; Kerckhoff, 1986; Kulik and Kulik, 1982). However most of the benefits of "ability" grouping are benefits for teachers and schools whereas most of the disadvantages concern the negative effect on students (Hallam and Ireson, 2003) (although there may be some specific advantages for "gifted" students and those with special educational needs). The advantages identified by at least some of the teachers included enabling more able students to be challenged or extended and enabling resources to be better targeted (Hornby and Witte, 2014). Oakes states that existing research evidence shows all of these assumptions to be false and indeed 'these differences are institutionally created and perpetuated by tracking' (2005, p 194). One reason why low "ability" groups may be disenchanted with schooling is that there is a tendency for teachers assigned to high "ability" groups to be both more competent and more motivated (Kerckhoff, 1986). In addition, expectations can affect students' motivation which over the long term can have quite a cumulative effect - students who are placed in sets in primary school can have their attainment and consequently their life chances severely damaged (Boaler 2005; Ireson, Hallam and Hurley, 2005).

Teachers have more positive interactions with higher attaining groups (Ireson and Hallam, 2001; Hallam and Ireson, 2003) while their expectations are lowered in all other classes with the result that they make less effort to enhance the students' attainment and they communicate low expectations with damage to self-esteem and consequent stigmatisation

(Slavin, 1990; Hornby and Witte, 2014; Ireson, Hallam and Hurley, 2005). Many teachers treat children differently depending on their conception of their "ability" (Bartholomew, 2001) and indeed tend to stereotype them when they are grouped by "ability", believing "ability" groups to be homogeneous so that it is not necessary to differentiate (Hornby and Witte, 2014). Moreover, Francome and Hewitt (2018) found that, in contrast to all-attainment groups where students were encouraged to work collaboratively in small groups

> the most common experiences of pupils in the "ability" grouped setting … were teacher centred with the whole class being kept together and the teacher knowing exactly what mathematics the lesson would contain. Students in "ability" groups reported expecting to work mostly on their own, mimicking a method shown by the teacher and following a textbook/worksheet closely. (p 15)

The set a pupil is in can be crucial to their attainment as teachers construct pupils differently and teach differently according to their set. Higher attainers are constructed as well motivated, hardworking, well behaved and capable of independent working and independent thought. They are expected to work faster covering work in more depth. Lower expectations of low attainers are communicated through a number of mechanisms. Lower attainers are constructed as limited in "ability", poorly motivated, less focused, badly behaved, possibly lacking a work ethic, incapable of independent working and independent thought (Hornby and Witte, 2014; Wilkinson and Penney, 2013). Teachers provide children in low sets with access to a reduced curriculum where there is less discussion, more practical activities and more repetitive tasks which require lots of practice (De Geest and Watson, 2005). They also provide more structured work, broken down in smaller steps so learners cannot make for themselves the connections needed to understand the mathematics they are doing; time is spent merely copying off the board (Boaler et al., 2000; Hallam and Ireson, 2005c; Ireson et al., 2002). In addition, the recent research by Francis et al., (2019) confirms that schools prioritise higher attaining groups to the detriment of the bottom groups and in particular, bottom groups are more likely to be taught by a teacher with only GCSE as a qualification.

Low attainers and high attainers who produce work of a similar standard find their work viewed quite differently by teachers (Marks 2016). Their teachers talk about them differently and talk to them differently. Low attainers are described as being incapable of concentrating and teachers adopt a more authoritarian mode of talking to them (Watson and De Geest, 2005). Moreover, teachers construct behaviour very differently in high

attaining and low attaining groups. Bartholomew (2001) and Marks (2016), for example, report that teachers' focus on learning in high attaining groups while in low attaining groups they focus on behaviour.

In general, any advantages teachers see in all-attainment groups are in social terms. More experienced teachers tend to be more supportive of all-attainment teaching but mathematics is seen as problematic because of teachers' belief in the need to obtain correct answers and grasp abstract contents. Hence grouping in mathematics is more common than in most other subjects (Kerckhoff, 1986; Francis et al., 2017a).

"Ability" grouping: concluding remarks

A number of major conclusions emerge from this literature review.

Summing up:

- "Ability" grouping remains a class issue as working-class students are disproportionately placed in lower sets (Bartholomew, 2001) becoming demotivated and underachieving as a result. The preponderance of middle-class children in the upper sets show that grouping by "ability" favours the middle-class.

- In a socially-just world all students would have the opportunity to attain equally, unrestrained by external factors such as perceived "ability". It is the case that when children from the working-class have the same opportunities as middle-class children they can attain as highly (Boaler, 2005) though lower attaining students may need additional support so they can reach the higher expectations (Rubin and Nogura, 2004).

- Teachers who hold conventional conceptions of "ability" and intelligence may be the greatest obstacles to reform. Their beliefs can lead to resistance to change (Hynds, 2010) and they may enlist the support of parents who are part of the dominant class and who fear change will disadvantage their children (Oakes et al., 1997).

- If "ability" grouping worked as its supporters claim it works, then social class would be of no import, a child's behaviour would be irrelevant, and each child would be able to develop appropriately. Allocation to "ability" groups would be commensurate with students' current attainment and they would be constantly monitored and re-

assigned to the correct group throughout their school careers with a mix of working-class and middle-class children but this does not happen (Archer et al., 2018).

- As well as middle-class children having more economic capital they also have more cultural and social capital than working-class children. Middle class children's understanding of the rules of the game that is school is much more profound and they can use the rules much better to their advantage. Alongside, powerful high-SES parents use issues of intelligence, "ability" and merit to exercise power and control enabling them to secure high "ability" groups for their often less than qualified children (Oakes, 1994; Oakes et al., 1997).

Common-sense conceptions of "ability" are at the heart of schooling. A technicist approach to reform will not work as it assumes resistance to changing "ability" grouping is rational. "Ability" grouping is an ideological battlefield:

> *Setting and other "ability" grouping practices are signifiers within discourses of standards and "natural" distinction that constitute technologies of privilege. These discourses are central to the (re)production of privilege, and its defence. (Francis et al., 2017a, p 10)*

Teachers in the main are convinced by the powerful dominant discourse of individualisation accompanied by a natural ordering produced by "ability". A wholescale restructuring of school expectations and culture is required (Oakes et al., 1997), which is something which is unlikely in the current neoliberal environment, in order to succeed in providing a more just experience for working-class students in secondary mathematics classes in England.

Chapter 4: Methodological considerations[27]

Introduction

According to Walker (1985), the strict meaning of the term methodology is the logic of methods but frequently there is confusion about the terms methodology and methods and they are used interchangeably. I use the two terms to refer to two different aspects of the research process. I take methodology to be the articulation of the ontological and epistemological assumptions underpinning the inquiry, and methods to be how the research process is enacted. Thus, I use methods to be the protocols and procedures which are employed in order to create reliable knowledge that tells us 'what to do and what not to' (Brewer, 2000, p 2). But, not least because of this connection with reliability, every method raises methodological considerations. As Hughes has it, every method 'is inextricably embedded in commitments to particular versions of the world and ways of knowing that world made by the researcher using them' (Hughes, 1980, p 13). This means that, in turn, any claims to validity are made within the philosophical approach underpinning the inquiry:

> *To use a questionnaire, an attitude scale … and so on, is to be involved in conceptions of the world which allow these instruments to be used for the purposes conceived. No technique or method of investigation … is self-validating: its effectiveness, its very status as a research instrument, making the world tractable to investigation, is dependent, ultimately, on philosophical justification. (Hughes, 1980, p 13)*

This view is supported by Brewer who says it is because methods,

> *reflect broader theoretical and philosophical ideas about the nature of knowledge, explanation and science that the research community gives them authority to endow knowledge as reliable. (2000, p 2)*

Thus, methodology is 'the broad theoretical and philosophical framework' (Brewer, 2000, p 2) into which the methods used fit. Reinforcing this viewpoint Nutbrown says that it is

> *the methodology, the construction and justification of the enquiry which ultimately gives credence to, or calls into question, the findings … methodology must stand the test of time, show itself worthy of the investment of the research act and offer testimony to the credence of research outcomes. (Clough and Nutbrown, 2012, p ix)*

My research question - How is it possible to introduce, maintain and extend all-attainment teaching in mathematics in English secondary schools in the current education environment?

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27 This chapter has developed from work done for my first and second Ed. D. assignments.

(and its sub questions) - is essentially, as Pole and Morrison (2003, p 18) note, the usual (qualitative) question i.e. "what is going on here?"

In this chapter I write first about the philosophical approaches underpinning my methodology followed by the research design and the data collection methods used, principally open and semi-structured interviews.

Philosophical approaches underpinning my methodology

In this section I first discuss critical theory which has formed the main contribution to my methodological framework and then consider the implications of this for issues of rigour, reliability and validity. I then briefly outline some ideas from two key writers who have also influenced my thinking. The first set of ideas comes from the work of Gadamer and the second from Gramsci.

Critical theory

Critical theory as a philosophy of social science has its origins in the 1920s in the Frankfurt school which began life as the first "Western Marxism" think tank. Its main proponents were Horkheimer (1895-1973), Adorno (1903-1969), Marcuse (1898-1979) and Fromm (1900-1980). However critical theory only really came to prominence in Anglophone countries during the dispute about positivism in the 1960s. In contrast to the positions of both positivists and interpretivists, critical theorists actively acknowledge that knowledge and discourse are not neutral but are socially constructed and moreover, that the decisions as to what knowledge and discourses are important are political decisions controlled by the powerful in society[28]. The position of critical theorists is that all knowledge and discourses are political and should be acknowledged as such. As Cohen, Manion and Morrison (2007) say, the expressed intention of critical theorists is 'deliberately political – the emancipation of individuals and groups in an egalitarian society' (p 26). Further to this Tedlock (2007), talking about critical theory, says that scholars working in this paradigm see it as a way 'to free academic work from capitalistic domination and to help schools and other institutions to become places where people might be socially empowered rather than subjugated' (p

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[28] As detailed in my backstory I grew up Catholic in Omagh in Northern Ireland. Even then it was clear to me that knowledge and discourse were not neutral. In general, the television news reporting reflected the priorities of the 'state', the Irish News (paper) reflected the nationalist position and the Belfast Telegraph reflected the Unionist position.

153). In addition, critical theorists embrace an intention for their research to act as an emancipatory force in the world, an intention mirrored by my own in undertaking this study.

The underlying philosophy of critical theory is thus intensely political. Its aim is to help people understand the underlying power structures in society and to enable them to transform these power structures in order to

> *bring about a more just, egalitarian society in which individual and collective freedoms are practised, and to eradicate the exercise and effects of illegitimate power. (Cohen et al., 2007, p 26-27)*

In adopting critical theory as a research methodology, I am acknowledging that knowledge and discourse are not neutral, that I have a particular political standpoint[29] (Rouse, 2009), and my research will reflect this[30]. Scott and Morrison (2007) say that the principal characteristic of critical theory is an acknowledgement that

> *researchers are unable to maintain a disinterested stance when collecting, organising or analysing data, but their belief systems, and more importantly their political projects, are implicated in their work as researchers. They cannot step outside these frameworks and political projects, so decisions they make about what constitutes knowledge, which data to collect and how certain types of data should be interpreted are always made from a particular perspective. (p 48)*

In educational research Habermas is probably the best-known proponent of critical theory. Indeed, according to Bohman and Rehg (2017), 'Habermas currently ranks as one of the most influential philosophers in the world' (np). I have found Habermas' ways of distinguishing between research paradigms helpful. He classifies research as falling into one of three such paradigms:

- empirical/analytic
- historical/hermeneutics
- critical (Scott and Morrison, 2007, p 48/49).

Critical theorists regard research in the first two paradigms as equally value laden as research in a critical theorist paradigm. They regard positivism as often not as honest because the relevant values are largely hidden from view yet commonly there is an

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[29]Again, see my backstory. Growing up in a politically conscious working-class family, where my father was an active trade unionist, gave me a particular worldview, one which inclined me towards issues of social justice.

[30] In Chapter 4 I attempted to articulate my own particular standpoint as I have also done in my backstory.

unspoken acceptance of these values within the research. Interpretivist researchers acknowledge their values and beliefs but maintain that by being properly reflexive they retain a disinterested standpoint. By making my values and beliefs explicit I am making clear the epistemological values I am bringing to the inquiry; in addition, I acknowledge that I am operating with and through a particular political project (Scott and Morrison, 2007, p 48). Critical researchers argue this is a more honest approach than one operating either in a positivist or interpretivist paradigm.

Of course, this approach to research is not without its critics. For example, Scott and Morrison (2007, p 48) identify what they see as two problems with research based on a critical theory paradigm. Both problems are connected with the overtly political approach of critical theory. The first one concerns the political aspirations of critical theory, that is, the emancipatory aspect of critical theory, while the other, in that the research is part of a political programme, raises problems about validity.   But this would appear to take us back to the argument that research in the other two paradigms is politically neutral and hence uncontested. So, we are left with the question: given that conventional definitions of rigour, reliability and validity fail to fully acknowledge the value-drenched nature of research, what alternative standards should be brought to bear in assessing critical theory research?

Issues of rigour, reliability and validity in critical theory research
Rigour, reliability and validity are all factors taken into account when assessing the quality of research in the social sciences. Lather (1991) claims that the aims of critical theory researchers are different from researchers in other paradigms. However, she disagrees with some other critical theory researchers in that she argues, in order for research in critical theory to be taken seriously, critical research theorists must also address the issues of rigour, reliability and validity albeit differently: a different approach is required, she asserts, because the conventional requirements of rigour, reliability and validity cannot be applied in any consistently meaningful way to critical research.

To address how we might think about these three factors in terms of critical theory research we need, first of all, to consider what conventional standards of rigour, reliability and validity might entail. Rigour is considered to be a commitment to being systematic and hence to controlling all of the parameters that can affect the outcome of the research. It tends to be based on research in which an hypothesis is first framed and then tested or in which a

question can be answered. Reliability is a measure of replicability or consistency: in other words, if research is conducted in a set of particular circumstances by one researcher and repeated under similar circumstances by a different researcher, we would expect a similar result. Validity is a measure of whether the research actually achieves what it set out to do. In other words, in conventional terms, does the research answer the research questions asked and is the outcome credible?

Rigour and reliability arose within an experimental approach to social sciences where they are both compatible and clearly defined. Some qualitative approaches also adopt this terminology although their applicability is contested (Lincoln and Guba, 1985, for example). Their relevance to critical theory research in general and to the research I have undertaken in particular is less obvious. I have applied rigour to my research in that I have been consistent in my choice of participants according to their strong commitment to teaching mathematics in all-attainment groups and I have asked all of the interviewees the same questions in similar circumstances. However, I have not framed an hypothesis and tested it as this is not an appropriate approach to my research. My intention was rather to uncover an as-yet-undefined set of attributes, intentions, outlooks and perceptions of all-attainment teaching that the participants possessed.

As regards reliability, in terms of my research, the conventional measures of replicability and consistency are not relevant as, given the same circumstances and even the same researcher, one would not expect exactly the same results: it would be perfectly possible and indeed expected for the interviewee to respond differently, not least because it is commonly the case that participants report being changed by their engagement in the research process (Povey, 1995). Hence, I have approached the issue of reliability from a different angle. For each of my interviewees I constructed a portrait from the transcripts of their interviews and emailed it to them for their comments. Of the six participants, five replied. Three of the participants who replied suggested minor alterations, the other two accepting the portrait without asking for any changes. Indeed, Sarah replied:

> *I've just read your interview notes and they are extremely accurate. I had no idea I'd revealed so much! (2018)*

All of these participants reported that the portraits were an accurate reflection of what they had said. These responses suggest that the data are reliable (and offer (internal) participant validity (Cohen, Manion and Morrison, 2018, p 253)).

The complexity of qualitative research necessitates many different paradigms meaning that 'the conception of validity that is appropriate is dependent upon the inquiry paradigms being engaged' (Cho and Trent, 2006, p 320): researchers must choose a definition of validity which works for them, one that is flexible, credible and appropriate for the research process (Cho and Trent, 2006). Validity is the measure of whether or not the research achieves its goals. In this thesis, set within a critical research theory paradigm, the key questions are therefore: is the research credible? and does it have the power to act on the world?

There are many different types of validity, of which Cohen et al., (2018) list twenty-one. I have found the approach of Cho and Trent (2006) useful here. They divide the individual approaches to validity into two separate camps, which they called transactional validity (here validity can be achieved by following certain procedures) and transformational validity (here validity in the research leads to a change for the better).

As an example of transactional validity, Cho and Trent (2006) point to trustworthiness, as developed by Lincoln and Guba (1985): Lincoln and Guba propose that for research to be trustworthy it should satisfy four criteria - it should be credible, transferable, dependable and confirmable. Some qualitative researchers equate trustworthiness with validity. For example, Nowell, Norris,White and Moules (2017) say that:

> *To be accepted as trustworthy, qualitative researchers must demonstrate that data analysis*
> *has been conducted in a precise, consistent and exhaustive manner through recording,*
> *systematising, and disclosing the methods of analysis with enough detail to enable the reader*
> *to determine whether the process is credible. (p 1)*

However, these characteristics of a trustworthy piece of research are those that I have included in rigour:and of the four criteria of Lincoln and Guba (1985), transferability, dependability and confirmability all fall within rigour and reliability as defined above rather than validity. The remaining criterion - credibility - fits within the conception of transformational validity discussed next.

Transformational validity deals with the issue of 'making explicit the value-laden nature of social, cultural and political meanings in macro and micro contexts' (Cho and Trent, 2006, p

324). The focus shifts from "are the data biased?" to "whose interests are served by the bias?" (Lather, 1991, p 14). This acknowledges that within a critical research theory paradigm, there is no such thing as unbiased data, and the emphasis becomes placed on the contexts in which meanings are produced (p 44). Meanings are socially constructed; hence it is possible to have many different meanings depending on the standpoints taken. Cho and Trent (2006) maintain that in transformational validity:

> *The question of validity in itself is convergent with the way the researcher self-reflects, both explicitly and implicitly, upon the multiple dimensions in which the inquiry is conducted. (p 324)*

This accords with Lather's assertion that in order to produce meaningful and credible research in the present climate of 'paradigmic uncertainty … our best tactic … is to construct research designs that demand a vigorous self-reflexivity' (Lather, 1991, p 66).

Cho and Trent (2006) propose to deal with the issue of validity in an era of a multiplicity of research paradigms by proposing 'validity as a process' (p 327). The purpose and hence process of interest to critical theory researchers is praxis/critical in which reflexivity plays the major role in validation. Reflexivity is the process by which new knowledge comes into being via the researcher's construction of their interpretation of their experience in the field, and the researcher's active questioning of how this interpretation of their experience came into being. In effect, it is the internal conversation the researcher has about their experience, their questioning of their new knowledge and how they came to know it. As Hertz says:

> *Reflexivity … is ubiquitous. It permeates every aspect of the research process, challenging us to be more fully conscious of the ideology, culture, and politics of those we study and those we select as our audience. (1997, p viii)*

Thus, in order for reflexivity within a critical research paradigm to contribute to credibility and hence validity, a clear articulation of how reflexivity has operated within the research is required. Reflexivity in the conception of the praxis/critical process involves reflexivity in the participants, leading them to better understanding their own lived experience, and also the self-reflexivity of the researcher challenging her/himself when grappling with something new or unknown.

In order to answer the first question - Is the research credible? - I need to show how reflexivity has operated within the research, both in terms of self-reflexivity and in the

participants. Hence, I discuss: transparency; deliberately looking for evidence to counter initial emergent patterns in the data; and being open to the unexpected, to surprises.

I have addressed transparency in my research by setting out as clearly as possible both in the Backstory and elsewhere where I am "coming from" in terms of my background. I have included elements of my upbringing including my schooling and family background and my later educational background at university. I have also talked about my work and life experience and the wider beliefs that I have come to as an adult. Such transparency puts the onus on the reader to decide if the research is credible: given the readers' awareness of my preconceptions and biases, my standpoint, does the account resonate with them?

During my interviews with the participant teachers I tried to make clear to them my position in terms of personal educational beliefs, that I had taught all-attainment classes throughout my mathematics teaching career and that I was even now as a teacher educator attempting to get my students to think about the issues around "ability" grouping. Thus, I have attempted to be transparent with the participants as well as with potential readers so they can decide how credible my research is.

Following my initial analysis I revisited the data many times, looking to counter initial emergent patterns. Although I found I needed to make minor adjustments - for example, initially I thought that all of the participants had an interest in research but by more careful reading of the data I became aware that most did but what they all shared was an interest in curriculum development – none of the initial themes failed to survive this scrutiny.

However, a number of the themes that emerged confounded the expectations with which I had entered the field. I believed prior to my field work and analysis that parents would prove to be a problem as that is what is indicated in the research literature. Apart from Bob's[31] experience of parents worrying about the lack of "ability" grouping this proved not to be the case. In contrast Adara reported that parents were supportive, as did Pete. In particular, Adara reported that new parents expressed pleasure that their children were not being put into ability groups. This was a surprise. In addition, some themes I had not anticipated emerged from my analysis of the data and also surprised me. These included a

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[31] see page 66 for a complete list of interviewees

love of mathematics and very good subject knowledge and the impact of ITE on some of the participants – the literature had led me to expect little, if any impact.

The participants all had the opportunity for reflexivity during my interviews with them and later if they so desired. During the interviews all participants recounted and reflected on how they had come to be mathematics teachers, sharing many details of their lives and their motivations. Later when I shared the portraits I had written from their interviews, as noted above, five of the six got back to me, three with minor modifications. These portraits are available in much-shortened form in the thesis while extended versions are available in appendices 3 - 8.

The second requirement for research within a critical theory research paradigm is concerned with the impact the research has on the social world. Lather (1991) believes that for critical theory research to be taken seriously it must be trustworthy and also needs to display catalytic validity: catalytic validity enables the participants to understand the reality of their lived existence and empowers them to do something about it. As Cho and Trent have it

> *participants should be able to differently perceive and impact the world in which they live …*
> *At the center of this changed world making is the notion of emancipation. (2006, p 332)*

So, what does catalytic validity mean in the context of my research? The six participants are all currently engaged in all-attainment teaching and being involved with my research enabled them to talk at length about their practice. It opened up a space to examine what they were doing and why they were doing it and, furthermore, empowered them to renew their own thinking on all-attainment in the here and now and to reflect on implications for the future. The response from Pete aptly illustrates this:

> *I would say that being involved in your research has had a positive impact as being asked to articulate and talk through the rationale underlying what I/we do has helped clarify my own thinking and made me reflect on aspects of our approach in a way that perhaps would not have been done otherwise. I know that in parallel with the discussions you had with others in the faculty this has led to some fruitful and reflective discussions among the faculty leadership which has again helped clarify some of our thinking and approach. [Pete, research participant]*

Teaching against the grain (Cochran-Smith, 1991) is not easy and Bob, another research participant, feels that being interviewed as part of my research validates what he (and Sarah, a third participant) are attempting to do:

> *I suppose the interview did, however, give my course of action a sense of legitimacy. The very fact that you had travelled to interview me (and Sarah) made me feel that I had something to say that was worthy of an interview. Whether that was the case, of course, is up to you. Your research did strengthen my conviction that mixed-attainment was a legitimate form of grouping students when "common-sense", particularly at the school I was in at the time, held that the opposite was true. [Bob, research participant]*

Sarah was the main instigator of the all-attainment mathematics conferences and three of the other participants have also run workshops there. These conferences started shortly after my fieldwork and it is possible that my fieldwork may have played a small part in this initiative.

In addition, building on and extending Lather's definition, my interpretation of catalytic validity also necessitates an opening out to include others in the social world. For example, other mathematics teachers interested in all-attainment teaching who are seeking to empower themselves in their teaching and parents who seek to understand better the arguments for and against all-attainment teaching in mathematics. In chapter 9 I discuss further the extent to which, and in what way, my research has already impacted or failed to impact on the social world and speculate how it might continue to do so.

As a critical researcher I seek to understand and interrogate the current perspectives of teachers, particularly secondary mathematics teachers in England. Critical theory seeks to lay bare and critique the set of assumptions behind the hegemonic discourses – the common-sense – within which in this case current secondary mathematics education is understood. Jordan and Yeomans (1995) say

> *it is the work of critical social theory to provide a critique of ideology that will allow teachers to penetrate the "true" nature of their practice. (p 403)*

In addition, writing in 1989, Anderson noted that there is an essential requirement of including an answer to the question "What is to be done?". A basic tenet of critical research is not just to understand the world but to change it. As noted by Anderson (1989), a persistent criticism of critical theory in educational research is

> *its tendency toward social critique **without developing a theory of action** that educational practitioners can draw upon to develop a "counter-hegemonic" practice in which dominant structures of classroom and organizational meaning are challenged. (emphasis added, p 257)*

He says that 'there is an immobilising tautology implicit in most critical research' (p 262) in that, quoting Willis (1977, p 186)

> *nothing can be done until the basic structures of society are changed, but the structures prevent us making any changes[32]. (p 262)*

In this current study I have taken these warnings seriously. To this end the choice of a professional doctorate – the Doctorate in Education (EdD) – was particularly appropriate. The description of the Doctorate in Education in the course Handbook seemed to me to provide a good fit with my purposes. The Handbook states that the Doctorate in Education

> *represents an opportunity to conduct an in-depth enquiry into issues that have emerged from practice experience … and represents an opportunity to make a contribution to public discourse in their professional field through engagement in a sustained enquiry into a professional or practice issue. (Garland, 2012)*

Hence, the aim of my research is to develop a theory of action to promote ways in which all-attainment teaching in mathematics could be supported.

Finally, the use of a critical research methodology is in line with my decision to identify as participants teachers who choose to teach their pupils in all-attainment groups: following the ideas of Lather, for me being a critical researcher implies that there exists a set of common beliefs between the researcher and the researched, in this case when considering ideas of schooling and the teaching of mathematics.

Additional theoretical contributions

Although I draw mostly on critical theory as my main philosophical tool, I also utilise ideas from the thinking of Gadamer and Gramsci who are not identified as critical theorists.

Gadamer

It is not my intention to discuss in depth the different strands of interpretivism here: rather I will briefly discuss interpretivism in general and the contribution of Gadamer (1960/2003) in particular as it has influenced my methodological thinking.

Scott and Morrison (2007) state that:

> *The basic tenets of interpretivism can be easily expressed. Social actors negotiate meanings about their activity in the world. Social reality therefore consists of their attempts to interpret the world, and many other such attempts, by those still living and those long since dead. These are real and constitute the world as it [is]. Thus interpretivists subscribe to a realist ontology. (p 131)*

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[32] See Implications for practice in Chapter 9 in which I attempt to suggest ways in which to address developing a theory of action from this research.

However, this reality is different from a positivistic version in that it is the interpretations that constitute the reality. Interpretivists start with individuals (Cohen et al., 2007) and theory is emergent, arising from particular situations:

> From an interpretive perspective the hope of a universal theory which characterises the normative outlook gives way to multifaceted images of human behaviour as varied as the situations and contexts supporting them. (Cohen et al., 2007, p 22)

Thus, my research does not constitute a search for an over-arching, all-explaining theory. Rather I seek to understand and represent the thinking (and practices) of a specific set of teachers with a view to shedding light on a specific social phenomenon. I expand further on questions of generisability in chapter 9.

My particular interest in interpretivism is that of the work of Gadamer (1960/1975 and 1960/2003). Using this as a supporting strut of my methodology necessitates framing my research in such a way as to enable me to understand how it is that mathematics teachers have arrived at their current practices. I have found helpful two concepts from Gadamer's work: his concept of situation, and hence of experience occurring within a situation, and our inevitable entanglement in these; and the concept of a horizon.   Gadamer maintains that:

> We define the concept of "situation" by saying that it represents a standpoint that limits the possibility of vision. Hence an essential part of the concept of situation is the concept of "horizon". The horizon is the range of vision that includes everything that can be seen from a particular vantage point ... A person who has no horizon is a man (sic) who does not see far enough and hence overvalues what is nearest to him. (Gadamer, 1960/1975, p 269).

Hence, the concepts of situation and horizon as defined by Gadamer offer further theoretical tools to interrogate the current pedagogical practices in mathematics teaching in England. For Gadamer understanding takes place in a particular situation determined by history and with a particular horizon. I argue here, in keeping with Gadamer, that the historically and pedagogically situated practices of most English secondary mathematics teachers lead to the teachers having extremely limited vision. They experience their situation both narrowly and without an horizon. That is, the way things are is inevitable and how things must be: there is no possible beyond. In particular, the current dominant discourses work to limit the possibilities for practice that mathematics teachers think can work. As Gadamer explains:

> To have an horizon means not to be limited to what is nearest, but to be able to see beyond it.
> A person who has an horizon knows the relative significance of everything within this horizon,
> as near or far, great or small. (1960/1975, p 269).

So, an intention of this inquiry is to support English secondary mathematics teachers in looking beyond their current situation, to see and therefore to be able to look past the dominant horizon; to, for example, extend their gaze on "ability" practices to other subjects, to other countries and to other historical times to enable them perhaps to interrogate at least some aspects of the familiar and the nowadays in mathematics teaching in England, "strange" practices of not grouping children by perceived "ability".

Gramsci

A second additional strand is provided by Gramsci's thoughts on common-sense, good sense and hegemony (Gramsci, various writings, Forgacs, 1988). Hegemony, from a Gramscian perspective, is the means by which the ruling class enlists the participation and support of the dominated in their own domination (Gencarella, 2010). Hegemony is not static but is continually adjusting to take account of changes in ideology and culture. It is the means by which a small ruling class maintain their domination without recourse to physical "violence". Common-sense is what the "man in the street" believes to be the way things are. Common-sense ideas are the everyday expressions of hegemonic discourses. However, embedded within common-sense is good sense – ideas which are also based in the everyday, but which do not conform to dominant discourses but to emancipatory ones. Gramsci believed it was important to draw out and elaborate those underdeveloped feelings that people already have but which are constrained by opposing notions; they needed to be enabled to draw out the good sense from the common-sense. He believed 'the philosophy of praxis[33] can exert a leverage on people's consciousness because a part of that consciousness is already aware of its truth' (Forgacs, 1988, p 323).

For example, as previously stated, within the context of English schooling today, a dominant structuring common-sense framework is the discourse of "ability". This discourse maintains that children are born with a fixed amount of "ability" and this ultimately determines how well they achieve in school and indeed in later life (Boaler, 2005; Stobart, 2008; Syed, 2011). The discourse of "ability" is a hegemonic idea that permeates the culture and ideology of

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[33] According to Gramsci the 'philosophy of praxis is both the theory of the contradictions in society and at the same time people's practical awareness of those contradictions' (Forgacs, 1988, p 429).

schooling entering into the consciousness of teachers and as such has been accepted as the norm by the dominated.

This common-sense idea, that is, the discourse of "ability", framed in terms of the thinking of Gramsci, represents a hegemonic way of thinking that reflects the interests of the dominant class. This class portrays their way of seeing schooling as common-sense and "natural". Hence teachers within the school system accept as a given the idea that the common-sense way to organise teaching is by putting children into "ability" groupings.

However what Gramsci emphasised was the need to find within common-sense the embedded good sense (Bambery, 2006):

> Good sense is the 'healthy nucleus' of common-sense … [which] … promotes … an understanding of the practices of a given hegemony (Gencarella, 2010, p7)

For example, in the case of schooling, good sense would include a commitment to maximising in the educational context the welfare, happiness, respect for and attainment of all children, a commitment to which the hegemonic discourse lays claim and which is regarded as common-sense. But good sense sees that this commitment suggests organising teaching on a different basis, one in which 40% of children do not routinely fail[34] and consider themselves to be failures. This would require a paradigmic shift in the thinking of English mathematics teachers who first need to recognise the damage done by the current "common-sense" that only some have the "ability" to achieve. However, this will not just come about: in order for this to happen, according to Gramsci, mathematics teachers need to engage in some form of struggle such that the good sense becomes common-sense. In the current educational climate where teachers struggle to defend even the status quo against neoliberal incursions this is challenging.

Research design[35]

I have argued above that my research question implies for me the use of a critical research methodology. Adopting critical theory as my research methodology had important implications for my research design in that 'a critical epistemology assumes that valid

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[34] The number of children who fail is currently around 40% and presumably will continue to be so in the interests of protecting "standards" rather than the well-being of these children. See also footnote 23, p 22.

[35] This section draws on the second assignment of my Ed. D.

knowledge is obtained in part through shared understandings, reflexivity, sensitivity to insiders' (Jungck 1996, p 624). The research methods I chose needed to fit with critical research as this is what ultimately gives authority to the outcomes (Clough and Nutbrown, 2012; Brewer, 2000; Hughes 1980). Being a critical researcher implies that there exists a set of common beliefs between the researcher and the researched, in this case when considering ideas of social justice, schooling and the teaching of mathematics. Thus, the methodology led to identifying as research participants teachers who are committed to teaching their students in all-attainment groups. This opens up the possibility to some degree for the shared understandings referred to above. As I explain in some detail below, my final chosen method was to use in-depth interviews.

Methods I considered and rejected
In the earlier stages of my doctorate I considered two alternative approaches: critical ethnography and, drawing on a Bourdieusian perspective, questionnaires. Previously when I had conducted my pilot study, whilst taking cognisance of critical theory, the methodology I used was informed mainly by the work and philosophy of Bourdieu. As much of Bourdieu's research was based on data derived from questionnaires, I chose to use a questionnaire. While the experience of conducting a survey was interesting, I decided it was not a method I wanted to use in the thesis phase of my doctorate as the data I had obtained from the use of questionnaires was not as rich or informative as I had hoped. I refocused my methodology on critical theory. Having thus concluded that the methodology used in my research would be best underpinned by critical theory I considered which data gathering methods would fit in with my methodology. The methods I considered were not necessarily mutually exclusive and included ethnography and thematic analysis.

During the second taught module of my doctorate, when considering which methods to use, a critical ethnographic approach seemed to offer the research method that best fitted in with my methodology, particularly as my research at that point was informed by the ethnographic studies of Lacey (1970) reported in Hightown Grammar, Ball (1981) reported in Beachside Comprehensive and Willis (1977) reported in Learning to Labour. Furthermore, Cohen et al. (2007, p 187) say that 'questions of legitimacy, power, values in society and domination and oppression are foregrounded' in critical ethnography which seemed to fit in well with my use of critical theory. On the other hand, Foley (2002) maintains that

> *most so-called critical ethnographers still think of themselves as doing intensive empirical investigations of everyday, lived cultural reality. (p 472)*

He notes that such empirical work is likely to include at least a year's fieldwork in which conventional ethnographic methods are used such as participant observation and interviewing. As I am doing a professional doctorate a year's fieldwork seemed impractical, so in the end, with some regrets, I had to abandon an ethnographic approach.

After some consideration I decided interviews would be most suitable as the research tool. Interviews as a research method fit well with critical research as they are adaptable (Bell, 2005); there are opportunities for personalisation and construction of knowledge through shared meaning. The literature also suggested interviews provide opportunities for in-depth probing and asking questions which can be quite difficult and open-ended. Semi-structured interviews provide the opportunity to ask non-specific questions which through prompts and probes from the interviewer allow the interviewee to give depth to their response (Cohen et al., 2007). In addition, my previous research experience suggested that one to one semi-structured interviews with carefully thought out questions would provide the data I needed to answer my research questions which at the time of the interviews were[36]:

How do mathematics teachers resist grouping by "ability"?

     a.   What are such teachers' philosophies and understandings?

     b.   How are these shaped by the local context in which they work?

     c.   How do their personal histories influence the development of their perspectives?

The nature of the interviews

Interviews can take many forms from formal highly structured interviews to completely unstructured interviews: they can be undertaken on an individual basis or in the form of focus groups and they can be life history interviews. Highly structured interviews are more suited to a positivistic methodology whereas unstructured interviews, similar in many ways to conversations, are the method most frequently used in ethnographic interviewing. The type of interviewing I undertook can best be described as semi-structured. I created a script to achieve this (Figure 2). However, the rapport I quickly developed with my interviewees

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[36] My research question changed several times as stated in chapter 1.

meant that the interviews were more like conversations kept on track by my interjections and questions.

There is, of course, an interviewer effect in a face-to-face encounter which can influence the course of the interview. Some researchers see this as a problem, albeit as surmountable (Brewer, 2000, p 7) by using "how to" rules. But critical researchers see this as inevitable and, indeed, welcome as a fundamental part of the co-construction process. Approaching my research using a critical theorist methodology tackles head-on the problem that Blain (1997) identifies

> the researcher's contribution to the interview and the selection of data to record must be guided by something … and hence if one assumes … that one can minimise preconceptions … they become implicit, and their guiding effect on observation becomes hard to uncover and remove at a later date. (p 2)

However, both see as beneficial 'developing close relationships with the respondent' (Brewer, 2000, p 67) and place value on sensitive awareness of the context, location and so on within which the interview is occurring.

I interviewed the six participants in their schools[37]. In the case of Adara, Philippa, Akhila and Sarah I was pleased to assist them in their classrooms immediately before our interviews. This was also the case for Pete for the first part of our interview. I then interviewed all except Philippa in their classrooms immediately following the lesson. Interviewing the teachers in their own classrooms along with the opportunity to assist the teachers in lessons helped contribute to the relaxed nature of the interviews, as although I was not a mathematics teacher at the schools, I was an insider in that I had been a classroom teacher in several schools over many years and an observer/participator in many different classrooms in my role as a mathematics educator. I did not have the occasion to assist Bob as the opportunity for an interview only became available late on the day of the interview. On reflection it seemed to all of the teachers that I was someone who had thought a great deal about mathematics teaching and that in terms of teaching I understood what they were doing and why they were doing it.

Pole and Morrison (2003), talking about the strengths and limitations of interview data, suggest that they are valuable as long as it is noted that interviews allow analysis of 'what

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[37] See below and chapter 5 for details.

people say they say, write and do rather than what they say, write and do' (p 35).   Whilst acknowledging the accuracy of this, I also note Blain's warning that the implications of this need handling with care:

> *Attempts to uncover the subjective meanings of participants are dependent on the researcher's own perceptions and lay open the researcher to charges of misinterpretation and bias. (1997, p 2)*

My intention in the interviews was to gather rich enough information from the interviewees that narrative constructions could be a possible analytic tool to answer my research question. To do this I needed to give the interviewees 'ample freedom and time to unfold their own stories … [followed] up with questions to shed light on the main episodes' (Kvale, 2007, p 57).

As noted, the interviews I conducted were semi-structured and not unlike conversations in the sense that

> *the research interview is based on the conversations of daily life and is a professional conversation: it is an inter-view, where knowledge is constructed in the inter-action between the interviewee and the interviewer … [but] … is a conversation that has a structure and a purpose … of obtaining thoroughly tested knowledge. (Kvale and Brinkmann, 2015, p 4-6)*

They also had aspects reminiscent of life history interviews. Life history interviews focus on key actors who may either be interesting in their own right or be in some sense representative of a group; such interviews enable the researcher to understand better the circumstances which have led the actor to their current situation and their current thinking, and frequently shed light on those of their colleagues (Brewer, 2000; Pole and Morrison, 2003). Life histories are congruent with the paradigm of critical research as they enable the interviewer and the interviewee to come to a shared understanding of the cultural changes that have led to their joint social construction of the world (Marshall and Rossman, 2011).

Designing the interviews

Kvale (2007) says there are no standard rules or procedures for conducting a research interview, only 'standard choices of methods' (p 33). He proposes seven stages of which the first three are:

- thematising - the why and what of the investigation;
- designing – planning; and
- interviewing

Thematising involves determining what the research questions are and thus the 'why, what and how of the interview' (p 37). As noted above at the time of the interview my research question, and sub-questions, were:

How do mathematics teachers resist grouping by "ability"?

   a. What are such teachers' philosophies and understandings?

   b. How are these shaped by the local context in which they work?

   c. How do their personal histories influence the development of their perspectives?

According to Kvale (2007) when preparing for an interview it is a good idea to prepare two interview guides, a thematic guide consisting of the research question/s and a guide for the questions the interviewer will actually ask which are in everyday language. Figure 2 is constructed to show how my sub-questions, through which I intended to address the question guiding the research, were connected to the interview protocol adopted. The final interview script appears in - Figure 2. Relationship of research questions to interview questions.

Research questions	Interviewer questions

How do the teacher's personal histories influence the development of their perspectives?

What are the philosophies and understandings of teachers who resist grouping by "ability"?

How are the teachers' philosophies and understandings shaped by the local context in which they work?

Can you tell me some of the reasons why you became a mathematics teacher?

Have you experienced any additional pressures, either internal or external in your teaching as a result of your teaching methods/ group organisation?

Can you tell me something about the mathematics department?

Can you describe a good mathematics lesson?

Can you describe your current school?

What do the children think of the way they are grouped or do they even think about it?

Figure 2 Relationship of research questions to interview questions

Choosing the sample

In his book Doing Interviews, Kvale (2007) emphasises the importance of being well prepared for conducting the interviews and says it is more important to do fewer interviews well than more badly. He recommends conducting between five and twenty-five.

> *A general impression from current interview studies is that many would have profited from having fewer interviews in the study and by taking more time to prepare the interviews and to analyse them. (p 44)*

There are currently very few mathematics teachers who teach mathematics in all-attainment groups in England. Indeed, the Best Practice in Grouping Students study (Best Practice in Grouping Students, 2019) which ran concurrently with my research found it impossible to recruit the target number of schools for their research. I decided to use opportunistic sampling to recruit the teachers I needed for my research. At this stage I was simply looking to identify teachers who were teaching all-attainment and who would be willing to be interviewed as part of my research. I expected to be able to recruit individual teachers directly, through the Association of Teachers of Mathematics (ATM) and through personal contacts, rather than through their schools, and so I anticipated that the permission of the headteacher would not be needed.

One of my university colleagues gave me two leads, one of which led to a teacher in a local school while the other led to a small Twitter group of teachers either already engaging in all-attainment teaching or interested in it with a view to perhaps introducing it into their schools. Another colleague from a different university gave me a very productive lead which led to a school which was heavily engaged in all-attainment teaching. Both colleagues are members of the ATM.

When I commenced the fieldwork for my research study it had been my intention to interview 8-12 teachers from different schools using semi-structured interviews with a very open protocol. I thought before I began searching for potential interviewees that interviewing a single teacher from each school would enable me to obtain rich data on all-attainment teaching practices with the benefits of a range of different schools in the sample. However, during the process of conducting the interviews I began to realise that I was tending to get richer data on all-attainment teaching practices where I was interviewing more than one teacher in each school. So, in the end I interviewed teachers from fewer schools than I had anticipated. In all I interviewed eleven teachers from only five schools.

After a quite exhaustive process, which I will explain fully in the next section, I decided to use only six of the interviewees as research participants in this thesis. As I began to immerse myself fully in the data, I also continued to read about which methods and philosophical processes were most in tune with my research. I consequently continually redefined my research questions as the process of immersion in the data and the methodological reading worked interactively with each other. Eventually I obtained clarity on the nature of the research question I wanted the thesis to answer (see chapter 5) and concluded that, in the interests of rigour, only some of the participant interviews would contribute to this. Figure 3 spells this out clearly. The other five teachers who were interviewed for this research were either teaching all-attainment or interested in teaching all-attainment and had other things to say but these were not germane to my doctoral research. My interview with Samira[38] formed the basis for a conference paper on teacher expectations and working-class children and it is my hope to make use of the data from the other interviewees in other papers.

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[38] Paper published in proceedings of 14th International Conference of The Mathematics Education for the Future Project (Jackson, 2017).

Chapter 5: Data collection, processing and analysis

Introduction

In this chapter I talk about the process of collecting, processing and analysing the data. I also give some brief background information on the schools involved. I discuss the evolution of my research question as I endeavoured to get to know my data and begin to understand what they were telling me. I also discuss potential ethical issues.

I also discuss the transcription process, from personal beginnings to professional transcription describing how it enabled me to become thoroughly familiar with my data. Furthermore, I describe how I started the process of analysing my data through developing portraits for each participant and how these helped me to begin identifying markers emerging from the data.

I then describe how I utilised these markers to begin developing a concise thematic analysis to analyse the data, eventually identifying three major categories each of which encompassed several themes.

Finally, I include short portraits of the teachers, longer versions of which are contained in appendices 3 -8.

Data collection

Having found several potential sources of interviewees (see previous chapter) I emailed those teachers I had identified via my contacts and the teachers on the Twitter group to ask them if they would be willing to be interviewed as part of my research. My letter of introduction was attached to the email I sent to the teachers (see Appendix 12). In it I stated that I had been a mathematics teacher for several years in a number of different schools, mainly in London. I also said I was now an academic and I had commenced a doctorate 'with a particular focus on grouping students by "ability"'.

Those teachers who replied were happy to be interviewed but in at least one case we could not find an interview time which suited both of us. Initially I arranged to interview six teachers in five separate schools (one school had two potential interviewees) over a period of several weeks towards the end of the summer term in 2016. The interviews were to take place in the teachers' schools at a time which was convenient for them.

The interviewees I had been directly in touch with all assumed, rightly, that I would like the opportunity to participate in a lesson if that was possible. As a former mathematics teacher, this was a great privilege for me and while not directly feeding into my research, it helped me to contextualise their situation. Consequently, I participated in lessons with all of the interviewees apart from Bob, the head of department at Shortvalley who volunteered to be interviewed on the day I was there interviewing Sarah.

At Brierley Grove I was expecting to interview only two teachers, Pete and Philippa. I arrived for my visit before school started and spent some time in the mathematics office, which had a very relaxed atmosphere. In addition, the mathematics department felt very open and welcoming. During the first period I assisted in a year 7 lesson taught by Jean. Later that morning I assisted in a year 10 lesson which Philippa was teaching, interviewing her shortly after the lesson had finished. At the end of the school day I interviewed Pete who, at that time, was the second-in-charge. I found Pete a very easy person to talk to and we struck up a rapport which meant we had a wide-ranging conversation that covered lots of ground in terms of all-attainment teaching and education generally.   By the time the school was closing for the night we had just about covered my first question. As we seemed to have barely begun Pete invited me to return to continue the interview at a later date suggesting that other teachers might agree to be interviewed when I did so. On the day of my return Pete had arranged for me to interview four more teachers. In the morning I assisted in one of Akhila's lessons interviewing her shortly afterwards. Later that day I interviewed Jean and Chandra jointly and Fred separately. At the end of the day I continued my interview with Pete. The two interviews combined were over three hours in total and Pete was more than happy to share his time talking about all-attainment teaching, how it had been introduced and where it was going in terms of the school.

Hence, the visits to each of the schools, typically, took between half a day and a whole day with the exception of Brierley Grove where I spent two days. The interviews, in general lasted around an hour. As already noted, the interview with Pete took place over two days and lasted over three hours. The interview with Bob lasted over ninety minutes and in the end was only curtailed because he was due at a school event. It could easily have gone on for much longer as he was more than happy to share his thinking with me.

As a former mathematics teacher and as a teacher educator who visited mathematics classrooms regularly I was able to blend seamlessly into the background, in the school as a whole, in the mathematics department and in the teachers' classrooms. I understood the field intimately and knew how to respond both to the teachers and the students. I was so-to-speak a fish in water and the teachers and students treated me as such. I believe my capacity to empathise and respond to the teachers appropriately, having been someone involved with all-attainment teaching throughout his career, contributed to the quality of the interviews.

All of the teachers were happy to share their thinking with me as I was with them and I quickly developed a rapport with each of them. This rapport contributed to the credibility and hence validity of the interviews as did my participation in one of their lessons. Participating in lessons with all of the teachers, apart from Bob, gave me the opportunity to observe upclose their practices in the classroom; moreover in the course of their interviews, sometimes prompted by me, several of the teachers took the opportunity to exemplify their practices by refering to what had taken place in the lesson.

An overview of the teachers interviewed, and their schools is given in Figure 3. All of the interviews were recorded on a dedicated digital recorder and the files were transferred onto a password protected laptop.

School	My impressions	Teacher	Commentary	Included
Brierley Grove Comprehensive	Inner London comprehensive inner city school -largely Bangladeshi and other ethnic minorities -largely working-class	Pete	Second in the mathematics department at the time of the research Instrumental in introducing all-attainment teaching Completely committed to all-attainment teaching	✓
		Philippa	Position of responsibility for curriculum development Completely committed to all-attainment teaching	✓
		Akhila	Masters student Completely committed to all-attainment teaching	✓
		Fred	Supply teacher (Australian who is a qualified art teacher) Committed to teaching the students in whatever way he is required to do	
		Chandra*	Ex-student of school Committed to teaching the students in whatever way she is required to do	

		Jean*	Drama/mathematics teacher Committed to teaching the students in whatever way she is required to do	
Shortvalley	School on outskirts of coastal city -large (poor) working-class cohort (approx. 40%) in previously middle-class school (result of school closure)	Sarah	Lead teacher Completely committed to all-attainment teaching	✓
		Bob	Head of department Completely committed to all-attainment teaching	✓
Hope	School in large town in London commuter belt -large working-class cohort	Samira	Lead teacher Interested in all-attainment but not currently teaching in a school which uses all-attainment in mathematics (although the school leadership was committed to introducing all-attainment but this was being resisted by the head of mathematics)	
Homefarm Comprehensive	rural school on edge of northern city -not noticeably deprived	Mick	Position of responsibility Leading on 'all-attainment' This was being implemented in year 7 but in the form of bands at the time the research took place	
Duckworth Community School	rural school in Cambridgeshire - not noticeably deprived	Adara	Lead teacher Very experienced in all-attainment teaching Completely committed to all-attainment teaching	✓

*interviewed jointly but not included in data

Figure 3 All-attainment teaching study: Teachers and schools

Refining my research question and the transcription process[39]

During the process of collecting my data, I began to listen to the recordings I had made to begin to familiarise myself with the data and start the process of thinking about how I would analyse it.

At this stage I was still refining my research questions. At the beginning of the doctoral process in 2011 I had two very tentative and very much related research questions:

1. Why do English mathematics teachers appear to be committed to teaching in "ability" groups?
2. Why does there appear to be an inbuilt resistance to working with all-attainment groups?

Through discussions with my peers and reading extensively about all-attainment as the taught section of the doctorate proceeded, I came to realise that asking 'why' questions was unlikely to be very productive and I would need to reframe my questions. I rethought the questions over the next few modules and by the time of the transfer event the question had become:

How do mathematics teachers resist grouping by "ability"?

a. What are such teachers' philosophies and understandings?
b. How are these shaped by the local context in which they work?
c. How do their personal histories influence the development of their perspectives?

This was my research question at the time of my fieldwork but one which I felt still needed some work.

As my field work proceeded and my data started accumulating, I began to transcribe the interviews. However, transcribing is quite a laborious process so by the time I had completed four I decided that little would be lost by having the remainder professionally transcribed. As it was, the interviews I had already transcribed had given me a good feel for the data and I had listened to the remaining recordings several times. Five interviews in total were transcribed professionally.

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[39] The writing on storytelling draws on my Masters thesis.

School	Teacher	Transcription		Included
		Longhand Complete	Professional	
Brierley Grove Comprehensive	Pete		✓	✓
	Philippa	✓		✓
	Akhila	✓		✓
	Fred		✓	
	Chandra*			
	Jean*			
Shortvalley	Sarah		✓	✓
	Bob		✓	✓
Hope	Samira	✓		
Homefarm Comprehensive	Mick		✓	
Duckworth Community	Adara	✓		✓

Figure 4 How recordings were transcribed.

At this stage I was engaging in a dialectical process whereby I was considering all of my data both from individual and holistic perspectives and thinking about what my data could tell me about how my research question might be refined.

The more I engaged with the data and got to know it better the more it dawned on me that the original premise on which my overarching research question and its subquestions were framed needed to be rethought. As I struggled with these processes it became clearer to me that what I was really interested in was those teachers who had actively chosen all-attainment and had been able to enact it, that is, that all attainment had not been imposed on them by some external agent, that they had freely chosen to embrace it in intention and in practice. This led me to conclude that five of the teachers I had interviewed did not fit my criterion. It was not that these teachers were subject in their schools to the forces feared by the Frankfurt School, of a nightmare vision,

> of an 'administered' modern industrial society which has such ideological control over the deepest desires and feelings of its subjects that they are quite literally unaware of their exploitation, frustration and happiness. (Macey, 2001, p 75)

Indeed, it could be argued that those teachers in schools where the students were in "ability" groups were more prone to be subjected to such forces. Rather the teachers I chose to reject, by the responses they gave in their interviews, had either not themselves chosen all-attainment or had not been able/begun to enact it or both. (See Figure 3 for further details.) Despite the prevailing neoliberal environment the teachers who became my final research participants were engaged in creating in the mathematics departments within their schools a positive educational climate which embraced all-attainment teaching, one in which all of their students could prosper and therefore my questions needed to reflect this more appropriately. Hence the focus of my questions shifted to an affirmation of what the teachers were trying to do rather than one which suggested a more defensive attitude.

Initial approach to data analysis

Before commencing the fieldwork, my intention was to use storytelling to analyse the data. When I had concluded the interviews it still seemed that this would be a suitable method for doing the analysis. According to Doyle:

> *In large part the turn to narrative in research on teaching and teacher education is an effort to bring the richness of this particular way of knowing to the complex world of classrooms. It is also an admission that the conventional search for warranted true belief with respect to teaching and teacher education has more often than not led to conceptual bankruptcy. (1997, p 96)*

However, as Bruner (1996) points out, the use of narrative methodology in educational research is not universally accepted:

> *It is usually the case that discussions of narrative reality lead not to reflections on the negotiation of meaning within the human community, but to the indignant rejection of "stories" as sources of human illusion. (p 148)*

It is Bruner's contention that the world we live in is constructed more according to the rules and devices of story than to the intolerant puritanism of 'scientific method,' (p 148-9). Indeed (Clough, 2002) maintains it is a human trait to think in stories. Nevertheless, Goodson (1997), who is generally supportive of narrative raises some concerns that relate in the main to voice and context. In a narrative, whose voice is it anyway? In what sense is the subject of the narrative speaking through the account? Is it not rather the researcher's voice that is heard? However, my research methodology, as outlined previously, is in the main underpinned by critical theory, which is 'a research perspective that foregrounds the notion of emancipation' (Scott and Morrison, 2007, p 47). Storytelling appeared to be an

appropriate analytical approach as, listening to the recordings of the interviews, it started to become clear that several of the teachers who were completely committed to all-attainment teaching were not just interested in the mathematical attainment of the students but also had an emancipatory outlook in general.   Given the general dearth of mathematics teachers teaching all-attainment classes I reasoned that at least some of these teachers would have important things to contribute as individuals and that their personal stories might be instructive in terms of my research on all-attainment teaching.

Having narrowed down the number of participants to six my initial approach was to write my version of their story as told to me during the interview. I read and re-read each transcript individually reflecting on my own varied experiences as a mathematics teacher in several different schools in different areas of the country in order to help me make sense of the story each participant had told me during the interview. As a practising teacher, for the earlier part of my teaching career when I was not a head of department, I had actively sought out and chosen to teach in mathematics departments where the students were taught in all-attainment groups,. Later when I became a head of department, after a period of two terms, I introduced all-attainment teaching across all year groups simultaneously. I drew on those experiences to help me understand the type of processes that may have been in the mind of these teachers when they were confronted by the realities of the mathematics teaching careers they had embarked on. Having fully immersed myself in the data and reflected on my own experiences I wrote the story for each teacher as I understood it from the conversation we had had.

I had the luxury of teaching in a different era when, at least in Inner London, all-attainment teaching in mathematics was the norm. As with all teachers, the participating teachers did not embark on their teaching careers in circumstances of their own choosing 'but under circumstances existing already' (Marx, 1852/2006, np): their already existing circumstances were very different from mine.   As Goodson (2012) explains:

> *In the life stories of teachers, nowadays, the normal storyline is one of technicians who follow government guidelines and teach a curriculum that is prescribed by governments or departments of education … [whereas when I started teaching thirty years ago] … those stories would be of professionals who have autonomy and the capacity to decide what curriculum to teach and what content is organised to carry that curriculum. (Goodson, 2012, p 20/21)*

Notwithstanding this these teachers had chosen not to embrace the role of technician but to exercise some agency and hence to choose all-attainment teaching. When I began initially transcribing the interviews, it was with the intention of constructing a portrait, that is, a snapshot in time, for each participant. Each portrait would be my construction but through correspondence with the participants they would have some input and the portrait would be amended, if required, by their feedback. The portraits I constructed for each of the participants varied according to how the conversation had gone: they are attached in appendices 3 to 8. Of course, there are many different ways of constructing such portraits and, like stories, these portraits will have subplots contained within them (Reason, 1988). In addition, people always display agency within stories, meaning there are elements of freedom and, hence, reasons for what happens (Bruner, 1991). Thus, in interpreting stories/portraits, researchers are looking for markers (Sikes and Goodson, 2017) that distinguish the participants from others and in writing these portraits it was these markers I was looking for. Figure 5 shows the initial markers I had begun to observe in the data. At this stage these were simply at the level of things I had begun to notice.
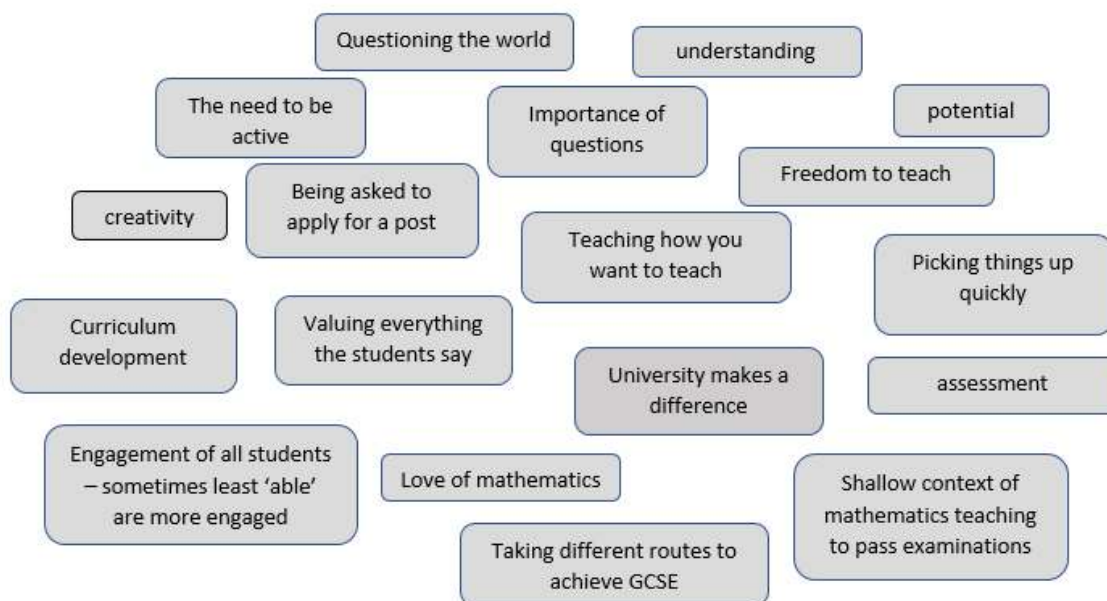
Figure 5 Markers beginning to emerge from stories

At this juncture the markers I had identified in the separate stories seemed to me to have some commonalities but, as Stephens (2017) reports, interpretations by the researcher and the participants bring meaning to the text but these meanings are highly dependent on context. Context includes one's point of view, values and experience which can change over time and hence interpretations are only ever possible explanations of why things happened the way they did (Horsdal, 2017; Povey and Angier, 2014): these need to be further re-interpreted after initial analysis of the data in order to complete the hermeneutic circle (Ådlandsvik, 2012)   With context in mind it appeared that it would be useful to me, at this point, to rethink my analytical strategy as analysing the stories of the participants was leading me to look at the teachers individually but in terms of research implications for the teaching profession I needed a more collective research response. Writing the stories of the teachers had proved a useful start in getting to grips with the data but I now decided to examine the data holistically and to identify themes which would be helpful in making recommendations in terms of teacher practices.

Thematic analysis

About thematic analysis

Although much use is made of thematic analysis in qualitative research it is frequently not thought of as a separate method but rather a 'process performed within "major" analytic traditions' (Braun and Clarke, 2006, p 78). Nevertheless, many qualitative researchers consider thematic analysis to be a separate method which, because it is not tied to a particular methodology or epistemology, can be used across a variety of research approaches (Nowell et al., 2017; Braun and Clarke, 2006). Notwithstanding this, there are many different approaches to thematic analysis and in deciding to use thematic analysis researchers need to be clear in their research write-ups about what they did and why they did it (Braun and Clarke, 2006). Potential procedures for conducting thematic analysis may be either:

- inductive – building themes from codes identified by the researcher in the data or
- deductive – developing theory and looking for confirmation in codes in the data (Terry, Hayfield, Clarke and Braun, 2017).

An inductive approach fits in best with qualitative research as there are no assumptions built in as to the right way to analyse the data. It also fits in with a methodology underpinned by critical theory

> *as the subjectivity of the researcher is seen as integral to the process of analysis (Terry et al., 2017, p 20)*

The reflexivity of the researcher is an important part of the process of identifying themes in the data as

> *A theme captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set (Braun and Clarke, 2006, p 82).*

Through a continually reflexive process starting with an initial immersion in the data and a continual iteration and re-iteration themes, sub-themes and categories are built from the codes identified by the researcher.

Thematic analysis: the process

As this was a new approach I decided to start afresh as I analysed the data thematically (Maguire and Delahunt, 2017; Nowell et al., 2017; Guest, McQueen and Namey, 2012).

I began by scanning the three handwritten transcripts into my computer so that I had an electronic record of the three interviews. I now had the six transcripts electronically, so I printed out a copy of each transcript with a view to beginning my analysis.

I read through all of the transcripts in turn making a note of themes I identified in this first read through. As I read, I assigned each theme I identified a different colour and used these colours to mark-up relevant sections of the text. In this first read through I identified 12 different possible themes. For some of the themes I also identified a number of possible subthemes. The themes together with the subthemes are listed in Figure 6. Not unexpectedly some sections were marked up with several different colours as they were potentially relevant to more than one theme. I then re-read the transcripts, beginning as I did so, to highlight sentences/sections which pertained to each theme/subtheme by putting a vertical line in the relevant colour beside the sentence/section.

Possible themes		Possible subthemes		
1	University tutor or other significant person			
2	Research and/or curriculum	Evidence		
3	Pressures	Parents	school management	workload
		OfSTED	existing staff	GCSE
		high attainers	persuasion	headteacher
		Literacy		
4	Personal history	life events	school	family
		Union		
5	Pedagogy (students)	Groupwork	collaboration	curriculum and tasks
		Talk	learning journals	residentials
		Independence	autonomy	
6	Mathematical ethos	everyone can enjoy mathematics	teachers should enjoy mathematics	active engagement by mathematics department
		PGCE students	recruitment	retention
7	Anecdotes about students	what students say		
8	General educational ethos			
9	School context	Behaviour	organisation of sets	communication
10	Control	who has control of the curriculum?	make up of groups	who teaches the groups?
11	Classroom environment			
12	Becoming a parent			

Figure 6 Themes and subthemes identified in first read through of data

Having marked up all the themes and subthemes I then made sure all the pages of each transcript were numbered. On each page I wrote the page number by each section of marked up text, so it could be quickly relocated when I had cut up the transcripts. I then scanned the annotated transcripts into my computer. I now had six annotated transcripts

which I printed out using a different colour of paper for each transcript, so the participant could be easily identified. The next step was to cut up the transcripts and distribute the sections of marked up text according to theme. As some quotes were identified by more than one colour, I initially allocated them to the theme I was going to consider first with the intention of reallocating them once I had dealt with that particular theme.

I then read through the sections of marked up text I had collected for each theme and subtheme. Next, with my research question in mind, I began analysing the various bits of text, endeavouring to make sense of them in order to support my thinking and answer my research question. When I completed each theme, I reallocated any quotes that had more than one colour to the next theme I was working on, again sorting them into subthemes as appropriate. I continued in this way until I had worked through all of the themes. At this stage the data was still organised along the lines of Figure 6. I then read through all of the themes still keeping to the fore my research question and subquestions. As I was doing this, I decided that there was a better way to organise the data: I decided that some of the subthemes were more appropriate in a different theme and also that the themes themselves were reflecting more over-arching issues. Hence, I moved several of the subthemes to different themes and began grouping the themes into categories. Over the course of several months I reread and reworked my analysis, reconsidered my research question and subquestions and continually moved marked up text from one theme to another until there was a much better convergence between what the data was telling me and my reconsidered research question. Eventually I ended up with three categories:

1. How the teachers are sustained.
2. How the teachers introduce, develop and maintain all-attainment while convincing others.
3. How the teachers make all-attainment work in the classroom.

The final version of my research question is:

How is it possible to introduce, maintain and extend all-attainment teaching in mathematics in English secondary schools in the current education environment?

   a. Who are the teachers who achieve this and what sustains them?

   b. How do they introduce, develop and maintain all-attainment while convincing others?

   c. How do they make all-attainment work in the classroom?

The three categories which emerged along with the themes and subthemes are shown in

Figure 7.

Categories	Themes	Subthemes 1	Sub-themes 2
The teachers, what sustains them	The teachers and mathematics		
	An interest in research and/or curriculum development		
	Relationship to ability Thinking		
	Expectations about achievement and implications for curriculum content		
	Student attainment and enjoyment of mathematics		
Introducing, developing and maintaining all-attainment while convincing other	The need for support	Support from above	
		Support from colleagues	
		Convincing others	Convincing by example
			Convincing by data and research
			Difficulties and failure to convince
		Collaborative approach to curriculum planning and creating resources	

Categories	Themes	Subthemes 1	Sub-subthemes 2
How the teachers make all-attainment work in the classroom	The role, influence and nature of assessment		
	Approach to teaching	Understanding rather than rules	
		Critical thinking, independence and responsibility in mathematics learning	
		Critical thinking beyond mathematics	
		Collaboration and creative planning	
	Teacher methods: how the students work	Type of task	
		Learning how to learn	
		Time	
		Exploration and inquiry	
		Talk	
		Groupwork	

Figure 7: Categories, themes and subthemes[40]

[40] As described in the text the themes have emerged through an iterative process over a period of several months and have been examined and found to be credible, and hence valid, by my current supervisors.

Introducing the teachers

Before moving on to report the findings from the thematic analysis (chapters 6,7 and 8), in this section I introduce the six contributing participants.

These teachers are part of a very small cohort of mathematics teachers in England who teach in all-attainment groups (Hodgen, 2019). In addition to the short portrait included in this section the appendices contain an enhanced portrait of each participant gleaned from their interviews. Each portrait is, of course, my interpretation of the information they choose to share with me on the day of the interview. However, I believe it to be an accurate interpretation as the five participants who responded to my email containing their portraits asked for few amendments and indeed some commented positively about the portrait.

School	Teacher	UG	Class	Post Grad	Teaching Qualifications	Age	Years teaching
Brierley Grove	Pete	Mathematics		PhD. Mathematics	PGCE	>40	<10
	Philippa	Mathematics	1st		PGCE	<30	RQT[41]
	Akhila	Mathematics	1st	Studying masters	PGCE	<30	RQT
Short Valley	Sarah	Sociology, Mathematics Education		Masters Studying doctorate	GTP	>40	>10
	Bob	unknown		PhD.	2-year-PGCE	>40	>20
Duckworth Community School	Adara	Sociology			2-year-PGCE	>30	>10

Figure 8 - The teachers' qualifications and experience

Pete experienced all-attainment teaching when he was at school and was convinced by his own experiences, what he read and his experience on the PGCE that all-attainment was the right way to organise the teaching of mathematics. Philippa also had experience of all-attainment in years 7 and 8 of her schooling but what appears to have convinced her, initially at least, is the need to teach everyone conceptual rather than procedural

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[41] RQT – recently qualified teacher

understanding. Both Akhila and Adara were convinced by their experiences on their PGCEs of teaching in mathematics departments which used all-attainment while Bob was also convinced by his experience on his PGCE and Sarah was convinced by being in a school where all-attainment was working.

Pete

Pete's father was the headteacher of a small primary school in a mining village in County Durham and education was always something that attracted him. As a teenager in the 1970s he attended a Catholic comprehensive on the outskirts of Durham. He particularly enjoyed English and mathematics classes, recalling that those subjects, at least, were taught in all-attainment classes until years 10 and 11. Even at this early stage he engaged in helping those whose understanding of mathematics wasn't as highly developed as his own. He found working with other children a positive experience, his own mathematics didn't suffer and the children he worked with benefited from his help.

Later he moved to London to do his undergraduate mathematics degree. In the run-up to the year-end exams he would regularly run mini-tutorials and seminars for several of his fellow students, something he enjoyed and which he thought he was good at. On completion of his degree he undertook and obtained a PhD. in mathematics. At that point he considered teaching, but the miners' strike happened, and he became very involved with journalism and left-wing politics so that it was many years before he thought about teaching again.

When his son was born, he realised that he needed a more conventional sort of job. He loved mathematics so weighing everything up he decided to train as a mathematics teacher.

After qualifying Pete took a job in East London. Before he took the job, he understood that the school taught all-attainment at KS3. He was predisposed to all-attainment teaching due to his own experience and his PGCE reinforced his predisposition. However, he found the reality was rather different. Although the students were taught in form groups they were organised within the classroom in a similar way to many primary schools. He became increasingly unhappy about this and in his second year, seeing a job at a Brierley Grove, he applied for it and was duly offered the job, only taking it on condition that he could introduce all-attainment.

Philippa

Philippa had loved mathematics at school. In the first two years of secondary school she had been taught in all-attainment classes. However, she had struggled with mathematics at university as sitting in lecture theatres being told stuff did not work for her; there was no 'space to explore'. It had been a confidence thing, which had been rectified in the third year when she had taken a mathematics education module. This enabled her to reflect on her learning and to begin to understand why she had been finding it hard.

Finishing her degree she decided there was nothing that really interested her, so she applied for a PGCE in London on a bit of a whim but mainly because she loved mathematics and wanted to convince other people that they too could love mathematics. She has been in London ever since. The PGCE was a good experience for her. Both of her placement schools had offered her a job. She chose a school in east London but during her first year 'everything became about OfSTED' so she left. She wanted to do things because they were good for the children. Fortunately, while she was at the school she met and worked with Pete on a mathematics curriculum development project. This was to prove useful later in pursuing the type of teaching she believed in.

She wants to teach for conceptual understanding, not merely for procedural understanding. However, the mathematics department in her new school was not what she had been led to believe at interview. Luckily, she had kept up contact with Pete during this time and, when a job became available at his school, he invited her to apply for it. She had been offered the job and was now in her third year. She knew when she took the job that she would be able to teach how she wanted to without being hassled because she trusted Pete. Mathematics teaching at Brierley Grove makes sense to her in contrast to the way in which most mathematics teachers are expected to teach which she thinks is 'mad'.

Bob

Bob always thought he might do something in education, but it was no more than a vague idea. At the end of the summer he completed his first degree, he applied for a two-year PGCE[42] in mathematics and within a week was on the course. During his time on the two-

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[42] Two-year PGCEs in mathematics were run by a limited number of universities. The first year concentrated on mathematics while the second year consisted of a traditional PGCE.

year PGCE, Bob encountered an 'inspirational' tutor who espoused a discovery method of learning. For the last fifteen years Bob has been developing his own teaching methodology derived from the procedures that Polya (2004) suggested, a methodology which incorporates both deductive and inductive elements. His methodology is not purely discovery learning but also incorporates the teaching of relevant skills required to make progress.

On finishing his PGCE he was fired up with enthusiasm for teaching and obtained a post in a challenging north London comprehensive. His teaching experience on his PGCE had been in 'some very lovely schools in the local … area' but it was not a great preparation for teaching in a school in challenging circumstances. After two years he left. He moved abroad spending six years teaching history to comparatively mature students using inquiry approaches. During this period he began to think about how this type of approach might be adapted for teaching mathematics in a comprehensive in England.

Returning to England it was not long before he obtained a head of mathematics post. He taught at the school for several years beginning to develop and put into practice his own ideas on inquiry in mathematics. This was the formative period when he began developing his ideas on 'Inquiry' as an approach to teaching and learning mathematics in the secondary school classroom. The school environment encouraged creativity whilst the headteacher was supportive, leaving Bob to get on with running the mathematics department.

Having run the mathematics department successfully for six years Bob decided to move away. However, this initial move was dissatisfying and he returned to his previous school for a short time before deciding it was time to move on once more to a new school. He applied to Shortvalley as the demographic was very similar to his current - comprehensive school with a substantial pupil premium[43] intake (>40%).

However, his experience at Shortvalley had a less than successful final outcome. He had taken the job on the basis that he could introduce all-attainment, but he had to threaten to leave to get it implemented. An early OfSTED inspection put the school into Requires

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[43] Pupil premium - additional funding for publicly funded schools in England to raise the attainment of disadvantaged pupils (DfE, 2016)

Improvement[44]. On reinspection two years later, the school failed to get out of this category. As a result, the governors appointed a new headteacher who decided the school would no longer be pursuing a policy of all-attainment in any curriculum area. Bob left and moved to a new school in inner London. The school had all-attainment in year 7 and he was looking forward to the challenge of building on that.

Sarah

Sarah's first degree was in sociology. She stumbled into mathematics teaching by accident. Her experience of learning mathematics at school had been typical of most secondary school children in England in that it was taught procedurally[45] convincing her she was not very good at mathematics, that she could not do it. However, she had applied for a behaviour inclusion job at Chancellor School but ended up with a job as a teaching assistant in the mathematics department. Her views on mathematics and mathematics teaching were transformed by working with Bob and the other mathematics teachers at Chancellor School. Her experiences as a teaching assistant led her to decide to become a mathematics teacher. She enrolled on a degree course in Mathematics with Education continuing to work in school as a teaching assistant, studying part-time and attending the local university. On getting her degree, she enrolled on an in-school GTP[46] programme, working while she gained Qualified Teaching Status (QTS).

After qualifying as a teacher, Sarah taught mathematics at a number of schools in challenging circumstances in her Local Authority. This was a deliberate choice on her part; it was what excited her and what she wanted to do. All of the schools Sarah taught at had some all-attainment teaching apart from one school where she was a main scale teacher. Eventually she became head of mathematics at Knapper School.   Unfortunately for her after she had been there for three years teaching students in all-attainment groups a new headteacher arrived. Despite GCSE results in mathematics increasing from 45% to 65% during those three years the new headteacher decreed that the mathematics department

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[44] See OfSTED Education Inspection Framework - https://www.gov.uk/government/publications/education-inspection-framework

[45] When mathematics is taught procedurally the student are taught that understanding and doing mathematics is about learning and following rules whereas when it is taught conceptually the students are taught that mathematics is about understanding the concepts underlying the mathematics so they can apply that understanding meaningfully (Skemp, 1976).

[46] Graduate Training Programme – trainees worked nearly full-time in school while following a programme, validated and moderated by a HE institution, in order to qualify for Qualified Teacher Status (QTS).

re-introduce "ability" grouping forcing Sarah to move on because she did not agree with setting. She moved on to Shortvalley School as a Lead mathematics Teacher because Bob, who had been the head of mathematics at Chancellor School, had just been appointed as the head of mathematics. Sarah left Shortvalley at the same time as Bob but had found no schools teaching all-attainment mathematics in the vicinity. Consequently, she had moved to a school a considerable distance away: the school is led by the ex-headteacher of Knapper, a school she had worked at previously.

Adara

Although Adara loved mathematics as a school student she did not pursue it at university studying sociology and education instead.   The education part of her degree had fascinated her and included modules such as Philosophy of Education, Psychology of Education and History of Girls' Schooling. Halfway through her degree, she had decided to do a mathematics PGCE. Despite there being quite a lot of statistics in her degree there was not enough that she could do a one-year PGCE. Instead she had enrolled on a two-year PGCE.

In the first year of the PGCE the group had been taught mathematics at an equivalent level to that of the first year of an undergraduate degree. She described this as 'lovely' and as enough 'to top you up'. During the second year of her PGCE she had had two teaching placements. Both schools had offered her a job.   She preferred the ethos of Fielding School, in particular the fact that mathematics classes were organised in mixed "ability" groups but she ended up at Xavier School, her first placement school, as she had already accepted their job offer. However, after four terms she moved to Fielding School, as they asked her to apply for a job as they had a vacancy. She had stayed there for nearly ten years though not always as a full-time classroom teacher as she had had two children in that time.

Subsequently Adara had taught part-time at Cobb College. She described it as an outstanding school. The whole mathematics department was 100% behind mixed "ability" teaching which they had been doing for years. She had been able to 'slot right in' as by that time she had years of experience of teaching mixed "ability". Duckworth Community School

then recruited Adara from Cobb College as a lead teacher[47] in the knowledge that Duckworth Community School was going over to mixed "ability" teaching in mathematics.

Akhila

Akhila attended a school in north London from age 11-16 followed by a girls sixth form also in north London. She had loved mathematics at school, it being the only subject she had really enjoyed at A-level. Both her school and sixth form taught mathematics in a similar way, teaching being very much textbook based and rule driven. Despite knowing from an early age that teaching was something she wanted to do, she applied to do dentistry at university. She had stuck at this for two years but at the end of her second year she had transferred to the mathematics degree. In the first year she had just learnt the mathematics in order to pass the exam. She had found this profoundly unsatisfactory but by the time she started her mathematics degree it had been 3 years since she had completed her A-levels as she had had a gap year in addition to the two years of dentistry. She had not liked the experience of learning mathematics procedurally in her first year and said that was the last time she ever did that. She had been successful in mathematics at school, accepting what she was taught and never questioning anything. It was only when she began struggling with mathematics for the first time at university that she began wondering 'why does this work? where does it come from?' At that point she began asking herself about her own mathematical knowledge which had come from her A-level studies and she began thinking she had not explored it 'deep enough'.

Finishing her degree she decided to do a PGCE. All-attainment was already well established at Keystage 3 when she arrived at Brierley Grove on her first placement. Despite her tutors at college encouraging the students to teach in a similar way to Brierley Grove she had never come across all-attainment teaching before and the experience there made her 'challenge' her own mathematics knowledge. She saw little of that style of teaching in her second placement. Her experience as a student there was more typical: she was encouraged to use textbooks and, to deal with behaviour issues, give the school students worksheets. Her placement experiences, and the accounts of the experiences of students in other schools, confirmed in her the desire to get a job at Brierley Grove if possible.

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[47] A lead teacher is a teacher who can lead others to develop themselves.

Short concluding remarks

These short portraits serve as a brief introduction to these teachers. The portraits in the appendices give much fuller accounts.

Ethical considerations

My research raised relatively few ethical concerns as I was interviewing people whose outlook and beliefs were supported by my own. The principal considerations were that the participants were well informed; that they gave informed consent to participate, and that issues of anonymity were properly addressed; that I reported their point of view honestly and reliably; and that I did not waste their time.

Before the interviews began, I briefed the participants on the nature and purpose of my research and they were each given an information sheet which also outlined this. After they had had sufficient time to read the information sheet, they were given the opportunity to ask questions if there was anything they were unsure of or which they thought needed clarification. They were then given a consent form[48] to read and sign. The consent form stated that they had fourteen days to withdraw from the research if they decided they no longer wanted to be involved.

The interviews were recorded electronically with a digital recorder. I also took the opportunity to make some field notes at the time of each interview. I included my impressions of the school in these notes. Where I was given the opportunity to assist in a lesson, I also made some notes about this. These notes supported me in producing trustworthy accounts of what the teachers had been telling me. My note taking was clearly visible throughout. All the participants have been given an opportunity to read and feedback on the portraits constructed from their interviews. The portraits have been amended as per the feedback received from the participant.

I made the participants aware that some or all of the interview would be transcribed. As is the usual practice I informed the participants that I intended to anonymise them in the research unless they indicated otherwise. This was not a problem for the majority of the teachers. However, a dilemma arose with Bob and Sarah, in that Bob said he was happy not to be anonymous whereas, at the time of receiving the portrait, Sarah had some concerns

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[48] The information sheet and consent form are contained in Appendix 12.

about being recognised. This was a consequence of interviewing more than one teacher in a school and was something I should have foreseen. This dilemma was subsequently resolved a year later when I met Sarah again. At this point she was no longer concerned about being recognised as the issue which had potentially been bothering her had been resolved. However, I decided that despite this all teachers would be anonymised. I also made them aware that the anonymised data might be shared within the Mathematics Education Research Group at SHU. All data is kept in accordance with the Data Protection Act[49].

Although I interviewed eleven teachers in total I decided that only six would form the basis of my research. This raises the ethical issue about potentially wasting teacher time. However, it is my expectation that the data from these five teachers will be used in other research as indeed my interview with Samira already has been. My interview with Samira formed the basis for a conference paper on teacher expectations and working-class students[50].

All interviews took place in participants' schools, usually in their classrooms. However, interviewing in the participant's classroom was not always possible as sometimes they were unavailable. Nevertheless, all of the interviews were conducted in a space which was both comfortable and confidential. They mostly took about an hour although a couple were longer; Pete's interview was exceptional as it lasted over three hours and took place over two days as he had a lot to contribute. The amount of time spent on Pete's interview may seem excessive and perhaps wasteful of Pete's time when compared to the other interviewees. However, the interviews were conducted in a very relaxed manner and he was more than happy to share his thinking and philosophy as he obviously thought it was important that other mathematics teachers were aware of what was possible.

A further ethical consideration driven by the critical research paradigm within which this work was situated is that critical research demands that the research acts on the world in some way. As I have previously stated the research gave the teachers the opportunity to reflect and develop their own thinking on the current state of their teaching and where it

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[49] The data is stored on a password protected and encrypted laptop and fully complies with SHU ethical regulations.

[50] Paper published in proceedings of 14th International Conference of The Mathematics Education for the Future Project. (Jackson, 2017)

would go in the future. It perhaps assisted Sarah in some small way in developing the impetus to begin organising the All-attainment conferences in which I am a contributor and participant; it enabled me to make a number of recommendations to help and support the thinking of teachers who are interested in developing all-attainment teaching and also to make parents more aware of the benefits of all-attainment teaching.

Chapter 6: Findings (1) - The teachers: what sustains them

In this chapter I discuss briefly the educational background of the teachers I interviewed and what motives them to teach their students in all-attainment groups in an environment where all-attainment teaching is rare. I set out what it is that sustains them in their continuing belief in it and in their continued commitment to it. I discuss the factors that sustain this motivation including their love of mathematics, their interest in research and their appreciation of the consequences of "ability" grouping on their students.

The teachers and mathematics

The teachers interviewed are all well qualified academically. More than half of the participants have higher degrees or are studying for higher degrees, which Hallam and Ireson (2003, p 353) state makes teachers 'less likely … to favour setting'. Bob and Adara both did two-year PGCEs, (the first year of which involved studying mathematics to degree level) having originally done a degree in another discipline while Sarah who already had an undergraduate degree and an MA, completed a part-time degree in Mathematics Education followed by a Graduate Teaching Programme year. The three teachers at Brierley Grove are all highly qualified mathematicians having studied mathematics at university: Pete has a doctorate and Philippa and Akhila both have 1st class Honours degrees. Although both Akhila and Philippa's mathematical journey at university ended successfully both had to overcome substantial challenges to achieve this.

A common theme among the teachers and one which is important in sustaining them in their espousal of all-attainment teaching is their love of mathematics: some have loved mathematics from an early age but all are passionate about it:

> *I became a maths teacher when I was very young. I just literally finished my undergraduate degree and went straight into it. I did it mainly because I just loved maths, I still do and I wanted to convince other people [to love maths too] [Philippa, interview transcript]*

> *I loved going to school, and I loved maths, it was the subject that clicked for me. … I was okay at other subjects, I was fine, but maths was just something I found easy, I found interesting and I flew with it … I always knew I'd end up in a career helping someone … something along these lines … but I really loved maths and here I can offload my inner geek really, so I partly became a teacher because I loved my subject. [Adara, transcript]*

Although Bob did not explicitly say he loved mathematics, it can be inferred from the way he enthusiastically talks about his initial ideas for Inquiry Maths (Blair, n.d.), a system for the

teaching and learning of mathematics at secondary level in which he has invested much time and effort and which he has developed over many years and which he continues to develop.

Loving mathematics does not necessarily mean the teachers always found it easy or wanted to take it further. In the first year of Adara's PGCE the mathematics the students followed was similar to that of the first year of a mathematics degree. She described this as 'lovely' and as enough 'to top you up'. However, she felt that one year of university mathematics was enough for her because she said:

> When it gets to a certain level where it gets too abstract, I switch off. … [The first year] wasn't beyond me. It hadn't got to the point where it was so abstract …it wasn't anything overly complicated and so that, that for me was my limit … I just know that when it gets too abstract, I do find it muddling … at this point I'm totally understanding it. [Adara, transcript]

Notably, although Philippa recognises that she is 'good at maths', as evidenced by the fact that she achieved a 1st class honours degree in the subject, she encountered some difficulties with mathematics for a time at university. This experience was generative of the thinking about teaching of mathematics in chapter 8 that she discussed:

> I did an education module and I was lucky 'cos I got to read a lot of John Mason … and it actually made me realise why I love maths for myself 'cos I always enjoyed it and when I started my degree … it was such a different way of learning that I … didn't enjoy the maths so much. I just realised I had to find a way to learn it 'cos sitting in those lecture theatres wasn't working for me, I found it really difficult, it was the first time I'd found maths difficult … I actually love maths even more now I would say. I used to always like it you know but I really like it now. [Philippa, transcript]

Philippa's experiences on the education module enabled her to grasp the importance of an exploratory mode of learning with time for reflection to allow mathematical understanding to develop while Akhila's experiences during different phases of her education including university showed her the importance of thinking things through and talking things over; both of these themes are picked up in chapter 8:

> I think I just really liked maths and I know I just really enjoyed the subject. … At GCSE I would always be the one my friends would go to if they didn't understand something or A-level … or even at university I think I would really have to think about something and I know I would go away after a lecture and take two or three hours trying to understand it because that was when I wasn't really sure about maths at that time so I think through that and when it came to revision for exams and stuff … half of my friends would come to me and say " I don't understand this. Can you talk me through it?" And I would find I was able to explain things, I think, in a way that would help other students. [Akhila, transcript]

Sarah is the exception to the others in that she 'hated maths at school – absolutely hated it',

> *Maths wasn't taught creatively [at my secondary school]. It was very textbook. The teacher would model how to do something, then we'd all answer 30 questions on how to do that. … I wasn't interested in it. [Sarah, transcript]*

Unsurprisingly Sarah had 'never wanted to be a maths teacher', stumbling into mathematics teaching by accident. She had applied for a behaviour inclusion job at Chancellor School but was told 'you didn't get that job, but we have got a space in the maths department'. She accepted the post and the experience radically altered her relationship with mathematics:

> *I definitely thought it was my worst subject at school – definitely. … So quite early on I had some experiences where I thought actually I'm not very good at maths. I'm good at other things but I'm not very good at maths. And then I couldn't do it. … [However] I felt differently about it when I saw how it could be taught. … After supporting Bob's lessons and other teachers that … had … bought into his ethos, I thought this was amazing and wish I'd been taught maths this way when I was at school. So then I had to go back and do another degree in mathematics education. [Sarah, transcript]*

An interest in research and/or curriculum development

All of the teachers are involved to some extent in curriculum development although Adara's involvement is of a more informal nature and mainly for her own use.

Bob, Pete, Sarah and Akhila are active researchers. Bob has recently gained his PhD and has thought about working in teacher education, something which he has rejected. Pete, who also has a PhD in mathematics which he gained some years ago, has recently done several research projects funded by the National Centre for Excellence in Teaching Mathematics (NCETM) while Akhila is researching the extension of all-attainment into year 10 as part of her masters degree. To discover that one of the teachers was engaged in research might not be that surprising but to find that four of the six teachers were actively engaged in research is very unusual and to find three of them have engaged in doctoral study is worthy of note.

As will be reported below the outcome of one of the projects funded by the NCETM lent support to Pete, Philippa and Akhila in their promotion of all-attainment. The mathematics department at Brierley Grove had taken part in some research on the teaching of fractions in year 7. They had worked with another school in the Local Authority where the children were in sets in mathematics classes. Together they had produced a unit which went 'beyond the curriculum', as Pete thinks that what is in the National Curriculum is 'often quite arbitrary',

> *We have continued fractions in there, which you don't even do at A-level, but we do them in year 7 because the kids like playing with them. It's fun. [Pete, transcript]*

The NCETM required that the project be run as a random control trial (RCT) and that both schools pre- and post-tested for the current level of knowledge and evidence of progress. The tests showed all students in the school had made progress. Moreover, the results showed that children at the top of the attainment spectrum in both schools made progress but the middle and lower attainers at Brierley Grove made much better progress than those at the school which put the students in "ability" groups. However, the students who made the best progress were the high attainers at Brierley Grove (NCETM, 2013):

> *What's interesting, that's true of every class … Every single class without exception - the same pattern. [Pete, transcript]*

Pete said the classes where the greatest progress was made were the classes where the teachers were most involved and most convinced by all-attainment teaching - it made a difference - but even where teachers weren't so involved the same pattern occurred:

> *I'm not claiming this is any great piece of research, but it certainly helped convince people here … the effect it had … was to convince people in here that … because the fear that was always expressed was if you do mixed-attainment teaching, it'll be okay for the weaker and middle kids, but you'll hold the top kids back. [Pete, transcript]*

At the time of this research Pete and Philippa were working on developing a new unit of work on logic, sets and Venn diagrams as part of a national project, also funded by the NCETM, on collaborative reasoning. Pete said that units like this typically took two years to create in order for them to work well with all-attainment classes. You had to look at the learning journey of the students which would consist of a couple of weeks learning: you needed to think:

> *about the structure of the lessons, what works, what tasks work well. It takes an awful lot of time. But it's worth it, because if you spend the time doing it well, it lasts. And the kids like it. [Pete, transcript]*

Bob has also used research to inform him of potential pitfalls in implementing all-attainment but with a somewhat different outcome:

> *Interestingly we've had problems challenging the middle ability at the right level, because we're very conscious of the 'top end' and making sure they make the progress that they're capable of, and in a way we kind of over-emphasise that to teachers perhaps. And also, we've got support in classrooms [for the lower end] … [Students in the middle] in research, as I understand it – do better in mixed-attainment groupings rather than setting situations. [But ours] haven't made as much progress perhaps as the two ends, … So it's been interesting. We've taken on board the research but then over-compensated. [Bob, transcript]*

Pete thinks it is important for the department at Brierley Grove to engage with government reports and academic research both as another way of coping with these pressures and so that they can keep up to date with current developments in mathematics learning and teaching. He regularly gives the mathematics department staff papers to read but is realistic about how much people will actually read:

> I'd say half the maths staff read quite a lot. … [it] creates a culture where a greater proportion of your staff are engaging with these issues. And having sensible conversations about them … even if they don't read all of it … that gives them some confidence that you sort of know what you're doing. [Pete, transcript]

Pete and Philippa are pro-active when it comes to defending their choice of all-attainment. They compile dossiers on research evidence which they give to the head. Pete believes it:

> sends a message - whether you agree with what we're doing or not, it's not just we've made this up on a whim. People are seriously engaging with research and evidence, so there's a purpose behind this and they're doing it for a well-thought-out set of reasons. If you don't agree with that, well fine, but come and have a proper argument about it. [Pete, transcript]

As will be noted below when OfSTED produced a report, KS3 The Wasted Years (2015), Pete and Philippa had 'spent a ridiculous amount of time reading all these things and reading the educational research'. They had gone to the head, 'gave him a big fat dossier' and said 'actually, that's not what the report says.'

Experiences prior to qualifying as teachers

While the participating teachers all love mathematics and are interested in research and/or curriculum development they have all spent time thinking about and reflecting on their experiences of teaching and learning at different stages of their lives.

Pete and Philippa had experience of all-attainment teaching in their own schooling, but that experience does not seem to have much impinged-on Philippa's thinking, whereas in Pete's case it 'predisposed [him] to that model of teaching'.

More importantly for Philippa was a critical experience that happened during her degree when she was doing an education module:

> I was lucky 'cos I got to read a lot of John Mason … Doing this module … allowed me to reflect on why I was finding [degree level mathematics] hard and I personally do think it's because I was just told stuff and I wasn't given that space to explore. [Philippa, transcript]

Perhaps surprisingly, the experiences on their PGCEs (Ball, 1988; Zeichner and Tabachnik, 1981; Buchanan et al., 2019) were important for five of the teachers (Sarah followed a

different route). While Philippa 'absolutely loved her PGCE' the other four are more explicit about how the experiences on their PGCEs played a significant role in their engagement with mathematics teaching and learning. Neither Bob nor Adara's first degree had been in mathematics but both were fortunate to have the opportunity to undertake two-year PGCEs. Bob undertook his PGCE at a midlands university where he encountered a tutor who espoused a discovery method of learning which Bob loved:

> On my PGCE course I met … a university tutor. He was … inspirational, and off I went, under his … tutelage. [Bob, transcript]

Pete's experiences on his PGCE confirmed him in his views that setting was not a good system:

> [My PGCE tutor] encouraged people to think and read and explore. And the more I read, and the more I went into different schools, and I read various research papers and things like that, the more I became convinced that both philosophically but also in terms of evidence, the evidence that setting was an effective way to teach wasn't high. [Pete, transcript]

Both Akhila and Adara had teaching practices in schools where all-attainment was already in place. Akhila's experiences on teaching practice at Brierley Grove contrasted sharply with the experience of other students on her course and with her second placement and made her determined to get a job there if at all possible while Adara's experiences on teaching practice completely changed her views on all-attainment teaching:

> [I thought logically setting is] easier for the teacher. 'Cos if you've got a narrower range then you can pitch it at just the right level … but having been at Fielding School [on my PGCE placement] and having seen the benefits of mixed "ability" and the fact that I could teach mixed "ability" totally changed my [mind]. [Adara, transcript]

> Mixed "ability" teaching in Keystage 3 was another thing I'd never experienced or seen before … I wasn't sure how I would cope … As a PGCE student I was a bit stressed, but I like that it got me to challenge my thinking. I definitely realised how much of a different experience I was having … than what other PGCE students were having … I knew that this was a school I definitely wanted to sort of keep connected to. [Akhila, transcript]

Reflecting on their initial teaching experiences on their PGCEs caused them to re-think and re-evaluate what they thought was important in teaching.

The teachers: relationship to "ability" thinking

Unsurprisingly, the teachers interviewed do not subscribe to the prevailing hegemonic discourse in mathematics education in England of fixed "ability" (chapter 4). This has been one of the dominant discourses in wider English society and hence schooling for nearly two hundred years. This discourse assumes as a basic premise that each of us has a "fixed" and

hence unchanging amount of "ability" and is portrayed as common-sense. The teachers interviewed do not subscribe to this common-sense discourse, their beliefs are more in keeping with the "good sense" expressed in Learning Without Limits (Hart, 2004) and as such they bring the field of social justice to bear on the field of mathematics education.

Although not all of them fully embraced a rejection of fixed "ability" thinking in their language – for example, being still able to talk about "brighter students" [Adara, transcript] they spoke feelingly about the damage done by fixed "ability " thinking and the subsequent setting practices:

> The ethos of the team [at Shortvalley] previously had been very much about protecting and nurturing the higher achievers and the middle-class students … it felt to me as well that teachers that had been here a long time – the school didn't always have the estate students … it was the worst form of setting, in my opinion, in that things were skewed in favour of the children having the most potential. [Sarah, transcript]

Notwithstanding this and despite the teachers' beliefs in all-attainment, all-attainment was phased in gradually and all of the schools put the students in "ability" groups at some point in their schooling. This gradual phasing in delayed the feeling of hopelessness and resultant disaffection the students in the lower sets had about mathematics but did not eliminate it, something which was reflected in the behaviour of some students. Philippa illustrates this by contrasting her experiences at Eastchurch with Brierley Grove while Adara relates what happened when "ability" grouping was reintroduced in year 10 and Akhila contrasts KS3 and sets at KS4:

> [At the end of year 9] they get set and it all goes wrong in my opinion. … If you teach set 1 it's lovely. If you teach the C/D borderline which I've got this year, it's a pain 'cos they all think they're rubbish … In year 10 it is there … you especially get it with the bottom foundation group … When I was at Eastchurch when they set them from the word go in year 7, the number of times I heard, I'm rubbish at maths … in the lower sets, all the time … Here in my mixed ability class I very rarely hear anyone ever saying that. I don't think anyone thinks they're rubbish at maths. I'd be really upset if I thought anyone thought that about themselves. [Philippa, transcript]

> I … kept the weak kids [when we re-introduced setting in year 10 at Duckworth Community School] and created this new bottom set and the change in the handful of kids I kept was phenomenal … behaviour deteriorated … [previously they were] working really well along with these great able mathematicians [but now they were no longer] seeing kids enjoy maths ... [and, they were no longer exposed] to better maths and more sophisticated methods'. [Adara, transcript]

> I have definitely disaffected students in my classes. I see it less in my KS3 classes but in my KS4 classes I definitely see a bit more perhaps … you definitely see enthusiasm dropping and disaffection much more present when you're kind of going along the sets. [Akhila, transcript]

As illustrated above putting the students in "ability" groups had the not unsurprising result that the students in the lower sets believed they could not do mathematics, something the teachers had experienced previously at other schools and which the gradual introduction of all-attainment in the schools began to change. In such circumstances the students' behavioural issues seemed to be aggravated by "ability" grouping, which was also something some of the teachers had experienced at previous schools:

> I actually find I'm working harder with my bottom set [than when the students were in a mixed-attainment group] because I'm having to impose behaviour management strategies that I never had to before because it's the bottom set I'm dealing with - 'we're crap at maths' … so, for me I'm a really good believer in mixed "ability" teaching. [Adara, transcript]

> [Working at Xavier where the students were in "ability" groups] was a real baptism of fire in terms of classroom management, behaviour management. It's a tough school to work at and I changed the way I teach in order to maintain good classroom discipline. That was fine, and it worked, and I had no issues. [Adara, transcript]

Being placed in a lower "ability" group confirms to the students they are no good at mathematics and poor behaviour often results. In addition, teachers not committed to all-attainment frequently made the equation that poor behaviour indicated a lack of "ability" as described by Sarah:

> The other thing that would happen with the maths teachers that had been [at Shortvalley] a long time … if they had a set 1, 2 or 3, and someone was messing about or behaving poorly in those sets, they would say they can't do the maths. They need to move down a set. … Having them in sets 4, 5 and 6 is not helping them. … [frequently] they could be really high-attaining students but the behaviour and the fact that they were performing less well in exams was moving them down into those groups. Then they became very disaffected, disengaged groups of children. With teachers that had very low expectations of what they should be doing and how they should behave as well, crucially. … what do you expect. … So then of course their results [reflected this]. [Sarah, transcript]

Perhaps not unsurprisingly when Bob and Sarah arrived at Shortvalley they were concerned about the "ability" grouping practices they found:

> We found Pupil Premium students who had achieved a level 5 in primary school had slipped down to set 4 out of 5, because… I don't know. Because of a perceived attitude, I suspect, to learning. And maybe behavioural issues as well. So, the Pupil Premium students were packed into the bottom sets, regardless of their starting point. [Bob, transcript]

However, while the spoken discourse is about "ability" there is another unspoken discourse which only surfaces in extremis:

> The school didn't always have the Sparrow Vale students – they used to go to a school … which closed. Then they came to this school. … it felt like sometimes that the school didn't feel that those children were welcome and … had preconceived ideas about them before they even came here. So … things were skewed in favour of the children having the most potential. …

The maths team … concern[s] always seemed to be about … the top set children, you know. Some of them had children that came here, as well, so we had a second in department whose son had been through this school in top sets. She was concerned about children like him, and not having their experience tainted by poorly behaved children. So, you end up with a top set of 20 kids in it. And set 4 with 28. [Sarah, transcript]

Expectations about achievement and implications for curriculum content

This difference in the participating teachers' beliefs about "ability" can be seen in their approach to their expectations for their students. All of them believe that all students should have access to all of the curriculum in contrast to the prevailing orthodoxy in mathematics teaching in England where currently low attainers are given a non-challenging, repetitive and restricted curriculum (Watson and De Geest, 2005). In order for their students to benefit from this belief they deemed a commitment to all-attainment teaching is necessary:

[The maths department at Brierley Grove] still fight(s) for an ethos about mathematics [which is] to do with offering [all] the students an enriching experience about mathematics, [one] that put(s) the kids first … I would want to see high expectations put on to the children … That might be different for different children but the expectation for each individual child would have to be high I think. [Philippa, transcript]

Part of a teacher's job is to make students realise that] they have the potential to do whatever they like. [When teaching your lesson] if it's something that inspires them … they really like that, that gives them a bit of hope in your subject you've done your job a little bit. [Akhila, transcript]

[Getting] teachers and kids … fighting for that idea that mathematics is something that can and should be part of everyone's life. And everybody is capable of accessing it in some way. … The more students that say they like mathematics and enjoy it, and that they feel it's something they can actually do, the better. I think that keeping that centre stage, despite all the compromises and all the other rubbish, that mathematics is part and parcel of what it is to be human. Finding in different ways to keep that spirit alive among teachers – because if you don't keep it among teachers you'll never get it. If teachers don't have it, you'll never inspire kids to have it. [Pete, transcript]

At the time this reported study was undertaken Brierley Grove taught years 10 and 11 in "ability" groups. Akhila noted that when the students were put in "ability" groups her expectations of the students were lowered in a similar way to how the teachers at Shortvalley treated the students with a pupil premium when Bob and Sarah arrived:

[Despite knowing this she says] I think as soon as you've set a student your expectation of the class does go down even if you don't realise. … I know when I am teaching mixed ability [at Brierley Grove] … I'm teaching content which I expect 95% of the class to at least try. … if you're in a set class you're just immediately thinking I'm not even going to bother to teach, you know, reverse percentages or something whereas I taught that to every single one of my children in year 9 … I don't think its fair [some] students aren't allowed to be introduced to an idea while some … I know if some of my kids are set in year 7 that the set they'd be in in year 7 would probably be completely different to the one they'd be in in year 9 because they've

had 2 years to develop their mathematical thinking by working with brighter students.
[Akhila, transcript]

They [the teachers at Shortvalley when Bob and Sarah arrived] would teach them [the students with a pupil premium] differently. So they would avoid problem-solving, they would avoid reasoning because the kids won't cope with that. They'll behave badly with that. So it was kind of… there was an approach that the best way to get them to behave was to give them something they could already do and just get them quiet and get them on task. … so of course once you ended up in a set 4,5, or 6 the chances of moving out of that group were not great. [Sarah, transcript]

Student attainment and enjoyment of mathematics

It has been the common-sense for many years in England, as in many other countries, that mathematics is a difficult school subject. Perhaps because of this mathematics has, for a long time, been seen by many students as a necessary evil, a qualification which one has to gain for advancement but one which most students want to discontinue immediately that is achieved (Nardi and Stewart, 2003; Brown, Brown and Bibby, 2008). Students in the lower "ability" groups realise that they have little chance of obtaining a meaningful mathematics qualification and frequently show this through disaffection and poor behaviour. Not surprisingly where students were in all-attainment groups this was much less of an issue:

For me, maybe because I was experienced at [mixed-attainment teaching] … with my class [teaching mixed-attainment in year 10] worked and I had students who disliked maths previously who were really weak at maths working with far more able students, seeing the groupwork and the discussion and these children being exposed to other students, who were seeing more sophisticated ways of working and behaviour just wasn't an issue 'cos these kids were focussed and on task. [Adara, transcript]

The teachers have different approaches to making sure the students participate fully in the learning of mathematics knowing this is a potential issue. Adara, for example, says:

What I want from the class is for them to be motivated. I want them to focus, I want them to engage … to contribute and to feel comfortable enough to ask me for help … I want [them to] feel secure enough in the classroom to do that. … I would love to instil a sense of enjoyment of maths in these kids but for me if that doesn't happen … [it could be] maths could be… one of those subjects that's just not for you. [Adara, transcript]

The majority of the teachers interviewed want to imbue all of their students with a love of mathematics similar to their own love of mathematics, that is, they want them to think like mathematicians, to become mathematicians, not just students who have to do mathematics. They believe that all-attainment is a prerequisite for that to happen and that this is a requirement for unleashing the learning possibilities of all the students,

We have to feel mathematics is something we're inspired about, and our role is to inspire the mathematician that's there, one way or another, potentially within every student. …

everyone can enjoy mathematics or access mathematics in one way or another. And I think that fighting to keep that alive – it's a team project. [Pete, transcript]

In order to illustrate what this means for the teachers, Pete relates an anecdote of how he and Philippa were working on a very difficult problem, the solution of which was not obvious;

> *We had a load of Year 11s … who stayed back after school to do some revision for their GCSE, and one of them had found this problem, and me and Philippa started … working on it together … slowly we realised there were about 15 Year 11s all standing round … fascinated at this process of two teachers who are mathematicians … grappling and enjoying doing maths, well that inspired the kids … the kids can see that their teachers are mathematicians who enjoy doing mathematics. I think it does make a big difference … if you want to communicate to the kids and inspire them about mathematics as something they can be passionate about … It's not something you just do to pass an exam. [Pete, transcript]*

In this chapter I have discussed briefly what motivates the participating teachers in their commitment to all-attainment teaching and I have discussed the factors that sustain this motivation. In the next chapter I discuss how they introduced, developed and maintained all-attainment teaching.

Chapter 7: Findings (2) - Introducing, developing and maintaining all-attainment while convincing others

Introduction

In this chapter I report on what the participants told me about how they introduced, developed and maintained all-attainment teaching while at the same time convincing other teachers of its benefits. All of the teachers either introduced all-attainment teaching (not always as head of department) or actively chose to join a department which was already teaching all-attainment or in the process of changing to all-attainment. The three schools all had different experiences of introducing, developing and maintaining all-attainment teaching but some common patterns emerge: these patterns are: -

- the need for support both from above and from at least one like-minded and committed colleague;
- the need to convince others in the department and how this can be achieved; and
- supporting the professional development of those others through collaborative curriculum planning and designing resources.

The need for support

One of the key issues, identified in my research, in introducing all-attainment is the need for support both from at least one mathematics department colleague and from some of the school's senior leadership team (SLT) including crucially the headteacher. Here I consider first the need for support from above and then move on to consider the need for and role of at least some collegial support.

Support from above

All-attainment was introduced in year 7 in both Brierley Grove and Shortvalley and simultaneously in years 7 and 10 at Duckworth Community School. All three schools introduced all-attainment initially in year 7 with the intention of rolling it up the school although Duckworth Community School tried to short circuit the process by simultaneously introducing it in year 10. However, they found that to be too much change for them at one time because of other simultaneous unconnected changes to the curriculum and they

quickly reverted to setting in year 10. All three schools had good experiences of introducing all-attainment into year 7 and rolled it into year 8. At Brierley Grove Pete noted that:

> *what was already obvious was that the ethos was better among the Year 7s – that the kids were starting to enjoy maths, there was less disaffection, and the lessons were getting a bit more interesting. [Pete, transcript]*

While at Shortvalley Bob stated:

> *in that Year 7 where only maths had mixed-attainment teaching and learning – the gap didn't open or opened by a few percentage points in perhaps three or four classes. I mean, our main focus was to ensure the gap didn't open. And it didn't. So, there was evidence there that we were having success. Progress generally in line with national averages, which for this school is… good. [Bob, transcript]*

Unsurprisingly one key factor in the introduction or continuation of all-attainment teaching was the attitude of the headteacher and the attitude of other influential members of the senior management team, deputy heads, SENCO[51] and so on. If the headteacher actively opposes all-attainment even if it is working successfully, it can become impossible to either implement or continue with all-attainment. However, one of the striking things to emerge from the data is the extent to which the teachers, particularly in this study in a culture where compliance to authority is the norm (Hall and McGinty, 2015), took the power they could find or make available to themselves and vigorously used it to support and defend all-attainment teaching.

Support from above played a significant role in the successful introduction of all-attainment and the need for this support was recognised by the teachers:

> *The previous headteacher [at Shortvalley] – he was the one that introduced mixed-attainment across all subjects in 7 and 8 last year. He was behind mixed-attainment. He also had similar views to Bob and me. We have a lot of Pupil Premium students and we need to serve the needs of those Pupil Premium students. Having them in sets 4, 5 and 6 is not helping them. They're not making the expected progress. So, he shared those views. [Sarah, transcript]*

> *The headteacher [at Becker School which I am moving to], who was the one that I worked with [most of my time] at Knapper, I know he's philosophically behind it. I'm kind of feeling like if I go there … I've basically chosen a school for the headteacher and the vice-principal. [Sarah, transcript]*

Pete and Bob had joined their schools, Brierley Grove and Shortvalley respectively, on condition that they could introduce all-attainment, Pete as second-in-charge of Keystage 3 mathematics and Bob as head of mathematics. At Brierley Grove the headteacher, who had

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[51] The teacher in charge of organising support for the students with special educational needs.

been headteacher for a long time and trusted his heads of department, devolved responsibility to the head of mathematics. At Shortvalley, in contrast to this and in this instance less satisfactorily, the headteacher, whilst eventually permitting the development, was initially less supportive:

> A job came up here [Brierley Grove] … So, I thought I'll apply for it, but I'll make it clear where I'm coming from. And more or less say if you want to give me the job, what I'd like to do is use lots of collaborative activity-based learning. And I'd like to, at least in Key Stage 3, work towards … mixed "ability" or mixed-attainment … So, if you give me the job, that's what you're getting … So, [the headteacher] ... to his credit, said fine … Jeff was head of department. Was Jeff convinced? No. But basically Jeff's attitude was if you think that'll work, you do it for Key Stage 3, because that was my responsibility … his attitude was fine, try it, see if it works. [Pete, transcript]

> When I arrived, I had been given an undertaking that we would have all-attainment teaching in maths in year 7 in the first year arriving here [Shortvalley] but it took a year to get it and I had to make a threat that I was going to leave if the promise wasn't honoured. [Bob, transcript]

The support of the head of mathematics at Brierley Grove was important and interestingly his support seemed to be genuinely based on what was occurring, unlike in so many contexts (chapter 3). Therefore, it was important that Pete was prepared to monitor, report on and base his argument on results, "hard" and "soft":

> By the end of the first year, we had some students who had As … and what was already obvious was that the ethos was better among the Year 7s – that the kids were starting to enjoy maths, there was less disaffection, and the lessons were getting a bit more interesting. … Jeff [head of mathematics] spent a lot of time looking at [the data], and then he was convinced. So, then we said we'll roll this out to Year 8s, and the kids who have been in Year 7 will continue it into Year 8. … Jeff was always really supportive. He always sort of said that's where we're going. And he sat back a little bit and made sure that people couldn't block it. [Pete, transcript]

Just like Bob above, Pete had needed to use the threat of leaving the school in order to maintain the programme of change for which he had been appointed. He and Philippa were also able to use the shortage of mathematics teachers in London as a threat:

> [At Brierley Grove] as long as our results are OK, the head [who has only been in post a few years] here wouldn't dare say that [the department should set]. I think he personally agrees with setting. But I know from conversations with him that as long as we meet all the right results, there's not a cat in hell's chance he would dare say that, because … He hinted at it once, a couple of years ago when he first came, and I just said well I wouldn't go down that road with you, then you're going to have to start looking for a whole new set of maths teachers. And as you know they're in short supply in London. So, he dropped it ever since then. [Pete, transcript]

> We've had to put our argument across as to why we're doing "mixed ability". The head himself has said to us 'Well, every other school in the borough is teaching in sets, you need to be teaching in sets'. So, we've had to put quite strong arguments forward. We use the

*shortage of maths teachers to our advantage in that case … it's difficult work convincing
people, when you're trying to do something that maybe isn't the norm. [Philippa, transcript]*

So important is the support from above that when the situation at the school moves in the opposite direction to that desired by the teachers and "ability" grouping is reimposed by a change of headteacher they are left with a choice: stay and comply or leave, taking their vision and commitment elsewhere. Sarah ended up in this position twice; at her previous school (Knapper) and subsequently at Shortvalley where both she and Bob took the decision to leave. She says:

*I cannot lead a department [at Knapper school] as head of mathematics and promote setting
to a team because I am fundamentally opposed to it, so I'd always be saying I don't agree
with this … … it's made me move on … That's how seriously I take it. [Sarah, transcript]*

Leaving Shortvalley to find a school where they could teach all-attainment had far-reaching implications for Bob and Sarah's personal lives and the lives of their families. Bob moved to London and Sarah moved to a school which meant she could not commute, only seeing her family at weekends.

Similarly, but at not such a personal cost, Philippa sought out the opportunity to work in an all-attainment setting rather than stay in a school which set:

*[At the school I left (Eastchurch)] people are expected to teach [in a] way that doesn't seem to
make any sense at all. It's mad. … I just mean that has no background, there's no research, as
far as I'm aware, that suggests this is the best way to teach … I struggled with that because I
was just … having to do things that I don't believe in … I took a job [at Brierley Grove] because
I knew I'd be able to teach in a way I wanted without being hassled. [Philippa, transcript]*

However, vital as the support of the headteacher is, sometimes it can prove detrimental to the long-term objectives of the participating teachers if it leads to ill-thought through policies and experiments that seem destined to fail and especially when operational decisions on the implementation of all-attainment are removed from the mathematics teachers. At Shortvalley this had a particularly strong negative impact:

*Our main problem was that the headteacher [at Shortvalley], having seen this in maths in
year 7, decreed to the school that all classes in years 7 and 8 in all subjects would be mixed-
attainment and didn't give any training or any justification in the lead up to that decision or
the implementation of that decision … I said to Sarah if mixed-attainment is shown not to
work in other subjects then we're going to fall into disrepute in a way and we've got no
control so it's good the headteacher took this decision but it's bad the way it's followed up
and it's been negative in terms of the school. [Bob, transcript]*

Operational decisions made by the senior leadership team, in this case the SENCO can affect the all-attainment agenda. For example, how classes are formed or the structure of the timetable can have a serious negative impact on what is achievable in mathematics:

We had no control over who taught which class … we didn't have any input 'cos the teachers had their timetable … the only way to have input was to change the teacher's entire timetable. [Sarah, transcript]

[The year 7 and 8 classes are] definitely skewed in certain ways so even though they're supposed to be … mixed-attainment we've got a class that has a lot, predominately SEN students because they were grouped by the SENCO. She put all the class lists together so that she could support them with less staff … we've ended up with classes we wouldn't have constructed in that way … It was hard to get that point of view across … it was very hard to get anyone on SLT to understand … a mixed-attainment class doesn't mean you can just put any kid in there … if you want it to be mixed-attainment you have to represent all of the attainments across the year group but they were kind of approaching it as we'll keep friends together, we'll keep … certain types of SEN kids together … it was all around how the SENCO decided to group the children … and we couldn't make any changes. [Sarah, transcript]

It was a very strange decision … if it had been a form group that might have worked … but the form groups are different … we've got no control whereas [previously] in maths we had direct control … That was the headteachers and the senior leader decision ... The form groups are different to the 8 classes in years 7 and 8 [at Shortvalley] … I'm only the head of maths, I didn't have any say in this. [Bob, transcript]

Other unsupportive existing members of the senior leadership team can cause difficulties too as illustrated by the experiences of Sarah and Bob:

We just got through the year [at Shortvalley] with the deputy head. We had a battle. … There was scepticism, there's no doubt about that, I can understand, that's a healthy debate, a discussion and well, we got the right result. I can be magnanimous now but at the time it wasn't so pleasant because I was getting frustrated having been given a guarantee [by the headteacher on my appointment], but we had the debate. [Bob, transcript]

In addition, if, for example, all-attainment teaching in mathematics is not being actively promoted by the SENCO, non-teacher support staff may not find opportunities to support critique of what seem accepted common-sense practices:

This is the first year that we've had mixed-attainment in Year 7 and in Year 8, and some of the learning mentors are feeling that mixed-attainment doesn't work, but they've only experienced lessons with cover teachers. [Sarah, transcript].

A change of headteacher can often cause problems because, ultimately, control can be exercised by the headteacher even in the face of success and high attainment:

We found when mixed-attainment was introduced at Knapper, the last year that I was there the year 11s got 65% A – C and it had previously been 45%. Really bizarrely the new headteacher that came in there also did away with mixed-attainment teaching even though the school had the best results ever so we kind of knew the writing was on the wall [at Shortvalley] with the new headteacher 'cos it is still unusual to find headteachers behind it. The new headteacher is coming in with the maths results being the issue, the maths results being the problem. [Sarah, transcript

It's a real shame that the new headteacher [at Shortvalley] won't allow mixed-attainment to continue. [Sarah, transcript]

It appears that departments need a very strong established track record of success across the full range of parameters for resistance to be successful against unsympathetic senior leadership and even that is sometimes not enough.

Support from colleagues

Although it is possible for one teacher, as head or second in charge of mathematics, to introduce all-attainment it is a difficult thing to do in the face of the current orthodoxy which endorses the prevailing thinking around "ability", seeing it as fixed and unchanging:

> *It was driven forward by me, essentially. And I persuaded three or four other people to go along with it. There was one teacher who's left now, who became quite enthusiastic in the course of the first year. So that was helpful. [Pete, transcript]*

> *I wanted to work with Bob again. … They didn't have mixed-attainment when I came here [Shortvalley] but I knew he was coming here as head of maths and I knew he'd introduce it. [Sarah, transcript]*

Furthermore, even knowing the research evidence supports your thinking and you are convinced you are doing the right thing and moreover you have the support of the senior management, going against the "common-sense" prevalent among your mathematics colleagues is problematic. In such circumstances the support of one or more colleagues is very important:

> *I took a job here 'cos I knew I'd be able to teach in a way I wanted to teach without being hassled. … I trusted Pete. I'd worked with him for a couple of years [on a curriculum development project]. He explained a massive amount of detail about what they're doing. … I knew what I was coming into and it seemed I would be mad not to take it. [mixed-attainment] was in years 7, 8 and 9 … when I arrived. [Philippa, transcript]*

> Me and Philippa worked really well together, it sort of put that heart in the faculty … if I'd been just me, I'm not sure we'd have sustained it. … I think having two people at the heart of it who had that sort of shared philosophy and shared approach and trust [was more than helpful]. [Pete, transcript*]*

> *Before I joined Lena [the head of mathematics at Duckworth Community School said] they wanted to go mixed "ability" … she said 'well, how do you feel about it?' Well, I'm well up for it so what I assume the discussions that took place here was, what can we do that would benefit the students and that was one of the ideas they bounced backwards and forwards and everyone was willing to give it [mixed-attainment] a try despite not having done it before … Lena, Mark and Shaun were very keen, and Jack and Sam had reservations but were willing to give it a try. [Adara, transcript]*

Thus having, or creating, a core committed team is an important factor in resisting the dominant "common-sense" culture where fixed "ability" thinking is the norm and hence makes an important contribution toward success.

Teachers who were engaged in moving to all-attainment were on the lookout for teachers who are willing to look beyond their current horizon and hence were open to change. It is also very helpful to have more than one teacher driving the introduction of all-attainment forward as the teachers can provide mutual support to each other. One way of enabling this is involvement in initial teacher education as engaging with Higher Education establishments can be a good source of sympathetic teachers:

> I know at [my London college] we were really encouraged to teach in a way that was similar to what Brierley Grove does in terms of interesting creative lessons where they're finding out things for themselves … that was really encouraged here but not encouraged in my other placement school … I definitely realised how much of a different experience I was having in my placement [at Brierley Grove] than what other PGCE students were having on their placements … so I knew this was a school I definitely wanted to sort of keep connected to … I was definitely desperate to hope that there was a job here and I kept in touch making sure if there was a job going. [Akhila, transcript]

> We've had a very deliberate policy … we're taking lots of PGCE students and the ones that we like, if there's somebody about to leave, or for whatever reason move on, we will look for people we've trained in this approach and give them jobs. [Pete, transcript]

> Everyone that currently works here was recruited by Bob and myself. Two of them - we were really pleased to get because they came here as PGCEs and they made a decision to work in this school because they were behind both mixed-attainment and inquiry. So, they were offered jobs – other schools also expressed interest in recruiting them - even though this school … is regarded as the toughest school to teach in [in the authority]. [Sarah, transcript]

Convincing others

Unsurprisingly also, the attitude of the existing mathematics teachers is important and needs to be taken into account. As well as having support from above and from at least a minority of existing colleagues, convincing other colleagues in the mathematics department is regarded as a longer term essential:

> You have to convince, persuade, show… sometimes that can involve some quite sharp arguments with people, but at the end of the day, there isn't a short-cut. It will only work if people want to work here, within this ethos and feel that they're a valued part of the team. If they don't … they won't stay. [Pete, transcript]

> We were facing years of tradition … this is how you teach maths, not just the practice in the department but people's expectations from their schooldays … two teachers who'd been students here I suspect were teaching in exactly the same way as they'd been taught here. [Bob, transcript]

Occasionally, participating teachers may experience a context in which little convincing is needed. Some teachers may come across all-attainment or indeed have even worked in a school where there is some all-attainment. Adara is an example of a teacher who has worked in several schools that teach mathematics in all-attainment groups. At the beginning of her PGCE she thought that it was logical for teachers to choose setting but after her

experience on teaching placement at Fielding School, where she saw all-attainment in practice and experienced its benefits, she changed her mind. But in general, convincing other colleagues was a fundamental aspect to the successful implementation of all-attainment teaching. The participating teachers approached this in two main ways: convincing by example and convincing by data and research. Ultimately this combined approach proved successful:

> We've convinced enough people that there's now a settled ethos in the department that in Year 7, 8 and 9, people think… they prefer to keep mixed-attainment classes. They feel it works. And they don't want to go back to setting. [Pete, transcript]

Convincing by example

There are still a few schools that organise children in all-attainment groups and some of these are comparatively close to each other but in general all-attainment in mathematics is so infrequent nowadays that simply telling other teachers that all-attainment works, that it can be done effectively, that it improves engagement of all students and that it improves attainment at all levels does not usually work as virtually the only type of mathematics classroom organisation that they ever come across is children in "ability" groups: because "ability" grouping is almost ubiquitous, most teachers have no experience of all-attainment and their opinions reflect this. Convincing teachers that all-attainment works may not be such an issue where nearby schools show all-attainment which is working and, in some instances, has been for many years. Gadamer's concepts of situation and horizon are of particular relevance here. Many mathematics teachers are so immersed in their own situation that they effectively have no horizon beyond the status quo; they cannot see that things could be different. They think students have fixed "abilities" and that is just the way it is. There is nothing that can be done to change it (Stobart, 2008; Syed, 2011; Francis et al., 2017a; Jones, 2016; Marks, 2016).

Teachers who believe in all-attainment and are responsible for its introduction typically write schemes of work and lesson plans but there is no attempt to compel other teachers to use them:

> We didn't impose it [mixed-attainment] on anybody. We said look if you want to teach differently… we made the classes mixed "ability" but said you don't have to teach it this way with these resources. And some people, to be honest, didn't … only in a minority of lessons with a minority of teachers did something else begin to happen. But it was enough. [Pete, transcript]

We had to go through some training processes [at Shortvalley]. And ensure the staff were comfortable teaching mixed-attainment. So, we had a core team of five teachers … [out of] maybe 10 at that stage … three people were very committed to mixed-attainment teaching and two were prepared to give it a go … one definitely needed convincing but was prepared to give it a go. And other people weren't prepared to give it a go. Initially anyway – they needed to see it could work. I understand that, because I'm new and I'm coming in and I'm saying … 'we're doing this'. [Bob, transcript]

[The curriculum units] are meant to be a bit like the Standards Unit[52] – here is a sequence of lessons, use this, change it, modify it how you like, but it's yours, it's the result of collaborative discussions and working together. [Pete, transcript]

We all do things very differently in this department [at Duckworth Community School] and we all play to our own strengths and so we don't have that kind of pressure where someone says 'No, you've got to do it anyway' … If you've got a colleague who may be struggling with behaviour, behaviour management, one of the things you might say well, change your seating plan, change the layout of your classroom, the way you want it to be, not just because everyone else might have them in groups, don't feel you need to bend to that pressure, do what works for you. [Adara, transcript]

The teachers behind the introduction of change tend to be themselves completely convinced and have every expectation that both observing and experiencing the change in practice will encourage others to join them. Thus, there is an expectation that other teachers will find these lessons useful in an all-attainment setting but, though teachers are encouraged to use them, they can still teach in a way that works for them. Pete expresses this shared expectation most clearly:

Most of the staff weren't convinced at all. Not at all. In fact, there was big opposition. So, what we started it with was in Year 7, basically I wrote a whole scheme of work. I did all the resources, all the lesson plans … My attitude was … the best way to convince teachers is to say (a) you come and watch what I'm doing, and (b) here are lots of resources and lesson plans you can use – I've saved you a pile of work. Saving teachers work is the best way to get them to do things. It's like, why don't you try this – it's all done. Give it a go. Over time, slowly people started doing that. More and more people thought actually, this seems alright. There were still one or two people not happy about it … You can have lessons which engage all kids where there's kids of different attainments working together and they all bring different things to the tasks of whatever you're working on, and they may be working at all sorts of different mathematical levels, but they can all learn from that, and it can all make them feel that they're capable of learning mathematics, and the buy-in becomes very high. And once people had some physical, real examples in front of them to say yes it can work, … then it's like a snowball effect. People are willing to give it a try and then are willing to work a little bit to make it work … [At first] in a minority of lessons with a minority of teachers did something else begin to happen. But it was enough, there was enough movement to allow it to go into Year 8. And by the end of two years having been through it, more people began to be more convinced, and then pushed it forward into Year 9. [Pete, transcript]

A key example of this approach, fostering both engagement and collaboration and opening up a space for student reflection, was also provided by Pete:

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[52]The Standards Unit: Improving Learning in Mathematics resources were produced as a response to the Smith report. The materials use active learning approaches for use across the secondary phase (STEM Learning, n.d).

The booklet for proportional reasoning … We spent a year working on it, to use it as a model of how to teach mathematical concepts in a mixed "ability" or mixed-attainment setting. I think we both think it's very good. And we were able to get everybody here and in two other schools to teach it – the whole maths department – and people really loved it, and the kids really liked it, and the mathematical learning was very good. And that went a long way to shift… that one we did get everybody to teach. That unit helped enormously in terms of, oh this is what they're getting at, this is the kind of approach they mean. And you could see the penny start to drop, because it was like, here is a model. ... Me and Philippa spent a year, a year and a half, trialling it out, refining it, changing it. [Pete, transcript]

It is worth noting in passing that at Duckworth Community School, which initially had a higher degree of commitment to all-attainment teaching among department members, the result was, perhaps, less impetus to change their teaching practices or to work together in a creative way. They do share resources but not in the same way as is being encouraged at Brierley Grove:

We have a centralised system on the computer [network] so there is stuff that is already there that we can then also add to … that you can dip into which is important because we don't have enough textbooks [though] in my classroom they don't get used [but] lots of people in the department do use textbooks. … I pull together from lots of different bits and make these bumper flipcharts and put them on the system and if anyone wants [to use] the bits and pieces they can. [Adara, transcript]

Finally, sometimes the introduction of all-attainment teaching can be an issue for parents. Where this was an issue it was likely to be with parents of relatively high attaining students (Francis et al., 2017a, 2017b; Macqueen, 2012; Oakes, 1994; Oakes et al., 1997). These teachers were able to respond to parents in ways which respected their concerns but enable their vision to continue:

We've had some issues with parents [at Shortvalley] of, from their perspective, their children are "very able", and they're concerned that they're in classes with people who aren't "very able", not in many cases, we've had a few who need reassurance that their children are being challenged at the right level … We've read the research and over-compensated at the top end. [Bob, transcript]

Perhaps as a result of the teachers' confidence in their vision and their commitment to communicate it, and despite the reported unhappiness of those parents with all-attainment teaching in general, parents were found to be supportive of all-attainment in contrast to children in "ability" groups:

The only time I've experienced any external factors or pressures is when children are setted. You do some sort of assessment and move children and then you get that contact from a parent saying, 'why has my child gone down? 'I don't want my child moving down, I want him in the top set' … When they made the decision to go mixed "ability" … we were waiting for the backlash, but it didn't happen … Interestingly when we had our open evening in October lots of the year 6 parents were saying we think it's lovely that you are mixed "ability". [Adara, transcript]

Convincing by data and research

As noted above even the most supportive data was not enough to convince people committed to the prevalent educational discourse. Nevertheless, the power of argument and debate, of using locally produced data (hard and soft) and articulating this successfully was also recognised:

> *You know, reasons need to be put, and evidence needs to be delivered. [Bob, transcript, emphasis added]*

> *We get a lot of freedom … nobody tells me what to do.   As long as the results are okay, we get through things like OfSTED … as long as everything is fine, and we tick all the right boxes as well, they basically leave us alone. … there's a game you have to play … but as long as we hit all of those things nobody ever interferes that much in how we do it, so … compared to most schools I'd say we have a relatively high degree of autonomy. [Pete, transcript]*

> *One of the things we're very insistent on is that we have to convince and show people, not just tell people. So, we're hoping that by modelling – look, this is how it can work in Year 10, by the end of Year 10 what I'm hoping is that – not by the end, but by halfway through – the evidence might be that both in terms of the engagement and happiness of the kids doing mathematics, but also the hard measures of attainment and tests and things like that, that increasingly over the course of next year. [Pete, transcript]*

This has particular resonance when addressing the issue of the currently highest attaining students: despite the research evidence (Ireson, Hallam and Hurley, 2005; Kulik and Kulik, 1982; Slavin 1987; 1990; and 1993), as is common with some parents as seen above, most teachers believe they will be disadvantaged in all-attainment groups:

> *I know exactly what will convince people - are the top end of the mixed classes [in year 10 at Brierley Grove in our forthcoming experiment] doing as well as the Set 1s. That's the gamble. That's what will convince people. Nobody would have a problem about the middling and the lower attainment kids. Their argument will really be about the top sets –that's what everybody, including the management, will be looking at. [Pete, transcript]*

With this in mind, Pete not only used the sort of hard data routinely collected by schools: he set up a small piece of action research with another local comprehensive school which set and wrote a detailed exposition of the data:

> *What does this little bit of evidence suggest? … What you could say here is that the top end kids do reasonably well in terms of moving forward in both schools, but where there's setting, the middle and the lower kids – there's not much. Whereas here, the middle and the lower kids are doing much better. … But the effect it had … was to convince people in here that… because the fear that was always expressed was if you do mixed-attainment teaching, it'll be OK for the weaker and middle kids, but you'll hold the top kids back. … the fear that people always had about it holding back the brightest – this was really important in saying well look where we are, two different schools … people were shocked when they saw it. I'd say about half the department at that time were convinced this would show the opposite. … And lots of people went – bloody hell. So those two things together, if you like, shifted people to the point where OK this is how we want to do things now. [Pete, transcript]*

The interviewees were aware that, in order to use data or research to make all-attainment work, they are sometimes playing the game (Bourdieu, 1992, p 66: see chapter 4) effectively. Hence, they are willing and able to engage in the debate about "ability" grouping and know the importance of doing so:

> *Both from management and from OfSTED and the prevailing culture, the pressure is always that you should set. Allegedly that's better … when that report came out - Key Stage 3 – The Wasted Years … about a year and a half ago. Basically, saying that in secondary schools, Key Stage 3 'Wilshaw says you should set'. … we didn't wait. We obviously went in… me and Philippa spent a ridiculous amount of time … reading the educational research. So, I went straight to the head, gave him a big fat dossier like that, and said, 'Actually, that's not what the report says, because if you read the report what it said was that where it's done well, mixed-attainment – he called it mixed "ability" - teaching works well. The problem is most teachers can't do it, therefore you should set'. [Pete, transcript]*

Difficulties and failure to convince

Despite all this, however, some existing staff found changing from "ability" grouping to all-attainment difficult or impossible: they were firmly located in their current situation with respect to "ability" thinking and worked within the horizonless situation of current policy discourse. Thus, although Bob and Pete had both used the shortage of mathematics teachers to their advantage in their negotiations with their headteachers, they were similarly constrained when they were attempting to change from setting to all-attainment. Bob knew it would be difficult to replace mathematics teachers who left so he had to make some concessions to those staff who did not want to change to all-attainment:

> *[The other teachers at Shortvalley] made a choice. They never vocalised their resistance or their disagreement in formal meetings. Only one ever said to me 'I don't want to teach mixed-attainment classes'. And I made a temporary compromise with him, because I needed staff – I didn't want him to leave, so I said OK I can guarantee you another year when you won't have to. And I'll give you all classes that are not mixed-attainment classes – in 9, 10 and 11. … He didn't really give an explanation or justification, but it was a philosophical view of what maths teaching is and maths teaching is better, or children learn better, in sets, where they are in with other children of their own "ability" … If he verbalised it coherently, I think that's what he would have said. [Bob, transcript]*

Similarly, Pete and Philippa had to make changes gradually:

> *There's less of an argument about mixed-attainment in Year 7 or in Year 8. In Year 9 you can feel that there's a lot of teachers who are still not convinced about it, and certainly aren't convinced yet about… they feel the gap is wider in Year 9 between what kids can do, and therefore that means 'we have to start moving towards setting'. [Pete, transcript]*

> *I think people [at Brierley Grove] are getting used to it more, starting to see the benefits but there is still absolutely resistance, for example, next year we are going to trial mixed "ability" in year 10 … and it's a minority, three of us who are and five of us going to set. … the reasons they didn't want to do mixed "ability" in year 10 is down to them saying the "ability" range has got too wide by that point … The end of year 9 … they get set …and it all goes wrong in*

my opinion … It depends which set you teach. If you teach set 1 it's lovely. If you teach the C/D borderline … it's a pain 'cos they all think they are rubbish 'cos they're not used to it. [Philippa, transcript]

Other extraneous factors may also affect the effectiveness of the introduction of all-attainment teaching undermining attempts both to convince by example and by data:

The other thing that we faced last year unfortunately was because people had already decided to leave, and had secured jobs elsewhere, their commitment was maybe questionable. So, some of the Year 11 classes that should have been safe last year ended up under-performing, and the results they got were way below what their class teachers were predicting, and both those teachers did not come back here in September. … You know how hard it is… that Year 11 you have to invest everything into it and you can't really necessarily take your foot off the pedal with Year 11 and still get the results. …I don't think they deliberately sabotaged the children's results, but we do wonder why they predicted so high. [Sarah, transcript]

I also know that Year 8 hasn't been a successful year. But I don't think that's because of mixed-attainment, I think that's because of staff shortages, issues around behaviour that have had an impact in Year 8, around the change in headteachers, the change in the school structure generally, the way they were grouped, all those things. … When you talk to colleagues, their experience of it this year hasn't been positive. And that's a shame, because all of those other issues have been sort of hidden under the fact that it's mixed-attainment classes. It's not working because it's mixed-attainment classes. [Sarah, transcript]

I'd already decided to go. With the head going and us getting Requires Improvement again and the results not moving at the top end 'cos they've had years of this setted situation, we hadn't been able to change that … the changes we'd made hadn't had time to work through. I knew the governors weren't happy. … one of the reasons they appointed this head 'cos she'd previously been a head of maths … me being in a minority you know in terms of mixed-attainment … I knew there was going to be some issues. [Bob, transcript]

Collaborative approach to curriculum planning and creating resources

The need for continued professional development and teacher learning was, in general, recognised as essential not just in introducing all-attainment but also in developing and maintaining it:

Putting people in … mixed-attainment classes … developing how to teach effectively in those classes, that takes a long time. … getting rid of sets … is the beginning of a journey about what kind of pedagogy and teaching approaches are effective in mixed-attainment classes. And that's a process of… that takes a long time to develop … it requires creating the right kind of tasks for students to work on, which work well in mixed-attainment classes. And that's not a simple or easy process. [Pete, transcript]

I wasn't sure how I would cope with coming to a school [Brierley Grove] that was asking me to teach all sorts of different students in one classroom and how I was going to have a plan for that. As a PGCE student I was a bit stressed about that and, but I like that it got me to challenge my thinking, ideas. [Akhila, transcript]

Collaborative planning was seen as a key element in this. Teaching against the grain (Cochran-Smith, 1991) is not an easy undertaking precisely because it is against the grain and the skills and understanding to do this successfully requires the active participation of all of

those teachers engaged in it. Hence, active engagement with the design of the curriculum is regarded as fundamental to developing an ethos within the department where all of the teachers are committed to making all-attainment work so that all students can learn without limits (Hart, 2004).

None of the participant teachers uses textbooks preferring to either produce their own materials or to use materials produced by their department colleagues, some of which might incorporate materials produced by teachers outside the department. In addition, the teachers may sometimes create and design their curriculum materials in collaboration with other colleagues, sometimes from scratch but not always. Curriculum units are continually reworked until they are effective in engaging all of the students:

> *All planning is done collaboratively. We have time set aside where people… [can] meet regularly. Obviously, there are good resources, there are some units we've made and there are some good resources around ... we've agreed collectively after lots of discussions, we have a broad scheme of work, we're not very prescriptive about the detail, but let's create some lessons and units. Put the emphasis not on creating individual resources or lessons but creating whole units that make mathematical sense of a journey. [Pete, transcript]*

One of the many reasons teachers give for not adopting all-attainment is that they believe it is harder (Oakes, 2005: see chapter 3) overall and as a teacher you have to work harder. The teachers who believe in all-attainment do not deny that teaching all-attainment groups is different. Instead they seek ways to deal with this perceived issue, one of which is by sharing the workload, an important aspect of which is to get teachers to work together on producing tasks suitable for all-attainment. This also contributes to teacher's professional learning:

> *What we are doing [in Duckworth Community School] at the moment is … just bog standard but under the new GCSE one of the things we need to teach … is iteration. So, we have actually dedicated two department meetings on how are we going to teach this? and so there are certain things on which we do come together, and we plan together, and we discuss. [Adara, transcript]*

> *We wouldn't be doing anything on our own. … we'd be planning, we'd be preparing lessons. And often what will happen is OK we've agreed the broad outline, so we'd do a sequence of say four lessons … you go away, put what we've discussed and agreed, and do the resources for the first two and I'll do the second two, and then we'll just hand them over. … And people can see it reduces your workload then when you get that kind of trust in people. You can agree the broad outlines. … so, I'm only doing two lessons. But you have to have enough trust and professional collaboration that I know that when you give me your resources, they're ones that I'll be able to use. [Pete, transcript]*

However, in a situation where all-attainment is being introduced, working collaboratively to produce resources may be a medium term objective as the teachers who are new to all-

attainment may feel they do not have the necessary expertise to create curriculum materials that are appropriate. In the short term it may be preferable for the teacher/s leading its introduction to produce the teaching materials. We saw one example from Pete and Philippa above. It also happened at Shortvalley:

> *Sarah prepared the lessons, so the lessons were there, and we discussed the lessons. It wasn't a question of collaboratively planning lessons, which we hoped to do, and which we would have developed and moved on to if we weren't leaving. It was more like this is a good way to teach mixed-attainment classes, let's discuss this model and then let's reflect on it afterwards, rather than let's all prepare together initially … We were very committed to that project, so we wouldn't have minded if [the onus of producing lessons all fell on me and Sarah] … But … to convince other people they have to feel that they're part of the process as well. [Bob, transcript]*

The medium-term aim is for collaborative planning, as well as reducing workload, to involve all teachers in creating all-attainment materials, so they are fully committed to the success of the project:

> *You can see all round the department, there's more of that where people are working together and developing that kind of trust, where you discuss some things in detail but other things you get a common language and a common approach. It evolves naturally. … over time your workload gets reduced, because it's a team. And you know everybody in the team is playing to the same sort of spirit. [Pete, transcript]*

> *We try to get it so that three teachers teach all of that, so we have two Year 7 classes each, partly because that reduces their planning and workload, because they've got two parallel classes, but essentially, they're teaching the same things. And it's a … team, with three of them, and we try to get it so that they have at least an hour block together on the timetable each week to meet and plan collaboratively. [Pete, transcript]*

In this chapter I described what the participants told me about the introduction, development and maintenance of all-attainment teaching. As I have shown the teachers had varying experiences but there were some shared patterns. I also discussed the need for support from others and the necessity of simultaneously persuading other teachers of its advantages. In the next chapter I will discuss how they made all-attainment work in the classroom.

Chapter 8: Findings (3) - How the teachers make all-attainment work in the classroom.

In this chapter I report on how the interviewees say they make all-attainment work in the classroom. I report on how the current external arrangements for assessment imposed by the chief external school regulatory body, OfSTED, affect the senior leadership team's behaviour around assessment and how the interpretation of these assessment demands by the school leadership team affect how the mathematics teachers interact with the school leadership team.

I also examine the underlying rationale for their approach to teaching including their emphasis on conceptual understanding, working collaboratively and developing critical skills in their students. Finally, I examine the methods the teachers use to implement all-attainment in the classroom including the type of tasks used, the way they induct the students into learning using all-attainment and the organisation of that learning through exploration, inquiry, talk and groupwork.

The role, influence and nature of assessment

Almost inevitably the turn to neoliberalism in England (chapter 3) and its associated managerialism and audit culture has profoundly altered English schooling particularly influencing the nature and role of assessment. With the deployment of the twin policies of "choice" and "accountability" in education, assessment has been the tool used to provide the required "data" for target setting (with OfSTED and league tables being the instruments used to deliver judgment). Moreover, mathematics and English have been used as two of the key pillars on which the performance of a school is judged and by which it is held accountable. Hence, mathematics departments are under continual pressure to ensure their students perform against high stakes testing, their success in secondary schools being judged by how many students succeed in "passing" the GCSE examination. Thus, for most mathematics teachers all assessment as well as all teaching becomes directed to this end.

However, it appeared to me that the participating teachers think rather differently from many mathematics teachers (and importantly from school leadership teams) about the function of assessment within mathematics education. As discussed in chapter 7 the

teachers were not seduced into attributing intrinsic value to the demanded assessment process as Philippa explains:

> We're expected [at Brierley Grove] to report grades at certain points in the year and in my opinion, they mean absolutely nothing … I just don't think it helps anyone. So, 'this kid's a level 6' what does that tell me? Absolutely nothing. They might be an algebra genius, but they can't visualise anything … We won't do that … that is a pressure but we [resist it] … Personally I feel like there's a pressure [at Brierley Grove] to try and grade or level every single thing that the kids do and it's all about that and it's nothing to do with offering students an enriching experience about mathematics … we push it aside so that actually we put the kids first and … [do the things] we believe are important first and then think about the exam afterwards … I think if you teach mathematics well the exam should be trivial … don't start with the exam and teach to that. … The problem is schools do it from the word go all the time … how many times do you … see people saying 'this is grade [such and such], this is what the examiner's expecting you to do'. What has the examiner to do with mathematics? [Philippa, transcript]

In addition, Philippa understands and rejects the role these required assessments play for the senior leadership team in managing and checking up on their staff and the ways predictive labelling is used in support of the process:

> It's just procedural … I think it's probably in their own mind the easiest way to get there [to succeed at assessments] … I think as a HoD you would have more control in that situation if people were following schemes of work which at the end of there's an assessment and … every kids going to get a number attached to it and I'm going to analyse that number it's going to mean something then it's easier to manage and that must be how, I'm sure SLT think about things … People can't cope if you don't label children, so the kids will … be labelled with a grade nationally … the moment they come into year 7. But we would not do that as a department. We don't agree with that at all. I just don't think it helps anyone. [Philippa, transcript]

As we saw in chapter 7, the need to play the game was acknowledged ('there's a game you have to play, because at the end of the day, GCSE results, A-level results' [matter] [Pete, interview transcript]) but also recognised as such:

> Last year [at Brierley Grove] we were lucky 'cos we got the top in terms of Cs and above in the borough … that's given us a little bit of leeway … to continue with the things we want to do … it's been a very successful story in terms of the long run over the last 10 years … so that helps in terms of winning arguments. [Philippa, transcript]

> As long as our results are fine … the pressures are there, but the trouble is, unfortunately, because of the exam factory thing in schools, it's a bit like football. It's a results business … If you're winning the game, they'll leave you alone. If the results ever start getting problematic, I suspect those pressures would intensify a lot. But that's not where we are here at the moment. The results are fine. Last year the GCSEs were … 12% above national average. [Pete, transcript]

The teachers were, of course, not immune to the pressures exerted by examinations. The teachers know the students also need to be prepared for their GCSE examination. But they use other forms of assessment to enhance student learning for almost all of the secondary

years and have the conviction that, coupled with an input on examination technique relatively close to the examination, the priority they have until then, placed on learning itself, will see the students through to examination success:

> *Assessment comes in not because someone has got a checklist … but actually comes in when it's needed and when it's natural. [Bob, transcript]*

> *They've got their assessments at GCSE … we've done all this maths and now we've got to ensure you know the exam technique … you need to do it at some point during their curriculum. The longer it can be delayed the better … You've got to write an answer and you need to teach them that but if they've got really good mathematical understanding that's easy to teach …the problem is schools do it from the word go all the time. [Philippa, transcript]*

Learning journals make a key contribution to assessment. In particular they provide a vehicle for students to self-assess their learning and their program:

> *I brought … [the learning journals] with me from the school I worked at previously and then adapted them to suit this school. So, this idea that it fits in with the whole concept of growth mindset, this idea that the progress needs to be visible to them. They stop viewing themselves as… previously, they might have gone around saying I'm a Level 3 or I'm a Level 4 or Level 5. So, they stop viewing themselves in that way, but to think 'this is a new topic, what do I already know, what do I need to learn next?'. If they can see what the progression looks like, they know what they're aiming for. And then that also helps them to choose. [Sarah, transcript]*

Approach to teaching

Thus, although the teachers interviewed want all of their students to succeed academically they do not see mathematics education as an exercise in jumping through hoops in order to pass examinations but rather as something that empowers the students, helping them to enjoy the subject, to grapple with real mathematical ideas and to see themselves as capable learners:

> *It's not about grades and results and stuff, I think it is actually just about teaching students their subject right and getting them to really love maths. [Akhila, transcript]*

> *All students are engaged in real mathematics and developing real mathematical ideas in a mixed-attainment setting, but in a way that they're all engaged essentially in the same task … there's kids of different attainments working together and they all bring different things to the tasks of whatever you're working on, and they may be working at all sorts of different mathematical levels, but they can learn from that and it can make them feel that they're capable of learning mathematics. [Pete, transcript]*

Bob finds the current vogue for mastery teaching to be the antithesis of what he believes in terms of giving students the opportunity to influence the direction of their learning:

> *I see mastery and inquiry very differently because … mastery is directed by the teacher; the teacher sequences the learning in very precise small steps. … I'm interested in students having a say in the direction of the lessons … and that is the complete opposite of a tightly controlled, teacher-led, sequenced lesson. [Bob, transcript]*

> *[The aim is for the students at Shortvalley] to become more independent, they take initiative, [they are] more creative and … for me there is a … phase when students can question and … there's an opportunity for students to direct their learning. [Bob, transcript]*

Understanding rather than rules

The teachers put a lot of emphasis on thinking about mathematics in order to understand it, emphasising in their approach that mathematics is not about learning rules:

> *I want to teach kids to conceptually understand. It's not about procedures for me … the task itself is a good question, an interesting question … and also the dialogue that's taking place between the teacher and the student … is … the teacher framing things to make the kids think even more … 'cos any kid at any level can respond to good questioning. [Philippa, transcript]*

They believe that such understanding is achieved through a problem based approach where mathematical reasoning is required and encouraged:

> *Definitely problem-solving. Definitely reasoning. [Sarah, transcript]*

> *mathematical reasoning isn't necessarily a very confined problem and there's one answer. It's far more open than that. [Bob, transcript]*

The learning involves activity, sense making and exploration:

> *The classroom should be a place where students are engaging their brains in grappling with mathematical ideas and concepts in one way or another way, and fundamentally that means doing something. [Pete, transcript]*

> *[The teachers need] an … expectation for each individual child [that] would have to be high … framing things to make kids think even more …, questions that are mathematically interesting … does the lesson make mathematical sense? … Everything they say is valued, it's not a black and white subject … there's something for everyone to explore and everyone can answer. [Philippa, transcript]*

Critical thinking beyond mathematics

Skovsmose (1994) believes it is essential if the students are not to engage in mathematics divorced from the realities of the world that they begin to think critically about mathematics. His thesis is that 'mathematics is formatting our society' (Skovsmose, 1994, p 43), controlling our thought so our 'mode of thinking is an obstacle to critical thought' (Jackson, 2014). Much of what these teachers believe and what their consequent actions are driven by, is a shared belief that what happens in school is not divorced from what happens in the rest of the world. Indeed, the teachers believe the mathematics lessons the students learn in school should enable the students to engage with what is happening in the world so as to interrogate it:

The more you get people to (question the world), the less likely they are to then simply accept things that are handed down from above. They feel an equality. Because they have this richness and ability to [think] if I don't know it yet, I'm open to learning and I want to learn it, and I'm capable of thinking, capable of learning it, and therefore I won't simply have to bow down and accept and question authority or expertise, I can challenge, question. You might tell me something, you might know more [than me] about this but I'm perfectly capable of thinking about that, if necessary going away and learning some more about it, and questioning. [Pete, transcript]

Thus all-attainment for these teachers is not only about the students' experience of learning mathematics important as that is. It is also about enabling the students to develop as critical thinkers so that they are not limited by their situation and develop an horizon, so they can see beyond their current situation (Gadamer, 1960/1975) in the same way that their teachers are able to do. Although the mathematics teachers interviewed are concerned about the achievement of all their students that is not their sole concern: they are also concerned with their future life chances. Unsurprisingly for most of these teachers the field of social justice impinges on the field of mathematics education informing their decisions (Bourdieu, 1992). Bob expresses this quite succinctly:

My reasons for mixed-attainment are the philosophical reasons of social justice and giving everyone a chance and putting the responsibility on the students, giving them the opportunity to show what they can do rather than me say 'This is what you can do' and bad luck whether you think you can do anything else, you're not going to get the chance'. [Bob, transcript]

Collaboration and creative planning
A final key aspect of their overall approach to teaching (as we saw in part in chapter 7) is that they also bring their values of understanding rather than rule following and critique and independent thought to their own practices in curriculum design. They believe in collaboration and creative planning. The teachers interviewed think that at quite a fundamental level teaching mathematics effectively means working with your colleagues and showing a degree of originality and independence in your approach. Bringing original thinking to curriculum design is a basic part of the job:

We've thrown out lots of content … There's not a copy of the national curriculum anywhere in the faculty. We don't look at anything like that. We start from having a conference to say look we know what they're going to do by the time they get to GCSE … We are confident enough in ourselves as mathematicians to think what is it that these kids need to learn – the big mathematical concepts, if they're going to be able to function mathematically and access that when they get there … What you will find is lots of people talking about what are the big mathematical ideas. [Pete, transcript]

I taught [history abroad] in an inquiry way, actually. And then I thought, ah, that's interesting. Because I really enjoyed that sort of style and the collaborative approach … I thought this is great, how can I bring this into the UK state education system? This inquiry approach,

collaborative, co-construction of learning and so on. How does that fit into an hour-long lesson in a comp? That's what I'm trying to answer – that question. [Bob, transcript]

One of the big things we have, and I suspect me, and Philippa drive people [at Brierley Grove] nuts on this, is that teaching has to be fundamentally creative. So, we're collaborative. We put a lot of emphasis in this department on saying to teachers, don't just take something off the shelf, some pre-packaged thing. Any PGCE student who comes in here and says I found this on the xxx website will get a right earful … If you want to teach something, don't get a textbook. You're a mathematician. Think. Create something. Do it. [Pete, transcript]

They see this as contrasting significantly with the current norms in teaching mathematics in England:

There's lots of emphasis on discovering things here [at Brierley Grove] *and investigating and thinking about how you can get students to investigate or discover a rule or a theorem for themselves [which] is much harder than just teaching the rule … I went to my other placement school, which was an academy in North London, and that was a very different experience where you were sort of encouraged to just get a worksheet, get a textbook … I'm definitely not a teacher who reaches for a textbook at all … I taught some averages last week, but I used the data created by the class to do it … there was a nice conversation. [Akhila, transcript]*

Teacher methods: how the students work

The current discourse in mathematics which constructs it as a strictly hierarchical subject, one thing leading to another, feeds into the fixed "ability" discourse, justifying the restricted curriculum of currently low attainers. As we saw in chapter 7 in contrast to this the participating teachers believe that all students should have access to the whole curriculum, indeed in some instances introducing them to mathematics not taught in the school curriculum:

We have continued fractions in there, which you don't even do at A-level, but we do them in year 7 because the kids like playing with them. It's fun. [Pete, transcript]

This view of mathematics leads to radically different approaches to the teaching of mathematics than that of the majority of mathematics teachers: these approaches are frequently based on pedagogies that encompass methods involving dialogue, exploration, investigation and discovery and a fundamental belief in all-attainment, that everyone can do mathematics at some level. In this section I consider some of the ways that these teachers' beliefs become acted out in practice which are different from the norm:

In the secondary lessons observed, the most prevalent style was one where the teachers demonstrated a new mathematical method which the pupils then practised. (OfSTED, 2008, p 11)

A follow-up report several years later confirmed little had changed in the way of mathematics teaching (OfSTED, 2012).

The many elements in this section are all interlinked and assist one another in creating the type of learning environment that supports and sustains all-attainment teaching. These teachers think that you cannot have groupwork without dialogic talk but it is perhaps not so obvious that the type of task used is also crucial in encouraging the sort of thinking necessary to promote and sustain the learning of all students in an all-attainment group.

Type of task

In an environment where the teachers want to encourage the students to engage heavily in dialogic practices the type of tasks used are quite crucial. Although it might be possible to start from well written textbooks where the authors have started off with all-attainment as one of their main objectives, such as the Century Mathematics (1991-93) series of textbooks, the more pedestrian traditional type of mathematics textbooks produced by most academic publishers and designed for the usual model of exposition followed by practice fail in this respect and are generally unsuitable for use in an all-attainment setting.

Thus, these teachers tend not to use textbooks:

> *We regularly discuss what we are going to do. We swop resources. I made this, add this to yours so there is collaboration in the department either in pairs or in the department as a whole … We have a centralised system which you can dip into which is important … those textbooks have been there forever – I don't know where they came from, they don't get used. [Adara, transcript]*

They tend to use tasks which are open-ended, have many possible different strands and diverse paths, tend not to have only one answer and require the students to use methods of exploration, inquiry and discovery as well as their own existing knowledge. Such tasks are designed to be suitable for groupwork and require the students to collaborate through dialogic talk in order better to understand the mathematics at a conceptual level so that they make real progress:

> *I would want the pupils to be learning from each other. So my favourite sort of lesson is when we start with an open starter that's got multiple entry points. Everyone can get something from it. … you have to have a question or a comment, you might not be able to get all the way to the end of a solution if it's an extended problem or multi-step problem, you might not be able to get all the way to the end of an answer, but you can … get part-way to a solution. [Sarah, transcript]*

[The task] might have multiple entry points. So in an inquiry for example, people make different observations about the same thing. And often it's about combining those observations on that same journey and then actually you might have a very open start and all work in the same direction in the middle but end up in different places. [Bob, transcript]

The beliefs of these teachers are in sharp contrast to what they observe happening in the mathematics curriculum in other schools, both primary and secondary. The role of questions and of who generates the questions is regarded as key:

My preferred choice is the low threshold/high ceiling task, the multiple entry task, where everyone essentially does the same thing but with different aspect, approaching it in different ways. … it's very collaborative …The questions shouldn't be coming from me, they should be coming from them … it teaches them they should be asking the questions and they should be making the comments, so the teaching input becomes quite minimised from the front … you have to train them to get to that point and eventually they will get there, and it becomes … the culture of the classroom. [Sarah, transcript]

[The students at Brierley Grove were] exploring something, but it's open-ended, an investigation … where they're choosing their own questions … making their own conjectures and convincing, whether that's done through a diagram or a picture or algebraically that's up to the group to decide on what they're most comfortable with. [Akhila, transcript]

An inquiry, as I conceive of it, starts with students' questions and conjectures from a stimulus that the teacher gives. It then moves perhaps to a phase of exploration and conjecture and generalisation … Once we've done the questioning phase and the observation phase … we look at the questions, we think about them, we talk about them, and then we decide on the direction that we'll go … the lesson might spread over three or four lessons … the teacher and the students are communicating, and each can see what the other knows and what they don't know. … there might be some kind of co-construction of that knowledge … it's a very flexible way of working, depending on where students are at, and what they're asking for. [Bob, transcript]

Learning how to learn

However, the teachers know that becoming an independent learner is not something that just happens within the current school system, the students have to be trained for it. For several years the new intake of year 7 students has spent the first few weeks in mathematics lessons learning how to work effectively in groups:

In year 7 there is a focus to kind of develop their groupwork and talking and questions so we do have some time at the start of the year when we work on their communication and collaboration with each other but also with the teacher and students so we do kind of get that from the minute they are in this classroom and just through problems, you know some are from NRich, some we've made up, logic problems, reasoning so that's what we kind of need them to develop because that's part of, you know, making a good mathematician. [Akhila, transcript]

It has to happen from year 7 onwards, that needs to be embedded in their culture in the maths classroom: they know as soon as they walk in that this is it, they have a role assigned to them … they're exploring something, but it's open-ended, an investigation … they're choosing their own questions to explore as a group, making their own conjectures … what they're doing is reasoning together … it takes time to get that kind of environment in the classroom. [Akhila, transcript]

For mixed-ability to work, as in any teaching to work, you need kids to work in groups I think. If you have that viewpoint on pedagogy. … We put a lot of time for example into working in groups at the beginning of year 7. We have half a term we don't teach them maths, we literally teach them to work together in groups, because we know it's so important and if they can't do that I'm not going to be able to teach them … they need to be able to work together … it's little things like … we might have a lesson in communication … it might have a bit of maths in it, say, problem solving, whatever, one of those ATM things … a lot of the time we do things like just stop, can everyone look what this group has done … someone has got up, they moved their chair over there and now they're in a really good position to work. I haven't told them to do that, but they've naturally done that … it just highlights the skills we think they naturally have and I just don't think they have at all … a year 7 class at the beginning of term … you tell them to work together it's like chaos, you really have to home in on what that means. [Philippa, transcript]

The learning journals discussed above make a significant contribution to these early training processes:

I want to see them make the right choices, so they also need training in that, so we have the learning journals to help them … I brought that from the school [Knapper] I worked at previously and then adapted for this school [Shortvalley]. So this idea that it fits with the whole concept of growth mindsets, this idea that the progress needs to be visible to them. They stop viewing themselves …as previously they might have gone ... I'm a level three or level four … but think this is a new topic, what do I already know, what do I need to learn next? If they can see what progression looks like they know what they're aiming for and that also helps them to choose. [Sarah, transcript]

[The learning journals promote] that idea of giving the kids more responsibility for summarising their own learning. … we had to fight quite hard with the kids at first about the process. … now the kids just take it for granted. … That idea that it's your responsibility to do what we call learning notes reasonably regularly. And summarise what it is you think you've learned. … the kids like it and it works quite well …it's changed and evolved a little bit over the years. [Pete, transcript]

The students are also trained in how to present their work:

The first time [year 7 presented their work] it was awful 'cos the first time they did it they weren't used to it but you know 3 or 4 times later they know what they're doing so … it's routine for them, they don't even think they're doing anything different but what they're doing is reasoning together in groups of three. [Akhila, transcript]

Critical thinking, independence and responsibility in mathematics learning

The teachers believe that teaching the students in a way that enables them to think conceptually rather than procedurally is one of the necessary prerequisites for helping the students to think critically. This pedagogical approach enables the students to begin to engage in critical thought within mathematics, so that in the first instance, at least, they think more deeply about the mathematics they are being taught. Not only did the majority of teachers interviewed have a clear vision for all their students that they should succeed mathematically, they also want them to develop as agentic citizens who engage with the wider world. The teachers are agentic and they want their students to be agentic too:

I don't want my students to just accept everything I teach them 'cos I know really what I was like as a student. I just thought sort of okay this is maths, this is what I need to know for a GCSE and just learned it … It wasn't until I got to university and started really struggling with maths … I was just questioning why does this work? where does it come from? You know I questioned my own mathematical subject knowledge from my A-levels, I never thought I explored it properly deep enough. [Akhila, transcript]

The aim is that they become more independent, they take initiative, they become more creative, and they participate in directing the lesson as well as doing the maths … inquiry tends to put it all together in a kind of organic process. [Bob, transcript].

Most of the teachers are committed to an approach to the curriculum that enables the students to develop their ability to function as independent learners and in so doing to take responsibility for their own learning. This independence is predicated on the interdependence of the learning community. These approaches usually involve some variation of discovery learning: also in their mathematics learning the students were expected to engage in discussions, make conjectures and begin to pose their own questions. The teachers see all this as all being part of a push to develop the students' independence so that they can develop both as mathematicians and as critical thinkers. Thus the teachers believe the students need to take responsibility for their learning while being guided by them:

We say to … [new year 7 students], this is a new start. … you might have been in sets before but show us what you can do. … you make the progress you're capable of. … We're not going to pre-judge, we're not going to say that you're this or you're that. We've got the data from primary. … We put the responsibility on them … [give] them the opportunity to show what they can do rather than me say 'this is what you can do and bad luck whether you think you can do anything else'. [Bob, transcript

The kids were completely used to it … For them the idea that they were responsible for the mathematical discussion was completely natural to them. You couldn't do that artificially. It was completely obvious, this was the normal experience of the kids, they expected to come into a classroom, be posed some mathematical questions, which you have to carefully construct, but then the main responsibility was then on them to discuss and argue and explore those. I was there at the appropriate point, if needed, to guide and help. But the main responsibility was them. I'd set the situation up for them and now it was their responsibility to do the mathematical thinking, with me there as a sort of nudge guy to probe as necessary. … you can't get that overnight thought. It takes a lot … even in Year 7. [Pete, transcript]

The students need to be engaged, otherwise you are not going to get anywhere, and they need to want to have that need to explore things on their own … and coming up with their own learning so they're discovering things for themselves, making conjectures, being able to convince themselves being challenged, there's no point in them discovering obvious things, they need to be challenged in multiple ways … there's something for everyone to explore and everyone can answer. [Philippa, transcript]

Although the pedagogy the teachers use encourages the students to assume control of their own learning so that they become independent learners, so they can think and learn

independently, as we have seen the teachers think working collaboratively with their peers helps them to develop both as mathematicians and critical thinkers:

> *Because they are sharing in the class discussion the students learn from their peers … they've taken part in the discussion and been exposed to it … They're not fearful of making mistakes, they're not fearful of asking questions, having others perceive it as a silly question, it's just that it's part of the process of learning, we ask questions, we make comments, testing whether or not they're true. [Sarah, transcript]*

Importantly Sarah thinks that setting increases currently high attainers dependence on the teacher as once they are placed in the top set they are happy to let the teacher control their learning:

> *My experience is that [high-attainers do better in mixed-attainment groups] … that is the case and it makes them more independent learners … sometimes the highest attaining students are more stretched in a mixed-attainment class because they're not going to accept what you give them. They're looking to be challenged and they're concerned that they won't be challenged, so they ask for the challenge. If they're in a top set, they're happy that they're in the top set and they're happy for the work to be not that challenging, because they're in a top set so that must be a good thing and finding the top set stuff easy. But if you put them in a mixed-attainment group, they ask questions and they want to be challenged and they push you as a teacher to push them – which is actually better for them. [Sarah, transcript]*

Time

An important feature of the teachers' thinking about the curriculum which separates them from other mathematics teachers is that, because they are not examination driven, they are prepared to spend time on mathematical learning so that there is not the time pressure by which many mathematics teachers feel driven:

> *The main idea is to spend a long time on a unit of work rather than a week on this topic, then moving on, trying to cram everything in, spending some time so they get a deep understanding of what they're learning. [Akhila, transcript]*

> *I've got this lovely starter[53] ... It ran the whole lesson – and teachers have this experience, everything clicks. … Exactly. So what this whole thing that I've tried to create is harnessing that and designing for that to happen – trying to create that situation where there isn't that time pressure, where students have got the chance to take their interests further if something grabs them. … they would participate in directing the lesson. And the lesson might spread over three or four lessons. [Bob, transcript]*

Part of that ethos is giving individual students time:

> *She always takes a long time but actually she's perfectly capable, just takes a bit longer to pick things up … The one who can struggle, she takes her time but actually when she's engaged can get there, she just needs longer than other students. [Philippa, transcript].*

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[53] Starter – an introductory activity which may or may not be connected to the main learning objectives of the lesson.

Adara is the only one of the teachers who appears to have partly accepted the current discourse that the learning of mathematics can be accomplished at some speed although she does accept that learning can take place over at least two lessons and there is, perhaps, a sense of her reflecting on or questioning her practice:

> I want my students each lesson to have made progress and to leave having learnt something, either acquired new knowledge, acquired new skill or something they previously didn't understand they now understand … that's quite an OfSTED thing for me to say … sometimes I set up lessons I know that it won't all become clear until the second one and I sometimes think of my lessons as doubles so, yeah, if they've made progress it could be that the progress is like for example … the amount of work produced [by a student who doesn't usually produce much]. [Adara, transcript]

Exploration and inquiry

The teachers believe that the students need to develop their reasoning skills by engaging with mathematics through a process of discovery and/or inquiry. This process may, if necessary, be structured by the teacher who may also provide some of the mathematical knowledge needed. Knowledge may be constructed collaboratively as part of the inquiry process. They believe that the students need to build on and make use of the mathematics they are already familiar with or are in the process of learning:

> [Currently we're] trying to get more investigations into the curriculum at the moment with year 9s … getting them to develop their reasoning skills. [Akhila, transcript]

> Knowledge comes in in a different way [in inquiry] – it's not a "aha!" discovery at the end of the process. It's … required on the part of students and introduced consciously perhaps by the teacher. So that overcomes this whole issue in investigations of – oh, I haven't made the discovery and I don't know how to make it, and are you going to tell me or not? … So I think an inquiry … [is] potentially more collaborative… and the aim is different. [Bob, transcript]

> [I value the students] engaging in grappling with something mathematical. … It might be they're exploring something, investigating something. It might be that they've already learnt something and they're trying to apply it to a new problem. [Pete, transcript]

> There's definitely an ethos in the department where you shouldn't really tell students what you're planning. You build it up, so they discover it and then consolidate it through practice. [Akhila, transcript]

Adara is the only one of the teachers who does not specifically describe her approach as exploratory. The reason for this would appear to be that for several years the examination boards required students to submit investigations as part of coursework requirements. However, as time went by and the importance of the students succeeding at GCSE grew because of the use of this as a school performance indicator by OfSTED, instead of being seen by many teachers as an opportunity for the students to explore mathematics it came to be seen as another hoop to jump through by many teachers. In order to jump through this

hoop successfully in mathematics many teachers treated coursework as just another algorithm to teach such that any idea it might allow the students freedom to engage in exploratory mathematics was soon forgotten. This experience appears to have coloured Adara's views on investigatory approaches. However she still does some investigations and reflecting on an investigative approach begins to think it might be a good idea for all-attainment:

> We used to do more investigative stuff. We used to have coursework … That was the bane of our lives. I would definitely say that I do less investigations now than I used to, but I do try to have a more problem-solving focus on everything I'm teaching … I wouldn't set [an investigation] for an entire hour not like I used to, maybe we're just going to work on this investigation. I generally have steered away from that. … for mixed ability [that] would be really good. You could have differentiation by outcome … I've not thought about that in a long time, but it would seem I've steered away from that. [Adara, transcript]

Talk

The most common mode of teaching in mathematics classrooms in England, despite all of the educational research over the last one hundred years, remains the traditional one of teacher exposition followed by student practice (OfSTED 2008, 2012). The default approach to teaching mathematics is for teachers to teach how they were taught, the rationale partly appearing to be, it worked for me so it should work for those I am teaching, ignoring the fact that the mathematics teachers are among those who were successful at mathematics in that mode of learning.

In this mode of learning there are few, if any, opportunities for talk in sets other than the top one, as this is usually deemed to be off task and, hence, at least potentially disruptive (Bartholomew, 2003). In contrast to this the teachers interviewed see talk by the students as an essential component of the learning process, both their own and as contributing to the learning community:

> A good mathematics lesson for me is one where I'm talking with someone else. … Dialogic, pupil-to-pupil talk. … I want one where the majority of students are engaged in that process at least for significant parts of the lesson. … Less teacher talk. Lots of pupil talk. [Pete, transcript]

> They're talking to each other all the time … inquiry is really powerful because it teaches them that they should be asking the questions and they should be making the comments. So, the teacher input becomes quite minimised from the front. So, teacher input is when you're circulating around the class and you're identifying… so if you've got students that you … want to show them what they need to be doing next to move on or supporting them in some way. … I think you have to train students to get to that point, and eventually they will get there, and it becomes a part of how they learn and the culture of the classroom … It's richer for

them, they've taken part in the discussion and been exposed to it … they've been part of the conversation - all contributions are equally valid. [Sarah, transcript]

Talk allows the students to support each other's learning and can lead to the co-construction of mathematical knowledge:

They're sort of teaching each other … so as a teacher you're kind of walking around and you can help one group, but you feel secure that they're helping each other, and you don't have to stress about what every kid is doing ... it's less of a worry when you know they're talking about maths together … it just works really well when you mix them in their groups so you have a brighter one working with someone who is not so bright and they're helping one another. [Akhila, transcript]

[A good lesson would have] co-construction of knowledge [between teacher and student, and student and student] and the [students would have a say in the] direction of the lesson … in a good lesson. I'd want that level of communication I think, and that level of flexibility. [Bob, transcript]

Talking also supports the students in setting aside the idea that all mathematical activity has a neat and complete end:

Year 8 … got really used to the idea you must contribute so you must have a question or comment. You might not get all the way to the end, but you can see parts of it, get partway to a solution …supporting one another, the idea that helping someone else also helps you, explaining to someone else deepens your own understanding … so it's of benefit to you and to the person you're helping. [Sarah, transcript]

The teachers firmly believe that mathematical understanding comes through verbalising and talking through ideas with other people:

You think you know something mathematically and then you have to teach it and talk about it and discuss, mmm, you know there's lots of emphasis on discussing things here and investigating and thinking about how you can get students to investigate or discover a rule for themselves is much harder than just teaching the rule. [Akhila, transcript]

I think it's really good for you to talk and work on maths problems with people who aren't good at maths, that gives you more skills sometimes. [Philippa. transcript]

There's the task where some pupils will do some aspects of it and others will be doing others, and it's very collaborative and they're supporting one another within that. … They're talking to each other all the time … And the idea that they should be questioning as well. So the idea that the questions shouldn't necessarily be coming from me, they should be coming from them. … they should be asking the questions and they should be making the comments. So the teacher input becomes quite minimised from the front. [Sarah, transcript]

Groupwork

Thus, all of the teachers believe in dialogic teaching and that talk is an essential ingredient in developing understanding in mathematics. There are differences in how they enable it in the classroom. The teachers at Brierley Grove think that groupwork is an important part of learning mathematics, that it is essential in investigating, exploring, collaborating with other students and discussing your ideas, helping everyone to develop their conceptual

understanding of mathematics. As we saw above, they also believe it does not just happen naturally, that the students have to be trained to work together in a group right from the start of year 7.

Groupwork is regarded as so important that the teachers work hard to convince colleagues:

> Groupwork has a lot of resistance in the department 'cos [some] people didn't see the point'…
> I do not know if this is to do with mixed-"ability" though I think it was just teaching in general
> … for mixed "ability" to work, as in any teaching to work, you need kids to work in groups if
> you have that viewpoint on … pedagogy … Sometimes teaching in these groups becomes a
> one-off and I think we really want … I mean Pete and myself, particularly, are trying to turn
> that around so that the groups become the norm. [Philippa, transcript]

Akhila and Philippa emphasise the advantages of working in groups and discussing the mathematics:

> I really want the students asking me questions in the lesson, not always me asking the
> questions, having conversations, asking each other questions when they're working in groups
> …it takes a while though you have to know your class in order to be able to do that 'cos I think
> it's a work in progress. [Akhila, transcript]

> They learn so much better when they're working in groups … [they are] constantly talking
> about stuff and you can't do that when there's only one teacher … that is genuinely what I
> believe … think of Vygotsky … it's very hard to do stuff in silence. [Philippa, transcript]

> Even if they're working in twos I will generally try to force it so they're working with mini
> whiteboards or something like that. They're never really just doing something by themselves.
> [Akhila, transcript]

Adara also believes in getting the students to work in groups particularly thinking that when the students are in all-attainment groups there are more benefits for the students. She thinks one benefit is that students who are currently low attaining can have positive mathematical experiences:

> I had students who disliked maths previously, who were really weak at maths working with
> far more able students, seeing the groupwork and the discussion and these children being
> exposed to other students who enjoyed maths, who were seeing more sophisticated ways of
> working out … these kids were focussed and on task. … this particular kid was totally different
> in mixed "ability" because he was working really well along with these great able
> mathematicians, was giving it his all. [Adara, transcript]

For the inquiry approach of Bob and Sarah to work as it should the students need to ask questions and discuss their ideas with one another and essentially that means for this to happen effectively they need to work in groups.

In this chapter I reported on how the interviewees say they make all-attainment work in the classroom, including on how the external assessment demands affect how the mathematics

teachers interact with the school leadership team. I also examined the underlying rationale for the teachers' approach to teaching and examined the methods the teachers use to implement all-attainment in the classroom.

Chapter 9: Conclusion

Introduction

In this chapter I firstly talk about the purpose of my research. I then briefly represent its findings before moving on to a discussion in which I draw together the findings and present two models of the knowledge and understandings the research has generated. I move on to implications for the practice of teachers intending to implement all-attainment in mathematics. Finally I consider the limitations of the study and my suggestions for further research.

The purpose of my research

I began this thesis by focusing on social justice and mathematics education in schools.

It is the only current in-depth study of mathematics teachers who are committed to all-attainment teaching and as such the findings in this section represent an original contribution to knowledge.

As my research is a small-scale qualitative study in education generalising the findings from the six participants in my research to any potential larger population of mathematics teachers in England engaged in or potentially engaged in all-attainment teaching can, at best, be approximate (Scott and Morrison, 2007). Drawing on the work of Guba and Lincoln (1985) as an example, they write that, rather than generalizability, some qualitative researchers have suggested a notion of transferability as a replacement or alternative. Transferability places the 'burden of proof' on the reader of the research. The role of transferability then is to suggest patterns and characteristics with the intention that they resonate with and are recognised by the reader.

Reay, drawing on Tawney, aptly summarises what I believe the underlying ethos of education should be:

> *In Tawney's terms a socially just educational system is one in which a nation secures educationally for all children 'what a wise parent would desire for his own children'. (Reay, 2012, p 590)*

In my thesis I have argued that a socially just education system should treat all of its students equitably. Focussing particularly on mathematics education I have further argued that the practice of putting children into "ability" groups is unjust; it does not raise the achievement of children across the attainment range; and moreover is detrimental to those children in the middle and lower "ability" groups, the majority of whom are working-class (chapter 3). However, fixed "ability" thinking is all pervasive in English society with most mathematics teachers subscribing to this common-sense thinking. Even at its height when conditions were most favourable, which was probably in the late 70s/early 80s, all-attainment in mathematics in secondary schools in England never achieved more than about twenty per cent of lesson coverage (Ruthven, 1987) and, even then, rarely extended beyond years 7 and 8. So, even at that time, most mathematics teachers were teaching most of their students in "ability" groups. Hence, most mathematics teachers are so immersed in their situation (Gadamer, 1960/2003) that they have no horizon and cannot conceive of a different way of thinking, one in which "ability" is not fixed but variable.

In chapters 2 and 3 I have shown there has always been a tension in the purpose of education between the needs of the state and the needs of individual children, meaning that social justice has never featured highly in the education system in England. Furthermore, I have shown how for the last forty years, since the mid-1970s, neoliberalism, the prevailing political ideology (Ball, 2017, p 2), has been pursued and implemented in education, to a greater or lesser degree by both major political parties (Ball, 2017, p 217). Indeed, since the turn to neoliberalism, education has largely been regarded as a tool to address the needs of the economy (Ball, 2017, p 13) with all that means for social justice: in the main the social policy aspects of education have been jettisoned and the effects of this on the working-class have largely been disregarded despite the Orwellian rhetoric. In addition, regardless of the introduction of widespread comprehensive education, the Conservative obsession with selection continues unabated, with continuing efforts being made on their part to undermine comprehensive education:

> *From Margaret Thatcher, John Major inherited an education system [in 1992] which had suffered a significant decline in investment and a corresponding increase in inequality … [nevertheless] his administration was equally committed to selection and elitism. (Gillard, 2018, np)*

The current divisions and inequalities in the structure of the schooling system are testament to the effects of these historical ambitions and the neoliberal thinking of both Conservative and New Labour governments. When I started teaching in the mid-1980s, despite the turn to neoliberalism, there were still opportunities for teachers with a different vision of education, one where social justice mattered, to practice what they believed in. In inner London, for example, where I worked, all attainment teaching was the norm in most mathematics departments. Notwithstanding this, strikingly, during the thirty-five years I have been involved in education, both as a teacher and a teacher educator, there has been a marked decline in all-attainment mathematics teaching to a point where it is very hard to find a secondary school mathematics department not putting their students into "ability" groups; and it is virtually non-existent in South Yorkshire, the area of the country where I have lived for the last thirty years.

According to Goodson (2012), as previously noted, neoliberal policies mean many teachers have been reduced from professionals exercising autonomy and making meaningful curriculum decisions into technicians merely following and implementing government policy. Despite this it is still possible for teachers with a different vision of education, one where social justice matters, to reject the role of technician and to exercise their agency to find opportunities and spaces to practice what they believe in.

Indeed, the beliefs and practices of teachers may be key to improving the outcomes for working-class students. However, they need training in order to teach all-attainment classes effectively as a huge contradiction exists between educational research on "ability" grouping and the practice of mathematics teachers. Despite the vast bulk of academic research on "ability" grouping showing that heterogeneous groups are better for all (or, just possibly in the case of the highest attainers, where some research shows "ability" grouping may have similar outcomes to heterogeneous grouping), most teachers continue putting students into "ability" groups. Despite the blatant contradiction this 'spiral of silence' (Noelle-Neumann, 1974) is a continuing feature of mathematics education. It is this contradiction which led me to researching all-attainment teaching in mathematics: I wanted to know more about this phenomenon. Most of the currently available research addressed the failure of the transfer of the above findings to teachers' thinking and practice (Ball, 1981; Oakes, 2005; Marks, 2013; Francis et al., 2017a; Archer et al., 2018). I was aware of the few studies that

focussed on a context in which teachers had attempted successfully to address all-attainment teaching (Boaler, 1997, 2006; Staples, 2008). But still, very little was known about those teachers and contexts where there is both a commitment to and enactment of all-attainment teaching in mathematics education.

Thus, in order to understand better who these teachers are and what sustains them in teaching against the grain (Cochran-Smith, 1991), this research set out to explore the experiences of mathematics teachers who practice all-attainment mathematics. In it I have attempted to find an answer to the research question:

How is it possible to introduce, maintain and extend all attainment teaching in mathematics in English secondary schools in the current education environment?

      a. Who are the teachers who achieve this and what sustains them?

      b. How do they introduce, develop and maintain all attainment while convincing others?

      c. How do they make all attainment work in the classroom?

A small-scale qualitative study, this research highlights the factors driving this particular group of teachers going against the grain and organising their students into all-attainment groups. I hope awareness of such may help other teachers who share the concerns about "ability" grouping in secondary mathematics education to do likewise.

Key findings

In this section I briefly summarise the key findings (chapters 6, 7 and 8) of the research.

The three key categories into which my findings were analysed are:

- what sustains these teachers;
- how do they introduce, develop and maintain all-attainment while convincing others; and
- how do they make all-attainment work in the classroom?

The first theme (Figure 9) is the means by which the participating teachers are sustained in going against the grain, and how they resist the common-sense fixed "ability" approaches which operate in most mathematics departments in England. The second and third themes

(Figures 10, 11) build on existing studies (for example, Archer et al., 2017; Boaler, 2006), expanding and enriching what is already known.

What sustains the teachers			
Their relationship to mathematics	**Mathematics and the students**	**The role of (initial) teacher education**	**Interest in research and/or curriculum development**
• committed to developing their own subject knowledge; • have unusually good subject knowledge (supports the constructionist style of teaching required for all-attainment teaching); • are aware that subject knowledge matters; • work together on mathematics and fostering an appropriate subject knowledge culture in their departments	• convinced that the most important issue in teaching and learning of mathematics is a love of mathematics; • want all of their students to develop this; • convinced that all students are capable of learning and doing mathematics and give access to all curriculum as a fundamental human right; • believe putting students into "ability" groups damages the relationship between teacher and taught and between student and mathematics; • intend to enable all of the students to think mathematically unleashing the mathematician within them	• boosted interest and involvement in all-attainment; • suggested a different way of learning is possible; • had a long term impact on thinking and practice	• interested in improving pedagogical knowledge and classroom practice; • participate in research and/or curriculum development to inform practice; • engaged in higher degrees and/or small action research projects; • collaborate with colleagues to devise interesting curriculum materials

Figure 9 Summary of findings (i)

Introducing, developing and maintaining all-attainment		
Need for support	**Convincing others**	**Working differently**
• very difficult for a single teacher to sustain - support needed from at least one other colleague and longer-term participation of more; • support of headteacher and some members of the senior leadership team needed; • headteacher needs staff support; • support for staff teacher learning required; • the final control of the curriculum area needs to be with the teachers; • regular supply of committed teachers who share philosophy needed to replace teachers who leave - involvement with ITE frequently a good source.	• imposing all-attainment on teachers is insufficient to guarantee they will take the ethos of all-attainment on board; • all-attainment impacts positively on the engagement of students - all students can feel capable of doing mathematics; • other teachers, seeing all-attainment working, are sometimes convinced enough to want to embrace all-attainment also; • getting all-attainment started successfully is a sufficient catalyst to begin to change other teachers' attitudes; • the needs of parents, often middle-class, of currently high attaining students need to be taken into account	• belief that all students need to be challenged in their mathematical thinking not simply the higher attainers; • all students need the opportunity to develop conceptual understanding facilitated through interactions with their peers and teachers; • use creativity and original thinking to develop materials and new and collaborative approaches to the curriculum that work in the all-attainment classroom; • requires teachers to be willing to work collaboratively with other teachers with aim of creating a cohesive team developing a common ethos

Figure 10 Summary of findings (ii)

Making all-attainment work in the classroom (a)		
Assessment	**Approach to teaching**	**Becoming critical**
• putting the students first - assessment seen as a tool to help the students make progress, not as an end in itself; • teachers assess their students mathematically through making use of learning journals; • getting part way to a solution is fine in an all-attainment classroom	• rejection of the prevailing hierarchical view of mathematics • have high expectations of all students; • doing mathematics, not rule following but about doing real mathematics and grappling with sometimes difficult mathematical ideas; • students should be dealing with questions that are mathematically interesting requiring them to think in such a way that they are develop their mathematical reasoning; • students have a say in directing the mathematics lessons; • students allowed to take their interests further if they get interested in something	• fundamental belief in social justice; • important that the students develop as critical thinkers and become agentic - believe that this will help them not only in mathematics, but also in the wider world; • students need to become independent, interdependent learners who take increasing responsibility for their own learning through discussion, exploration and argument with their peers and their teachers; • long-term perspective with all-attainment as the vehicle that facilitates these beliefs

Figure 11 Summary of findings (iii)

Making all-attainment work in the classroom (b)	
Working together	**The role of the teacher**
- necessitates radically different approach to teaching - dialogue, exploration, investigation, enquiry and discovery play a large part; - thinking and reasoning central - students working together in groups, designing tasks that facilitate this; - create time at the start of year 7 to train students how best to learn effectively including working well in groups; - good habits in groups including dialogic talk, questioning and communication skills, taking the initiative; becoming more independent; directing own and group's learning; and learning how to reason together; - group work helps low attainers to have positive mathematical experiences and hence group work should be the norm; - all students participate in discussions about the mathematics that takes place - each contribution is regarded as equally valuable	- need for a radical change in classroom culture; - teacher is not always seen as the fount of all knowledge but an important resource in the classroom which needs to be used appropriately; - teachers introduce (mainly open) tasks but the direction the task takes is determined in cooperation with the groups of learners; - during the course of tasks there is frequently minimal input from the teacher with students discussing, collaborating and combining their observations. - students given time to learn, to take new ideas on board and to deepen their understanding - less teacher talk at the start of lessons

Figure 11 Summary of findings (iii)

Transformative pedagogy

When I first embarked on my research in secondary mathematics I was focussed primarily on the social justice aspects of all-attainment teaching. Previously on qualifying as a teacher, as a result of a commitment to social justice, I chose to teach in a mathematics department where the children were in all-attainment groups as I had learnt during my PGCE that this way of organising classes led to better outcomes for all students and working-class students in particular. At the time I began my research I had been working in teacher education for several years in a mathematics education department which had a strong commitment to social justice and which reflected my outlook. As teacher educators as part of our pedagogy we tried to get our students to engage in thinking about organising classes in "ability" groups and the implications this had for school students.

As a result my research primarily focussed on the social justice aspects of organising classes in all-attainment groups in mathematics. My findings confirmed the importance attached to social justice by my participant teachers. However, many of the key findings also indicated that, as a result of introducing all-attainment teaching, the students' experience was of a transformative pedagogy. This was something I had not anticipated when I began my research and that at that stage was not something for which I was looking.

I decided to examine all the findings from Figures 9, 10 and 11 in detail to determine which linked to transformative pedagogy; but this led me to an overall list of over thirty which collectively contributed to it. Hence it was not possible to isolate key findings in terms of a transformative pedagogy; rather almost all the elements made an important contribution to the overall pedagogy and experience of the students. This transformative pedagogy suggested a learning model (The all-attainment mathematics learning tetrahedron, p 145) that would help them to develop their critical thinking capacity and lead to greater agency and improved life chances for them.

Discussion

In this section I first discuss the teachers' situation and I introduce a model (Figure 12) I have developed to explain and make this clearer. I follow this up with a discussion of

their beliefs and practices for which I have developed a further model (Figure 13) which is contained within the first model.

The teachers' situation

In Figure 12, I have represented how the participating teachers see and understand the framework within which they operate as secondary mathematics teachers in England. Not for them, the limitations on their students imposed by the hegemonic common-sense of fixed "ability" thinking (Archer et al., 2017). Critically engaging and questioning the world, they do not have the restricted vision of those mathematics teachers without an horizon (Gadamer, 1960/1975); instead they can see the possibilities for all the students they teach offered by a vision of learning without limits (Hart, 2004); they celebrate the worth of all their students.

Despite being in a situation where fixed "ability" thinking dominates, because they see the horizon to this thinking, they can see the opportunities beyond it. In doing so they are open to thinking about the possibilities from historical and current day perspectives. They are able to consider possibilities that have arisen in the recent past in England; for example, in the late seventies/early eighties when all-attainment existed in around a fifth of secondary mathematics lessons (Ruthven, 1987). They can examine the practices in other curriculum areas in schools in England where all-attainment still exists today to a much greater extent than in mathematics (Archer et al., 2017). They can look for schools where all-attainment in mathematics is still practised – there are still a few. They can look at other countries and see that all-attainment may not just be a practice but a legal requirement (Gates and Noyes, 2013, p 43); for example, it is illegal to put students into "ability" groups in Sweden due to issues of equity (Boaler, 2005). These teachers question the status quo, knowing that there are alternatives that serve all students better; they imagine what could be and attempt to enact it in their teaching, so things are better for all of their students, not just a select few.
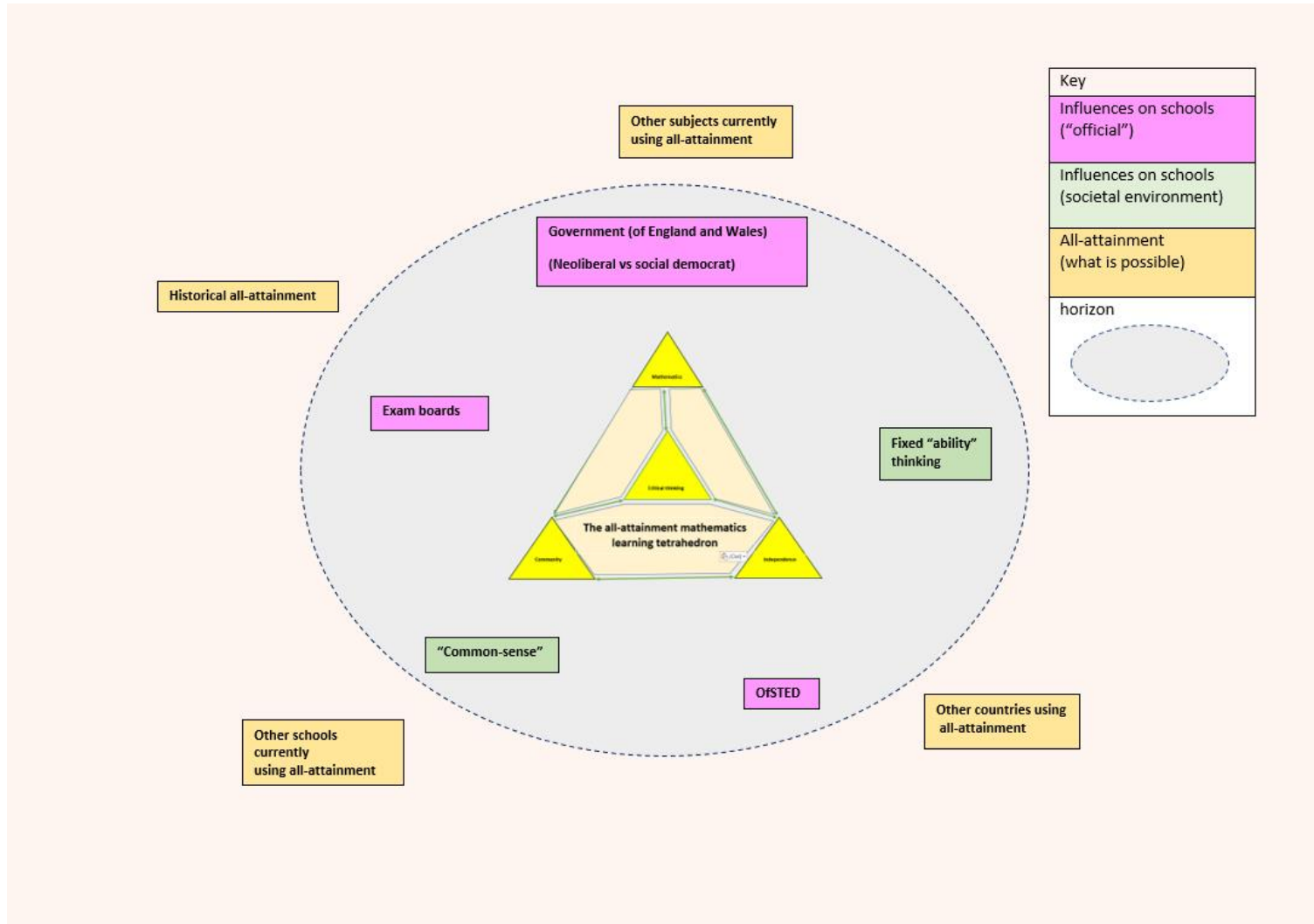
Figure 12 The teachers, the situation and beyond the horizon

These teachers are subjected to the same neoliberal educational pressures as the rest of their colleagues in the teaching profession (chapter 2). As Mattei and Salour point out, 'neoliberal rhetoric always disguises the coercion' (2019, n.p.). In the case of teaching in schools in England the coercion is enforced by the neutral sounding terms of "choice" and "accountability", policed by OfSTED, the "at arm's length" government inspection service, through their monitoring of schools, and, in particular, schools' examination results (Perryman, J., Maguire, M., Braun, A., and Ball, S. 2018). Indeed, the participant teachers are subject to even greater monitoring because of their espousal of all-attainment teaching: they have to be alert to potential attacks on their practice and be ready to respond or indeed anticipate these attacks, defending their practices, as necessary, with research evidence. The participant teachers know that, provided they are successful in enacting their beliefs and, in doing so, help their students to achieve in terms of examination results, they are secure in most situations. However, there are headteachers who are ideologically opposed to all-attainment and determined to replace it with "ability" grouping. In this situation, their critical thinking and the fact that they are both knowledgeable about and attach value to research findings allow them to recognise nothing they do will make a difference to the outcome. In these circumstances they know that this necessitates moving to a different school.

I envisage the teachers' situation, the core of this model, is represented by the all-attainment mathematics learning tetrahedron. The four vertices of the tetrahedron, the three cornerstones and the apex, illustrate the dynamic tensions linking the ways the teachers work with their students, the ways the students work with their peers, the context within which this is made possible and the goals and ambitions the teachers have for themselves and their students.

The teachers, their intentions and what they do
Although an objective of the participating teachers is to enable all of their students to achieve at GCSE level, for most of the teachers, although this is extremely important, it is ultimately a secondary objective – the primary objective of these teachers is to enable all of their students to become agentic, as they are agentic, to be autonomous and independent, so that their life chances are not limited by their schooling (Boaler, 2005). The three cornerstones at the base of the tetrahedron: mathematics,
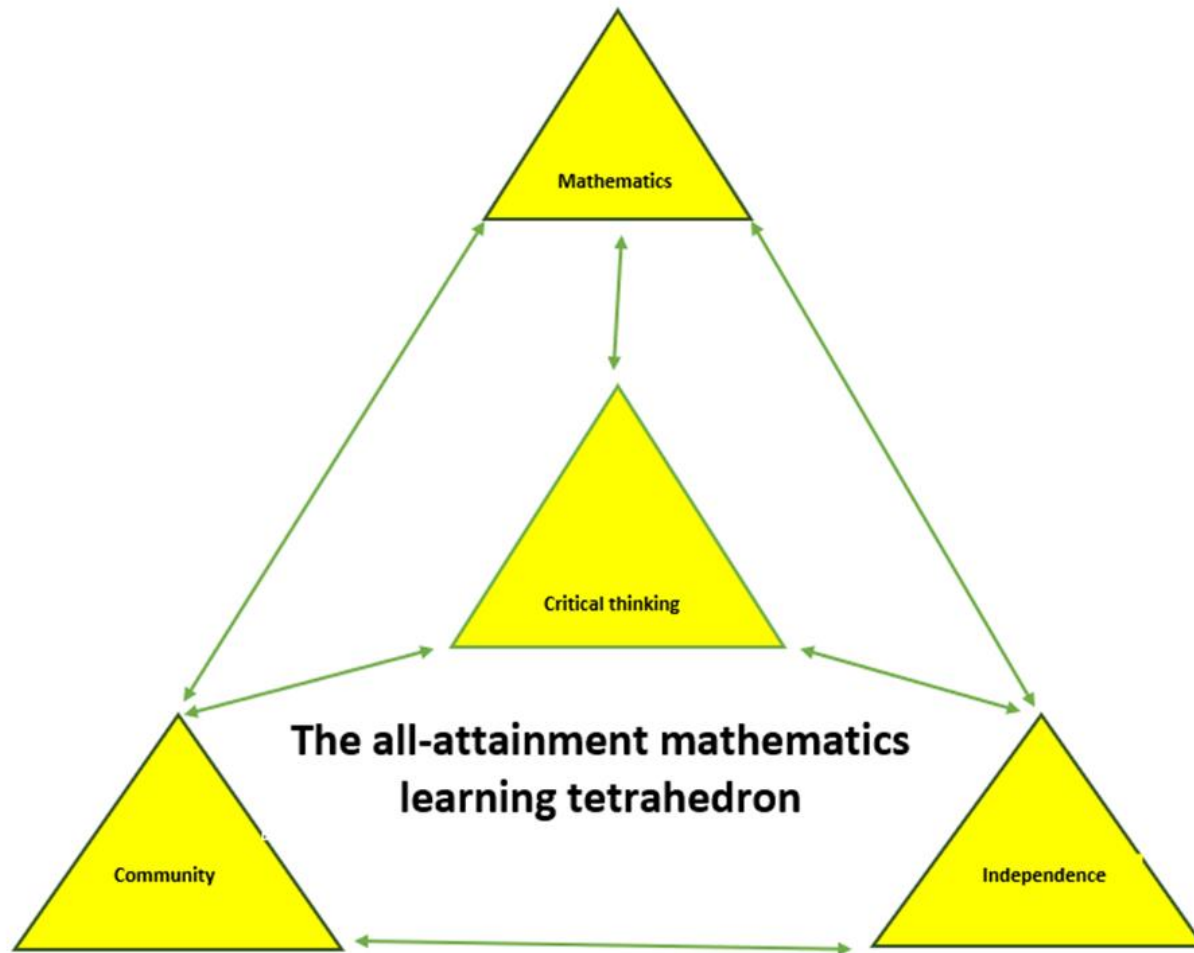
Figure 13 The all-attainment mathematics learning tetrahedron

community and independence are focussed on supporting the development of critical thinking in their students, the apex of the tetrahedron. These three cornerstones need to be laid down in stages in order to build up sufficient support for critical thinking in the students, the apex of the tetrahedron.

Cornerstone one: mathematics

Remarkably, perhaps, most of the teachers, at one or more times in their lives have had experiences, and frequently also met someone, usually a teacher or lecturer, though not always at the same time, which, taken together for them, have transformed their engagement with mathematics and its place in the world. These transformational experiences have convinced the participating teachers that all students can succeed at mathematics and that fairness (Rawls, 1999) dictates organising students in all-attainment groups. For these teachers, the teaching and learning of mathematics is not only about enabling the students to gain a GCSE qualification in mathematics. They love mathematics and, perhaps as a consequence, have good subject knowledge and most spend some time doing mathematics together.   Most of them would also like all of their students to have the opportunity to learn to love mathematics as they do. These teachers do not see their job in the simple terms of getting the students to jump through mathematical hoops. Rather they have a long-term view of the students, as not merely students doing mathematics but as developing mathematicians. Valuing good subject knowledge, they think strategically in terms of the big mathematical ideas that the students need to be able to grapple with to develop as mathematicians.

Mathematics in their classrooms is not a sterile time-limited "exposition and practice" environment but rather somewhere where there are opportunities to work together to explore, consider and exchange ideas. The mathematics is mediated through exploration, inquiry, questioning, dialogic talk and discovery leading to the development of their capacity for critical thinking

Cornerstone two: community

The teachers have a long-term vision, and hence a long-term plan, for building a community of mathematicians in their schools. The introduction of all-attainment teaching has freed up the students (and the teachers) from the usual winners and losers situation in mathematics where even the select few in the top set(s) may exist in a state of perpetual anxiety caused either by the struggle to remain in the top set or,

rather differently, the desire not to be there (Nardi and Steward, 2003). The students are encouraged to think of themselves as being capable independent thinkers within a community of learners which they can use to help them overcome difficulties and problems they may have in working mathematically, building up the power to overcome such problems.

The teachers strive for a community based on fairness (Rawls, 1999), organised such that the expectation of teacher colleagues is that they are collegial and collaborative as they in turn expect the students to be. The teacher side of the community is supported through active participation in research and/or collaborative curriculum development. Knowing that what they are doing is not in tune with hegemonic common-sense, they share together and discuss research findings to enhance their teaching and to justify it both to internal critics among the existing mathematics teachers and senior leadership team including the headteacher and to external bodies and individuals. Internally this may simply entail a shared awareness of relevant research on all-attainment teaching and its dissemination. On another level, it can mean the joint participation of at least some of the mathematics department in small scale funded research as happened. The teachers realise that another way to strengthen the mathematics community is by working together to develop the curriculum jointly. This as a minimum entails the sharing of curriculum resources but taking it a stage further can mean enabling the teachers to work together cooperatively to produce good mathematical tasks, facilitated sometimes through the teachers teaching the same year group working together. Linked to cornerstone one, during this process, they inevitably engage in working on mathematics together, deepening their knowledge of the subject.

Building a community of mathematicians necessitates that all students should have access to all of the curriculum. To enable the building of this community the teachers induct the students and new teachers into this way of thinking so that they in turn behave in ways that also propagate fairness. The development and articulation of a shared philosophy is understood as important both in the classroom and the department. The learning structures of the community are set up in such a way as to encourage dialogic talk and groupwork through learning mechanisms provided by joint exploration, investigation and inquiry. The emphasis on groupwork is used as a way of

encouraging all students to participate in the discussions and questioning around mathematics. Furthermore, it is also used to encourage the students to develop a questioning persona where they turn to their learning community to develop a conceptual understanding of the mathematics. In building the community of mathematicians, the teachers are not only concerned with developing the collaborative skills of the students, they are also concerned with enabling them to operate independently within the community as autonomous individuals. This links to the third cornerstone: independence.

Cornerstone three: independence
The third cornerstone of the all-attainment mathematics learning tetrahedron is independence. However, this independence is not the atomised vision of the neoliberal individual who effectively operates in a vacuum detached from his/her fellows, competing with them in order to gain advantage; rather it is based on the interdependence required to function as an individual cooperating within a community of the like-minded (Healy, 2019). Both this interdepence and the community of mathematicians described in the second cornerstone are fundamental to the partnership in learning created by these teachers.

As mentioned briefly above it is the desired aim of the teachers for all of the students to learn ways of being independent both from their teachers and their peers while remaining open to and capable of collaborative working with either or both. In other words, the students and teachers become both independent and actively mutually dependent on each other in the classroom; this interdependence is an essential element of the mathematics community the teachers are striving to build. In contrast, the teachers believe that putting students into "ability" groups creates passive dependency for all students, whatever "ability" group they may be assigned to, limiting their agency. They also believe that in order to become fully functioning citizens it is necessary that the students become independent learners able to think critically. The teachers think, at quite a deep level, that it is only by allowing all students access to all of the curriculum and enabling all students to participate fully in the learning of mathematics in the same classrooms that social justice can be fully realised.

The learning and teaching methods the teachers use, which include a mixture of inquiry, investigation and exploration as well as at times more traditional exposition

and practice, encourage the students to engage with and question the mathematics so that they begin to understand that learning (mathematics) is not about following half understood rules but participating in the construction of their own understanding and learning independently helped through their membership of a vibrant mathematics community.

In the discussions engendered through exploration and inquiry the teachers are attempting to instil in all of their students a profound respect for the learning capacity of all students. They are endeavouring to teach the students that all students are worthy of respect, not just an elite few. And that everyone is capable of developing the skills of critical thinking which is the crux of developing a mathematics community comprised of independent but interdependent learners.

The apex cornerstone: critical thinking
Based on the three cornerstones above the teachers are trying to build an interdependent learning community of independent mathematicians. Their aims include changing the world view of their students so that they experience a world of opportunities with improved life chances. Thus, as well as enabling the students' development as mathematicians, one of their aims is to develop the students as critical thinkers, so they can question how things are. In doing so, the students are enabled to become active citizens who can take the power they have available and play their part in formatting the world. They believe that since '*mathematics is formatting our society*' (Skovsmose, 1994, p 43) then everyone must be part of understanding and questioning that formatting. They know that simply enabling their students to succeed mathematically is not enough; unless the students develop their critical thinking capacity, they cannot become fully developed citizens. To fully exercise their rights the students need to be able to critically engage and question the reasons why society and, indeed, schools are the way they are.

The teachers believe that achieving academic success alone is insufficient: helping the students to develop their critical thinking skills within the interdependent community of independent mathematicians ensures the students are educated, not simply being schooled. In developing the critical thinking capacity of all students within the all-attainment mathematical community and by working with others of varying current attainments they think the students will develop the independence and

interdependence necessary to propagate a more just society. In developing their critical thinking skills the teachers believe that their students will be more able to counter the effects of disadvantage so that they can contribute to enacting a more socially just world.

Implications for practice

This research has most implications for those mathematics teachers who are committed to all-attainment teaching and trying to implement it. It also has major implications for headteachers and all parents of children in secondary schools. It also provides opportunities for teacher education lecturers in mathematics education and their students.

In circumstances where a mathematics teacher, or perhaps a group of mathematics teachers, wishes to implement all-attainment teaching, this research suggests the following is helpful if all-attainment is to succeed:

- The teacher who wishes to implement all-attainment should be in a position of some authority in the mathematics department, i.e. he or she should either be the head of department or in charge of a keystage, preferably keystage 3.

- The support of at least one other colleague at an early stage is needed. Although it is possible for a single very energetic teacher to oversee the introduction of all-attainment, it is very difficult and even harder to sustain. In the early stage s/he is going to be in a situation where s/he has to do most of the work, providing the intellectual drive, the scheme of work, lesson plans and the bulk of the resources and so a second teacher to support this work is very helpful.

- The support of the headteacher, tacitly or otherwise, and perhaps other members of the senior leadership team, is likely to be necessary. Even when all-attainment is successful, a headteacher who believes in fixed "ability" thinking can still derail a mathematics department committed to all-attainment. On the other hand, in a situation where a headteacher is committed to all-attainment, a rider needs to be added that it is necessary for the mathematics department to retain control over the organisation of teachers and resources if all-attainment is to work effectively in mathematics.

- An engagement with teacher education establishments is very helpful as this will enable the department to, at the very least, offer placements to teacher education students who are potentially a good source of future all-attainment teachers. This enables the department to give the student direct experience of all-attainment teaching and perhaps have some influence on the student's thinking about mathematics teaching, especially if the student is predisposed to thinking about issues of social justice in mathematics teaching. It may also allow the teachers to have an input into teacher education sessions at the Higher Education establishment.

- The teachers value and enjoy mathematics and have good subject knowledge or a willingness to improve it.

  (A possible explanation for this is that teaching all-attainment demands more of the teacher in terms of subject knowledge as the teacher needs to be able to help the student make the connections that teaching all-attainment demands in order to help the student develop her/his conceptual understanding and make sense of mathematics.)

- A teacher with poor subject knowledge who values and enjoys mathematics can be enabled to develop and improve her/his subject knowledge to become a more effective teacher. Otherwise there is less impetus to do this. Hence the department should prioritise a love of mathematics coupled with good subject knowledge in the recruitment process of new teachers.

- An engagement with research is important. There are many myths about all-attainment teaching which are easily dispelled with a commitment to this. The engagement with research could be in terms of small-scale action research projects and/or the dissemination, throughout the department and school, of research with particular reference to "ability". Knowledge of such research allows teachers to make the case for all-attainment teaching more effectively within the school and the department.

- A commitment to making time available for and actively encouraging the collaborative planning of lessons which includes student teachers and ancillary members of staff is important. This time should be available during school hours. It should also encourage all teachers to develop their pedagogy so that it

includes groupwork, dialogic talk and the development of conceptual understanding as a matter of course. This will necessitate continuing professional development. In particular, existing teachers who most likely have little or no experience of all-attainment teaching and who are willing to improve their teaching skills in order to teach all-attainment effectively need continuing professional development in order to cope with the different pedagogical approach that changing to all-attainment requires.

- The students need to be actively trained in exploratory and inquiry methods, groupwork, dialogic learning as learning in an all-attainment environment requires the students to work in ways they have probably had little or no experience of. Teaching them to keep a learning journal (developed by the mathematics department) in order to aid their learning and to record their progress would also be helpful.

There are implications for headteachers and their senior leadership teams:

- They need to be aware that that the simple external imposition of all-attainment in mathematics on an existing mathematics department will not succeed as the prevailing "common-sense" in secondary school mathematics teachers in England reflects the fixed "ability" thinking prevalent in wider English schooling. If a headteacher wants to introduce all-attainment teaching, in order to succeed he/she may need to appoint new members of staff who are not constrained by the current fixed "ability" thinking.

The research suggests implications for working with parents:

- parents should be encouraged to engage with the mathematics department so that they become educated about the benefits of all-attainment teaching particularly the research that shows that organising students into all-attainment groups benefits all students including the highest attainers.

Although not an implication, initial teacher education establishments engaged with school mathematics departments who organise their teaching in all-attainment groups provide opportunities for students to experience alternative ways of teaching than those they will experience in most schools.

Limitations of study

The study is based on interviews with six teachers from just three schools. In addition, with my first interview I was still finding my feet and I only interviewed one teacher at the school. Had I conducted this interview later in my schedule I might have had the opportunity of interviewing another member of the department (perhaps even the head of department as I was introduced to her during the time I spent at the school), which might have enriched the study.

I limited my research to interviews and so it is based on what the teachers say they do, not necessarily on what they do. However, several of the teachers very generously offered to let me assist them in the classroom which, while not directly contributing to the research, enabled me to gain some knowledge of what it was like to be a student in one of their classrooms.

I did not interview other members of staff including teaching assistants, neither did I talk to students apart from when I was assisting in the classroom. Finally, I did not interact with any parents.

At the time of the research none of the schools had all-attainment at Keystage 4 although Brierley Grove was planning to run a trial the year following my research interviews.

At the time of the research all of the teachers worked in schools where the current headteacher did not believe in all-attainment teaching. In Brierley Grove the previous headteacher had given at least tacit support to all-attainment in mathematics and at Shortvalley the previous headteacher after a non-committal start had given it his active support. However, both had been replaced by headteachers who were unsympathetic to all-attainment teaching.

Suggestions for further research

As noted above, at the time the research was undertaken, all-attainment was limited to Keystage 3 in the three schools in which the teachers interviewed taught. However, since then all-attainment has been extended into year 10 at Brierley Grove and perhaps even into the first term of year 11. I also became aware during my research of at least two schools who were teaching their students in all-attainment groups at Keystage 4.

Researching what, if any, differences there might be at Keystage 4 as compared with Keystage 3 would seem like a worthwhile endeavour.

Brierley Grove is an example of a mathematics department where all-attainment is working well and as such it would be worth researching what the teachers do as opposed as to what they say they do, probably through an ethnographic study where the researcher was embedded in the school either in the role of part-time teacher or teaching assistant.

Much existing research (Ball, 1988, 1989) suggests that pre-service teachers tend to teach as they have been taught and teacher education has little effect on their eventual practice in the classroom when they are qualified. However, this stands in contrast to my findings on all-attainment mathematics teaching as comparatively few pre-service teachers will have been taught mathematics in all-attainment groups. Thus, some higher education teacher educators do seem to influence significantly some of their students in contrast to much of the research literature. This phenomenon would repay further research.

Parents are a potential source of opposition to all-attainment (Lacey, 1970; Francis et al., 2017a, 2017b) although the teachers in this research did not find this to be the case: indeed, at one of the schools the experience was quite the opposite in that parents welcomed all-attainment. Researching the beliefs and attitudes of parents with regard to all-attainment including what happens to these beliefs and attitudes when they are presented with the available research on all-attainment would be worth studying. Another area which might be worth focusing on is how the parents feel about all-attainment when they are informed it is being introduced or when they learn that the school their children are coming to are taught mathematics in all-attainment groups; and also how their feelings developed and changed over time.

The attitudes of headteachers are also quite crucial in the implementation of all-attainment. It might be expected that the views of headteachers reflect the common-sense views of the wider population and indeed that of the majority of teachers. Indeed, from this research this does seem to be the case as most headteachers seemed non-supportive of all-attainment teaching. The behaviour of the headteachers who did not support all-attainment teaching varied quite significantly: some of these

headteachers did not interfere with the organisation of the mathematics department but some did, closing down all-attainment teaching even in one case where it was clearly successful. Of those headteachers who supported all-attainment most did not interfere but one who did took control of the organisation of all-attainment resulting in all-attainment being disrupted in an unhelpful manner. Research in this area could prove helpful.

Finally, I have not looked at teachers who are unsupportive or indeed directly opposed to all-attainment teaching either in schools where all-attainment has been introduced or in the wider secondary school context. Researching those mathematics teachers who work in mathematics departments where all-attainment has been implemented and who are opposed to all-attainment may be instructive as the research literature suggests that teachers opposed to all-attainment are one of the biggest barriers to its successful implementation.

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Appendices

Appendix 1:   Transcript of Pete's interview

INTERVIEW (one to one)

Duration: 147 minutes transcribed

PETE_ part 1: 14.00 to 23.30; 38.27 to 1hr. 22.30; 1.24.07 to 1.44.30

PETE _part 2: 0 to 3.36; 6.22- 10.58; 11.48 - 1.17 [1.17.00]

Transcript submitted: 20 December 2017

KEY:

- Interviewer questions in **Bold,** Interviewee in Regular text.
- Indecipherable text: _____ (timecode)
- Transcriber's best guess: [?word / phrase]

14:00 – 23:30:

Most of the parents and most of the kids can't read or write in that. Now, that's important because – my son's bilingual – if you grow up bilingual, say English and Danish as he's done, he's fully fluent and literate in both languages, that's a big educational advantage. Some people think well you've got kids who are bilingual. We have, but neither them nor their parents are fully literate in their home language. It's a spoken dialect. If you gave them a Bengali newspaper or book, they can't read it, most of them. They certainly can't write it.

Do they know the [?number system]?

Just about. Some of them know little bits, but they're very, very weak on that. I don't know any student who can fluently read even a basic newspaper. So you have to bear in mind that it is bilingual, but it has that peculiar character. It has massive implications for levels of literacy in books and things like that. So we have big problems. I'll give you an example in my Year 7 class, 7N – 26 kids, lots of them very bright, very good at maths, but out of those 26, 14, the majority, their reading – and remember these are 12-year-olds – on their official reading tests and all that, they're coming below 8. So there are issues to do with that, which is that…

But they've been through the British, English, T__ H__ [borough name] onwards.

They have, but when they go home, they're speaking Sylheti. They're not reading or writing Sylheti, it's just a verbal language, so there's lots of complicated issues. I'm sure there are people from a university background to research that, there would be some fascinating things to find out about how that pans out. All I'm telling you is how we see this end of it in school. I don't claim to any expertise as to how all the factors work, but it's a real factor that needs to be borne in mind in terms of the background of the school.

So they come into L__ P__ with a reading age of…

Not all of them, no. But it's not unusual to have a large number of kids whose general level of literacy is below what you might expect.

Does that improve?

Yes, it's got better over the last number of years.

But I meant has it improved as they're in the school longer.

Yes, because there's enormous… that's the point I was making. One of the other features of the school is that over many years it's taken a great pride – certainly with the old head who retired two years ago – in being a very inclusive school, for all students. And putting a big

emphasis on support for the most needy kids – so the kids with special needs, the kids with literacy needs, a very big level of, quite a good support staff to help them access education. I suppose it's that ethos about it. It's a community school, serving this community and there's been a big commitment and therefore we need to do everything that we can to give these kids from this particular background, with all their difficulties, the best possible access to education.

What do you do about that then?

There are various [?withdrawal] catch-up literacy groups right throughout Year 7. Some students will be taken out of the odd lesson for one-to-one support. And over the years it's been very effective. By the time you get to Year 9, 10 and 11, I'm not saying we've closed the gap but you can feel the impact of it. And that's why a lot of people are upset about reducing the number of teaching assistants that's going on at the moment. So that's it in terms of the general character of the school, that's that. The other thing… but it's contradictory, like all of these things… because one feature… it reminds me a lot of where I grew up. One of the features of the Bengali community in particular, like lots of communities where people are in poverty, it's not uncommon – I'm not saying universally – for education to be seen as a way out of that. So where I grew up in a mining community in the north east of England in the 1960s, that was a big ethos – you don't want to work down the pit, kid, qualify from school and get out of this.

Chance would be a fine thing these days.

These days. But that's very strong in the Bengali community.

It was very strong where I came from. I come from Northern Ireland. Get an education and get out.

And get out, yes. And that's very strong in the Bengali community in T__H__. About 60% of the school is like that. So that idea that we're looking at – parents might have come and not be well off, but get qualified and get on – is very very strong. So actually the work ethos… but it's not… there's a gender problem.

Girls work and boys don't?

The girls are much more articulate, aspirational and want to get on and get jobs, than the boys.

I think the problem is with the word 'aspirational'.

Yes OK…

Owen Jones pointed it out in his book *Chavs*. It's sort of used to kick the working classes, you know.

That's a very good book. And I agree with maybe all the arguments in it. But yes you're right, I'm using the language as used in meetings in schools.

Yes I know, I mean, it's what happens. You just get into using their vernacular…

You're right, I shouldn't use that language, but…

I'm not criticising, I'm just…

No, it's good to be… But lots of the Bengali girls… which also makes me mad cross when people stereotype and say things about Bengali girls who wear headscarves and so on. Lots of them are very determined and are supported by their families - the only decent future they will have is if they work hard, get qualified, go to university, and most of them will talk about then getting a job in a bank, a university, a school, a hospital. It tends to be finance or public sector.

Round here…

That's what you see around you. But they do, that's where they see their future. Not at home being oppressed or having kids or anything. They'll get married but they do see themselves as

career-oriented and very determined to get to university. The boys often it's more difficult than that, partly because their role models are their fathers. If you go to your typical Bengali family, the discourse you hear from the kids is that they look up to their mothers, because their mothers work hard and many of them have got jobs, lots of their fathers… the language that boys and girls use about their fathers is often quite disrespectful. Lazy so-and-so. Just goes to work driving a taxi, or a restaurant. Because what happens is their mum goes out to do a job, the kids go to school. The dad is sleeping most of the day, likely unemployed. Often a disproportionate number of Bengali dads [?without jobs] are working in restaurants in the evening. And it's not viewed with any high status. It has an impact more on the boys than on the girls. Obviously, if you investigate it, there might be more… I'm telling you this is what the kids talk about. That's how the kids present. It might well be more complex than that, but certainly most of my sixth form, I've had them since they were in Year 7. They openly talk like that. We've got a good relationship, and they only openly discuss like that to me - boys and girls. A lot of people say the same thing. I'm just trying to paint a picture of some of the kind of things that the kids talk about. That's not a scientific analysis or research. It's just a few titbits of the kind of language you pick up if you spend any time in the school listening to the kids.

That's quite surprising. I don't remember that sort of chat when I was a kid in school. We didn't talk like that about our… because when I was growing up, it was 25% unemployment, so you know it was just… that was it.

It's quite surprising sometimes, the language. They won't necessarily talk about it to everybody, but once they know you as a teacher, they're quite open about it. Lots of them… it's surprisingly common. You hear comments all the time, like yeah well, I'll just get a job in my uncle's restaurant, just like my dad. So with the boys often that's the kind of thing. Or the girls – I want my family to be not like my parents, it's not their fault, mum works hard but dad just works in a restaurant. I want it to be different in future.' There's a lot of that kind of language that goes on. But that's the background of the school.

I want to ask you a bit more about … (*overlapping*)

[?It's the maths we'll talk about.]

Well yes before we get on to the maths, the management of the school. Because I think, you know…

Don't quote me on this. *[Laughs]*

A couple of years ago, you said the head changed. Did the ethos of the school change? Or stay the same?

The old head, C_ D_, was here 19 years.

That's a long time.

He was very well respected and liked. He's quite an influential figure in the Labour Party. He taught Ed Milliband and David Milliband. Not at this school, when he was a young teacher.

38:27 – 1:22:30

The leadership team are in open revolt. All of them are against what he's doing. So we'll see. We'll see what happens. I think what will happen is we'll probably end up pushing it right far back. I don't think that changes… there's a slow but steady drive, like in much of education, if you like to conform to – what's the kind of language that's used – there's different labels that people put on. You're the… the [?Harris] Academy type. The fact that they've put this woman from Ark now as the new OFSTED inspector. But that whole model of education – it's the exam factory, narrow, setting, the only way to do things, exam results are the only thing that matters, there are set ways of doing things…

Well, obviously I'm from Ireland. There are _____ (39:20) that they're not actually saying. They're doing in America, the United States, I mean, huge privatisation…

Charter schools and all that, exactly. Those pressures are here as well. They're probably slightly behind where they are in much of the education system.

Well in our system… they don't make money from direct teaching, but they make money from their ancillary services they provide. People just don't know what's going on.

Ark, for example – so this woman who was a founder of Ark, who has now gone on to become the OFSTED inspector. You go on the AQA website, which is one of the major exam boards, in maths for example, their end of year assessments that they are now putting up there. They're not AQA. They're an Ark commercial product which they've given to AQA. So Ark are commercially going through AQA to get their stuff used in schools. And now the woman who's in charge of that is going to become the head of OFSTED. It's immoral. Anyway.

There's a lot of immorality around in the current government, I'm afraid.

But there's all of that going on. But then within that, obviously you fight about that, or you can walk away, but within that you can also try and fight and defend and create. You can't be passive in that process. To the best of your ability, teach. If you care about kids, care about teaching, you try and create something that… within the limits of what you're able to, as a better model than that. Nobody is under any illusions here that you can overcome all of these big pressures, but nor do I think the answer is that you can't do anything.

Which sort of brings us back to the ethos of the maths department.

The ethos of maths is… personally, when I was training to be a teacher… firstly, I went to a good old-fashioned comprehensive school with mixed attainment teaching.

Did you? Where, in Durham?

In 1970s in Durham. Good old Catholic comprehensive. I remember the Catholic community there was largely the miners. So it was working-class miners, Catholic school. Tony Blair went to the posh private school in the middle of Durham. I went to the Catholic comprehensive on the edge, which was all the mining kids coming in. But it was a proper… our old headteacher was a good old left wing Labour Party man. It was a proper genuine comprehensive in the best view of the… the kind of one that people like [?Clive _____ (41:50) had been writing about. I remember all the way through, until you got to what was then your 4 & 5 – 10 & 11, certainly in English, in Maths - mixed attainment. I enjoyed that experience. I saw kids around me who weren't initially particularly good but I worked with them. Did that hold me back in mathematics? No. Did they benefit from that experience – yes. So my own personal experience was that that was a positive thing. It works. I went through it. So that predisposed me, if you like, to that model of teaching. When I was training, I was at Goldsmiths, with [?Wendy Troy].

Yes I know the name. I don't actually know her, but I know she was an ex _____ (42:43) teacher I think.

She encouraged people to think and read and explore. And the more I read, and the more I went into different schools, and I read various research papers and things like that, the more I became convinced that both philosophically but also in terms of evidence, the evidence that setting was an effective way to teach wasn't high. And that there was at least good evidence philosophically, and also some evidence – you can argue about the evidence, how strong it is – that there couldn't be a better way to do things.

Well the research evidence shows that if you mix everyone up, the middle and lowest attainers do much better. And it doesn't harm the highest attainers. The only research that says it might benefit higher attainers to be set in ability groups, says that you have to give them a different curriculum. A special curriculum for the gifted and talented, and even then the evidence isn't that great.

I'll show you some things. I'll dig them out in a second. A little bit of research here. When I qualified I went to St Paul's way up here.

Yes, I've never been St P___ way at all… [?I had an interview St P___ way] in 1994, when I was looking for a job in London. Mainly because… my story is I worked in, I worked for _____ for a couple of years, then I did a PhD, went to [?Morpeth], spent two years there, went to Haringey, spent two years at ____ School. Then Hilary got the job in Sheffield. So I stayed at home for two or three years while our daughter got up to primary school age. Then, we were living [?in the country] at that time, so I thought actually this isn't great, so we moved up to Sheffield. At that point, I thought I need a job again, because my daughter was at school. So I got a job back in London, because I couldn't get a job in the north! Because at that time, even mathematics teachers couldn't get jobs then – terrible times it was. So I was working in Brent three days a week. Changed times.

At St P___ we used to teach mixed attainment in Key Stage 3, but it wasn't… because what had happened, you used to go in there – and this is my experience as an NQT and then the year after – I thought oh that's interesting, this sounds good, mixed attainment, I'm reasonably convinced now from what I've found out and read about, so it would be good to get a chance to try it. It wasn't. What you had – you were taught in forms. Then within each class, mixed attainment, or mixed ability as they called it at the time. You had kids who were on the red book, kids who were on the blue book, and kids who were on the green book. And what you were told to do was – you teach a lesson, you [?ensure] it's pitched at the middle, and then you assign exercises from the red, green and blue books to each group of kids. And you had the red table, the blue table, the green table.

Like primary school, that's what they do.

Exactly. This is not mixed attainment or mixed ability teaching. This is setting within the form. And it wasn't very great. So I became very dissatisfied with that. I read lots of more, blah blah blah. Then a job came up here. So I thought right. By then it was obvious, if you were a maths teacher, you could get a job. So I thought I'll apply for it, but I'll make it clear where I'm coming from. And more or less say if you want to give me the job, what I'd like to do is use lots of collaborative activity-based learning. Have you come across the Standards Unit?

Yes.

So that type of approach. And I'd like to, at least in Key Stage 3, work towards where pupil talk, pupil collaboration, _____ (47:00), mixed ability or mixed attainment setting was something we worked towards. So if you give me the job, that's what you're getting. I don't want anybody being under any illusions. So C_ D_, to his credit, said fine.

Was A__ the head of department at the time?

A__ was head of department. Was A__ convinced? No. But basically A__'s attitude was if you think that'll work, you do it for Key Stage 3, because that was my responsibility. His responsibility was Key Stage 4, and his attitude was fine, try it, see if it works. Most of the staff weren't convinced at all. Not at all. In fact there was big opposition. So what we started it with was in Year 7, basically I wrote a whole scheme of work. I did all the resources, all the lesson plans.

That must have kept you busy for a while.

A while. My attitude was you can try and convince people and talk to them, but the best way to convince teachers is to say (a) you come and watch what I'm doing, and (b) here are lots of resources and lesson plans you can use – I've saved you a pile of work. Saving teachers work is the best way to get them to do things. It's like, why don't you try this – it's all done. Give it a go. Over time, slowly people started doing that. More and more people thought actually, this seems alright. There were still one or two people not happy about it.

So this was Year 7.

Yes.

And you'd gone over to mixed ability.

Yes.

And some people were ambivalent.

Yes. But by the end of the first year, we had some students who had As and people were coming in and out of classrooms, and what was already obvious was that the ethos was better among the Year 7s – that the kids were starting to enjoy maths, there was less disaffection, and the lessons were getting a bit more interesting. So people suddenly thought – not everybody, but quite a layer of people, suddenly thought maybe this is worth looking at. A__ spent a lot of time looking at it, and then he was convinced. So then we said we'll roll this out to Year 8s, and the kids who have been in Year 7 will continue it into Year 8. We changed things a lot – all the lessons and resources and schemes of work – we refined them massively.

So was it just you doing that? Or were there other people?

No, we got everybody to agree to do it in practice, although probably three or four people were doing it reasonably seriously.

So it driven forward by three or four people. Is that about half the maths teachers?

It was driven forward by me, essentially. And I persuaded three or four other people to go along with it. There was one teacher who's left now, who became quite enthusiastic in the course of the first year. So that was helpful. And we together made lots of different resources. A__ was always really supportive. He always sort of said that's where we're going. And he sat back a little bit and made sure that people couldn't block it. We didn't impose it on anybody. We said look if you want to teach differently… we made the classes mixed ability, but said you don't have to teach it this way with these resources. And some people, to be honest, didn't. _____ (50:17) Some people would say well I've got a mixed attainment class, I'll teach them and have different worksheets for different groups. That did happen. But only in a minority of lessons with a minority of teachers did something else begin to happen. But it was enough, there was enough movement to allow it to go into Year 8. And by the end of two years having been through it, more people began to be more convinced, and then pushed it forward into Year 9. And by then, also, just natural turnover. Some people have left. And very, very deliberately and consciously – we set about recruiting people who shared a particular ethos. So K__ was a key person. And because K__ was at G_ G_ School, as I said before, just down the road, me and her worked together a lot, just because [?I knew her a few different maths teachers].

She told me she worked on the [?proportional] … (51:10)

Yes. It was just in this group of maths teachers. The one I want to find is the booklet for proportional reasoning, because that was the one that me and K__ did which uses Harry Potter to teach proportional reasoning. It's great fun and very good mathematically, I think. And we even got permission off J K Rowling to use it in this school. We're not allowed to use it more widely, but me and K__ had great fun writing that. We spent a year working on it, to use it as a model of how to teach mathematical concepts in a mixed ability or mixed attainment setting. I think we both think it's very good. And we were able to get everybody here and in two other schools to teach it – the whole maths department – and people really loved it, and the kids really liked it, and the mathematical learning was very good. And that went a long way to shift… that one we did get everybody to teach. That unit helped enormously in terms of, oh this is what they're getting at, this is the kind of approach they mean. And you could see the penny start to drop, because it was like, here is a model. To be honest, that took a long time. Me and K_ spent a year, a year and a half, trialling it out, refining it, changing it.

But it sounds like it was well worth doing.

It was. Because obviously you get to the point where to really convince people you need to get a tipping point where people think right, yes, I can see what this means now. The penny has dropped. And I persuaded somebody who was about to retire, I persuaded the head – it was still C_ D_ at that stage – to [?do a good deal] where basically we got K__ to come and work here. There was this person leaving, and that was important, because it meant that… because me and K__ worked really well together, it sort of put that heart in the faculty. And then since then we've had a very deliberate policy of… we're taking lots of PGCE students and the ones that we like, if there's somebody about to leave, or for whatever reason move on, we will look for people we've trained in this approach and give them jobs. We've now got me and K__. M__, who was here as a PGCE student who we trained and has then done a PGCE and is now… she's just taken over in charge of Key Stage 3. She's very very good. We've got F__, a Bengali woman down the far end of the corridor.

Was she wearing trousers?

With a headscarf. There's R__ next door, as well. The younger one. F__ is quite interesting, because I've taught her in Year 11 when I first came here. So she was in my first ever class doing GCSE. And she's now back as a teacher. And bizarrely I was her mentor when she was a PGCE student, so it's a bit strange. And now she's my colleague. But she's great. And then N__ and B__ were here as students last year. They're NQTs this year.

B__ is she the Polish…

The Polish woman.

The Polish woman.

And N__, the one you met this morning over there. So now you've got most of the people in the department – three-quarters of them are now people who are part of the [?CM] philosophy. We all agree broadly about this way of teaching – they've been trained and educated within that sort of framework, so that's now the general philosophy of the department. Other people – so J_'s been here a bit longer, but she's now convinced.

J__?

Yes. Black woman – Caribbean woman.

The one with the afro?

She can be sceptical but she's now quite convinced and likes it. So now I would say we have… nobody wants to go back to setting in Key Stage 3. Not a single person. We said to them, well what do people think? I was quite interested in R_ and J_ who weren't in favour, and now they don't want to go back. So in a sense we've convinced enough people that there's now a settled ethos in the department that in Year 7, 8 and 9, people think… they prefer to keep mixed attainment classes. They feel it works. And they don't want to go back to setting.

Next year, we've agreed we're going to do an experiment. Again, it's just trying it out. We want to keep mixed attainment in Year 10. People are nervous about that because by then you're into the GCSE. So what we've agreed is OK, let's do a bit of an experiment. M__ is doing an MA, so she's agreed with her supervisor at Kings that she's going to look at Year 10 mixed attainment and setting, so we've agreed that in three forms, the one I teach, the one K__ teaches and M___teaches. We're going to keep our forms into Year 10, so we'll keep them as mixed attainment classes. I haven't got a bloody clue yet how we're going to… we haven't got any scheme of work, any resources, we're going to have to plan that before September. That'll be fun. But we'll enjoy that. That will be good. And the other classes, there's going to be to five – will still be set. We're going to look at how that works. And M__ is going to do some research as part of her MA, and try and evaluate what the kids think about it, what the outcomes are. We're not stupid about it. If over the course of the year it becomes obvious it's not working, we'll change it. We'll have to be careful with the management, because come the

end of Year 10, they're going to want some data. My instinct is that what I feel that data will show is that the kids in the mixed attainment class are doing better than the kids in the setted class. But I might be wrong. We're going to try that in year 10 next year. If that works, the other people have agreed that then we'll move over to that. If it doesn't work, we won't do it, we're not going to impose anything on anybody. The point is in the whole school people are happy about trying this experiment. People have said that's fine, we'll go with that. So that's where we are at the moment.

One good thing is that the results – the students who left last year in Year 11 last summer, the GCSE results shot upwards in math. But that was the first year that had gone through mixed attainment from Year 7. Is it true that that change and that change alone is the reason for the increasing results? No, there are lots of other factors – whole-school factors and blah blah blah. It didn't do us any harm that there was a coincidence that the very first cohort to have gone through some kind of mixed attainment teaching 7 to 11, suddenly the results spiked liked that and were 10% above the national average, with 74% Cs and above. And that the number of those students who desperately wanted to… we had to turn people away from A-level maths, because their GCSE… they wanted to do A-level math, but we had to say you can't, your maths isn't good enough to cope with it. And we haven't got the staff to have classes above a certain size. But maths is very popular at A-level. It's the most popular A-level in the school at the moment.

So all that doesn't do us any harm. The kids really…. That's the ethos. If you read that thing I gave you, that's an attempt to sketch out some of the background. What does that mean in practice? It's not just about mixed attainment. One of the big things we have, and I suspect me and K__ drive people nuts on this, is that teaching has to be fundamentally creative. So we're collaborative. We put a lot of emphasis in this department on saying to teachers, don't just take something off the shelf, some pre-packaged thing. Any PGCE student who comes in here and says I found this on the ___ website will get a right earful. [?You're not doing that.] If you want to teach something, don't get a textbook. You're a mathematician. Think. Create something. Do it. We put a lot of emphasis all the way through on nobody planning or doing anything on their own.

OK that's interesting.

All planning is done collaboratively. We have time set aside where people… so next year I'll give you an example. In Year 7, people have two classes. There are six forms, so there'll be three teachers who have two classes each. Everybody who teaches Key Stage 3, 4 and 5 – not everybody will teach Year 7, 8, 9, 10 and 11. You might teach Year 11 and then 9 and 7. You might teach 8, 10 and 12. Try to keep it spread through. But within those teams, we'll say to people right, meet regularly. Obviously there are good resources, there are some units we've made and there are some good resources around, but you... we've agreed collectively after lots of discussions, we have a broad scheme of work, we're not very prescriptive about the detail, but let's create some lessons and units. Put the emphasis not on creating individual resources or lessons, but creating whole units that make mathematical sense, of a journey. And getting teachers… we're working on one at the moment, just to give you an example. Two at the moment. This is the one we're doing with the NQTs. We were looking at the Year 9 scheme of work with all three NQTs and saying one of the things we need to move on, there's lots of 2D geometry, we now need to move beyond…

What year is this?

Year 9. One of the things with our content, by the way, in Key Stage 3, we've thrown out lots of content. We don't look at the national curriculum.

That's interesting.

There's not a copy of the national curriculum anywhere in the faculty. We don't look at anything like that. We start from having a conference to say look we know what they're going to do by the time they get to GCSE. We know that. Let's park that for the moment. We are confident enough in ourselves as mathematicians to think what is it that these kids need to learn – the big mathematical concepts, if they're going to be able to function mathematically and access that when they get there. If you hunt around here you'll be hard pressed to find any official documents, and most of the teachers here wouldn't know what they look like. What you will find is lots of people talking about what are the big mathematical ideas, so Year 7 we put lots of emphasis on securing a feeling for number, a fluency of number, and particularly multiplicative relationships, proportional reasoning, those kinds of things. Algebra, we don't do very… we do a little bit about the general language of mathematics in Year 7. Algebra we don't… so we don't think in terms of levels and progression. There is progression, but for us progression is mathematical. Year 8 we move through a lot of geometry – 2D geometry and lots of algebra, generalising from number into algebra. And then in Year 9 we go a little bit further. I'll show you the stuff. It's quite challenging. This year for example, so in Year 9 we're looking at with the NQT – we're going to create a whole unit which says let's now move out of two dimensions. So obviously things like surface area, volume will come into that. _____ (1:03:20), [?Euler's] formula, investigations that lead to that. And we're going to bring in some decision maths from A-level and we're going to put that in Year 9 deliberately – on graph theory and vertices and things. I don't care, if it's interesting mathematics, it fits. If you want to look at vertices and edges in cubes, there is some maths, you might not normally do it until you graph theory in Year 12. But the maths fits. It's accessible. We've done it with Year 7s – it works.

Yes, I don't dispute that. When I was a teacher, we used to do a load of that sort of stuff and just _____ (1:04:00). But we (Sheffield Hallam) have a couple of mathematics projects we've done which are completely free and online.

Oh right. I didn't know that.

One's called Create Maths with an 8 in it. It's all free to do. It does some of the stuff but it's targeted at Key Stage 3, Year 8.

One of the things I'll always say to people, when we say 'create' things, that doesn't mean re-invent the wheel. It means think mathematically and create things and use all of the resources that are out there.

We have two different ones. One's called Create – it's got an 8, so C R E 8 A T E.

Cre8ate.

There's an 'a' after the 8. So _____ (1:04:49). So that was Cre8ate maths. So we did that between 2007 and 2010. But it's free, it's available, and you can get it from typing in Create Maths into Google. Or you can get it from the national STEM centre or something. From both sides. We also did something - when I say 'we', Hilary was the prime driving force behind it – called Mathematics in Context, which is harder to find because it was part of the Mathematics Careers Project, which was a thing about… slightly after 2011/12. But I'll send you links if you can't…

That would be useful.

The Cre8ate Maths stuff – it lasted three years. It was funded by one of these quangos at the top that the Conservatives abolished. Yorkshire & Humber something or other. It's about 180 hours of mathematics.

I'll look at that.

It's all free to download. And it addresses some of the [?network] (1:06:00) stuff you were talking about – graphs…

I always say to people when I'm planning, look, there's two ways of approaching this. You can use the old national strategy approach or now you can say that's what they have to do to pass their GCSEs.

We never used that approach. Our approach was that – OK, teachers want us to _____ notes about what to do. But that's all they were, notes on what to do. But you can do with it whatever you wanted. Up to you.

It's confidence. One of the things we say to people is look, have confidence. To put it bluntly, what the bloody hell does Michael Gove know about mathematics. Not that everybody writing the national curriculum is an idiot. I know some of them on the advisory committee for mathematics education.

Well [?Ann_____] was one of the people…

Yes some good people involved there.

They were given a pretty clear remit.

One of the things I say to people is don't fetishize it. Start by 'does this make mathematical sense to you'. Do you think, if the kids learn this, it's going to equip them to become better mathematicians and be able to think mathematically? If you do, let's play with that, let's explore it, and let's talk to each other about it and see if it works. And the proof of the pudding is – does this end up with kids being better able to function mathematically across all of the attainment ranges? And obviously as far as upstairs is concerned, and the kids are concerned, does it lead to better outcomes? There's always that accountability. But so far I'd say the evidence we've got in here is that it works, by and large. I'm not saying it's brilliant, but we… I've got them over there. See those Lénárt Spheres. Have you come across them before?

No I haven't.

One of the things we do with Year 9 is we do spherical geometry, which hasn't been in the British school curriculum since about 1940. I went to Hungary on a visit and I saw them being used there, so I bought one. And we've written a whole unit of work now where we get kids in Year 9 doing things like exploring the concept of distance – what's the shortest distance between two points – do it on the plane. Get the kids to say draw two points, draw some lines, which is going to be the shortest? They'll say a straight line. So I'll say get some string, and the string [?is pulled straight]. So you know that on the plane, you're reasonably secure. Right, so now do that on the… they're like plastic spheres. They're very good. _____ (01:08:29). *[Background noise / moving objects etc obscures speech].* It's very good for _____ geography. Compasses in there. And then of course if you do it on a sphere, if you do two points and then you say to the kids, so what's the shortest distance? They all say along here. And it's not. Because then you'll say get your string and I'll stretch it. And they realise it's not along a line of latitude at all, it's a great circle. And what is a great circle, how many points… and you're always going backwards and forwards between what happens on a plane and what happens on a sphere, and the nicest one of course is getting to do it on this way here. _____ drawing triangles. You get them drawing them on a plane, measure them, proving… you can measure it, you can prove it, you can do all sorts of illustrations, more formal proofs. It's always 180. So let's do it on here. You can see the kids have done this. These are Year 9 kids. Measure the angles, and it never adds up to 180. The bigger the triangle, the bigger the angle, so exploring and playing around with ideas like that. Can you draw a triangle with two 90 degree angles. Try it. You can't on a plane, you can on a sphere. In fact you can draw one with three 90 degree angles on a sphere. That's not on the curriculum.

Sounds like good stuff.

What we've found with things like that is that the kids enjoy it, and it's relevant. We live on a sphere. So that's relevant in one sense. But the most interesting thing we've found is by contrasting the geometry on the plane and the geometry on the sphere, you think that's taking them away from really understanding… because people say they [only] need to know the plane geometry for the exam. But actually by doing both simultaneously, their understanding of and retention of the plane geometry we've found is much higher. Because it's more interesting and engaging.

I can believe that.

So the things they need to learn about angles in the triangle they remember them much better because they've done them in this kind of context. All attainment levels of kids – they can mess around, they can draw, they can measure. In a way it's quite open-ended, the questions. So we're doing that with Year 9, we're trying to build that into it. There's another one that's in design – those post-it notes there, we're doing one for Year 7 on _____ (1:11:18) because one of the things that's in the new national curriculum for GCSE is set theory. Back to the future with set notation and set theory. Often what's happening in some local schools, what's happening in Year 10 or 11, we'll introduce that and they'll do their GCSEs. Well that's stupid. Why not bring some of it in Year 7 in terms of exploring these ideas of sets, notation, but also using venn diagrams, helping you apply that. Looking at factors and multiples and highest common factors – well let's do that through that kind of mathematics. So it comes in naturally as part of mathematical learning of kids from Year 7. We get lots of groups of teachers working on developing this. That sounds like hard work, and it is, but what's interesting is that the teachers are much more… they like it. Is that because we've recruited teachers who like that anyway? People feel some ownership, some creativity, and it's all collaborative – nobody does this on their own. It's all teams of twos, threes, sometimes fours working together. And we push that a lot. Because nobody's told, I never tell anybody what to do. I can't remember the last time I told anybody what to do in here. We talk to people, discuss it and say what do you think. People like doing that kind of thing. In particular, people like the fact that it's not isolated. People really like that idea of… partly because the first year K__ was here, me and her modelled that all the time.

Working together?

Yes. After school, we'd sit here. We wouldn't be doing anything on our own. We were marking, we'd be planning, we'd be preparing lessons. And often what will happen is OK we've agreed the broad outline, so we'd do a sequence of say four lessons, and say right OK you go away, put what we've discussed and agreed, and do the resources for the first two and I'll do the second two, and then we'll just hand them over. And people would say things like _____ (1:13:26) what are you teaching tomorrow. I said it's alright K__ has done the resources. I don't need to read through them. We trust each other. We work together. And people can see it reduces your workload then when you get that kind of trust in people. You can agree the broad outlines. Right, we know what we're doing now. You do the work for the first two, the detailed work of all the resources, the smart slides, whatever, and I'll do it for the [other two] so I'm only doing two lessons. But you have to have enough trust and professional collaboration that I know that when you give me your resources, they're ones that I'll be able to use, because I know…

Will you have worked through them at all? Or just discussed them in general terms?

No we will have discussed them in quite a lot of detail.

So it's not a complete surprise as to what's coming next.

No. But over time, what happens is, to be honest… over time you get to a point where you collaborate long enough with people and deeply enough… so Year 10, tomorrow morning, me

and K__ had a discussion, but we've done this so many times. It's revision, let's do it as a relay. We put our classes together and the kids really love it. And we'll team them up, one kid from her class and one kid from my class, in teams all around the class. And there will be 13 questions – revision. And the kids get a question when they bring the answer up to you. If it's right they get question 2. If it's not right they get some verbal feedback and they have to go away. And it's a race around the room. It's fun. It's a jazzed up way of doing some revision basically. But we've done this so many times now, I said let's do a relay, and she had some free time, she's done the relay, I've glanced at it, and it's fine. It took me 10 seconds to look – yes that's fine, that's right. But that comes after a lot of time. You have to build that.

Not overnight.

Some of the other [teachers], B__ and N__ now, you can see they're getting… you can see all round the department, there's more of that where people are working together and developing that kind of trust, where you discuss some things in detail but other things you get a common language and a common approach. It evolves naturally. You can then - over time your workload gets reduced, because it's a team. And you know everybody in the team is playing to the same sort of spirit.

As time's gone on then and you've recruited more people who you think are in sympathy with your ethos, things are becoming easier?

Yes much easier. Much better arguments.

Because I was telling [K_____] (01:16:20) a friend of mine who's a colleague who was working at Sheffield Hallam and went back into school to do the same kind of thing you did – introduce all attainment teaching. It was in a very challenging school actually. She did the same sort of thing as you. Eventually she just got exhausted and had to leave and the whole thing collapsed. That was three or four years…

I've been getting… it's bloody hard work. But getting, building a team…

She had a big advantage because she managed to recruit three NQTs ex-students who she knew would be in sympathy with her. Right from the beginning, she needed maths teachers, but because she was doing so much of the input, I think, and the school was quite challenging, and other things were going on in the school which weren't conducive to learning, you just sort of… she just left in the end. She was there three years. After that, it just really fell apart.

It could happen, but at the moment…

I'm not suggesting that's going to happen here.

To be honest, if I'd been just me, I'm not sure we'd have sustained it.

It was very helpful to have K__ as well.

More than helpful. I think having two people at the heart of it who had that sort of shared philosophy and shared approach and trust. And that's what people have really liked now that A__ has decided he wanted to leave, the fact that we said… and actually we modelled that collaboration by insisting to the school that we're not having this hierarchy any longer. Me and K__ will be joint heads of faculty, and everything is… so now we just share everything with everybody. The head probably doesn't like it, but all the planning and timetabling next year, we put it out to everybody and say let's talk about it. Or the budget – we'll just send it out to everybody in the faculty and say well let's discuss it and agree it. I don't think the head is really keen on that, but actually people in the faculty really like it. Nobody gets told what to do, with me. It doesn't mean you don't have arguments with people. I can be brutal hard about some arguments, but the point is, at the end of the day, if you try and force people to do things, it's not going to work. You have to convince, persuade, show… sometimes that can involve some quite sharp arguments with people, but at the end of the day, there isn't a short-cut. It will

only work if people want to work here, within this ethos and feel that they're a valued part of the team. If they [?don't have that belief] they won't stay.

Has anybody come and gone, while you've been here?

No. Not come *and* gone. Some people have left.

Yes I was just…

Not because they disagreed. Actually, R__, who did leave, she left because she was having children. And she was one of the best people unfortunately – I wish she hadn't left. A__, who didn't agree that much, but he retired. So nobody's left because they disagreed or don't want to work in this environment – nobody. And the people who've come, the younger people who've come and recruited, like it and want to stay. They're all staying next year anyway. And they're happy, by and large, with maths. They're not happy with lots of things that are happening higher up the school, but that's a different discussion. In terms of… for us it's not just mixed attainment teaching, it's mixed attainment teaching as part of a bigger package, which is about what mathematics education should be about, about what teaching should be about. One of the big arguments – it's the same as you've mentioned. Where have I put them… ? I had something to show you. With one of these units, these are the best ones… these are just some units… these are all ones we've made ourselves. What we try to do is develop these – but they're not fixed in stone. These aren't meant to be – here are some lessons, teach them like this. They're meant to be a bit like the Standards Unit – here is a sequence of lessons, use this, change it, modify it how you like, but it's yours, it's the result of our collaborative discussions and working together. And if somebody says well I did this batch, [?who cares]… it's the spirit that's more important. It's not meant to be a recipe that people follow.

But the ones I wanted to show you, because it's interesting… That one there on fractions. It's not particularly great because it's meant to be an attempt to take some inspiration from a visit to Hungary. We did it as a research project for the NCETM on that in 2014 – me and K__ and a few other people. It's not that great, because we had to do to work in schools which setted, because there were a number of schools across Tower Hamlets. So the way it's written there isn't how we actually use it, because we had to do it in a way that some other schools would use it, that still setted. But it _____ (1:21:41). I'll show you – it gives some idea. That's often what we start from – OK, what do we think students need to learn about fractions over the course of their mathematical journey? We start from the mathematics of this, and we go beyond the curriculum. So we have continued fractions in there, which you don't even do at A-level, but we do them in Year 7. Because the kids like playing with them. It's fun. And there's no mathematical reason… where these things are in the curriculum is often quite arbitrary.

I know.

So what other people think… Does everybody do all of that with every class? We don't actually use exactly that. We did some research which the NCETM funded us to do, if I can find it.

1:24:07– 1:44:30

That's the best one. That' the one we used as a model for people, which we do in Year 7 and everybody likes using that one, so that's probably the single thing that changed people's view about mixed attainment teaching – seeing that taught in practice. And it worked really well. They really liked that. Everybody in the department really liked it.

Good.

For that fractions one, we did a little bit of research – and I'm not saying this is the kind of standard of research you would do in university – it's not. Not at all. But NCETM asked us to do it, so we did it. What they've said… and they have a particular model they wanted us to use, and I have great problems with. What they said is give all the kids… they wanted to compare what we do in this school with R__, another school, and they were involved in writing the units. They said we don't… what they said is give all the kids in both schools a pre-test.

It was an RCT thing?

Yes. Me and D__, the head of maths there, marked all of them. Then all teachers in both schools taught it. Some had been involved in writing it, some hadn't. And then a month later gave all of the kids a post-test. Is that the right way to do things? No it's… anyway, we didn't have much choice. That was a condition of getting the funding, so we did it. For what it's worth, this is crude [*shows papers*] – this is all in percentages. L__ P__ pre: this is across the whole of Year 7, there's our box plot. And there's post: what's interesting there, is if you take it crudely, there's your lower quartile, that's progress there. You've made your progress there. Where is the biggest progress? At the top end. Mixed attainment teaching – it's more complicated, but what does this little bit of evidence suggest? That when all the kids regardless of where they are on that attainment spectrum, have made some progress. Is it true that the bright kids were held back? Well actually no, they've made the most progress.

[?That's what Jo Boaler says] (1:26:47)

What's interesting, that's true of every class, all the classes. Every single class without exception - the same pattern. Is there an effect of the teachers who are most committed and helped produce the unit? Yes there is. The classes with the biggest progress are the ones which were taught by the two or three of us who… I wouldn't lie. That makes a difference. But even if classes where teachers had never seen this before, you get the same pattern. If you like at R___, a similar sized school. The head of maths down there was involved in writing the units, so I'd say has our philosophy but hasn't been allowed to do mixed attainment teaching, but was committed to doing this research, _____ (1:27:31) of him in some ways. Their picture is a little bit different, isn't it. The top end has made good progress. Very different movement here, very different movement there. So it's not great evidence, but it's… is the quality of the teaching staff? Very similar. I've been to R___ loads. Some really good teachers. What you could say here is that the top end kids do reasonably well in terms of moving forward in both schools, but where there's setting, the middle and the lower kids – there's not much. Whereas here, the middle and the lower kids are doing much better. I'm not claiming this is any great piece of research but it certainly helped convince people here.

Did you write that up for the NCETM?

Yes it's on the NCETM website.

With your name on it?

Yes.

OK [?I'll find it.]

And all that's the detail and that's the… it's not fantastic, it's one unit, it's taught to one little bit of Year 7 kids in two schools – more than two schools actually, but the data we've got was from two schools, from Tower Hamlets. What does it prove? Not a lot. But the effect it had, coupled with this one in particular, was to convince people in here that… because the fear that was always expressed was if you do mixed attainment teaching, it'll be OK for the weaker and middle kids but you'll hold the top kids back.

But that's not what the research shows.

And it won't work. But people needed to be convinced. And how can you do it? How can you have lessons that will engage all kids? So what this did, when people… we brought it in and me and K__ modelled it, and people were convinced – ah, that's what it can look like. You *can* have lessons which engage all kids where there's kids of different attainments working together and they all bring different things to the tasks of whatever you're working on, and they may be working at all sorts of different mathematical levels, but they can all learn from that, and it can all make them feel that they're capable of learning mathematics, and the buy-in becomes very high. And once people had some physical, real examples in front of them to say yes it can work, that, we didn't quite tell people how much work and detail went into making sure that was going to work, because a vast amount went into that, but once you get people buying in that it's possible, then it's like a snowball effect. People are willing to give it a try and then are willing to work a little bit to make it work. And then the fear that people always had about it holding back the brightest – this was really important in saying well look where we are, two different schools, what's that little bit of evidence. And people were shocked when they saw it. I'd say about half the department at that time were convinced this would show the opposite. And D_ from R__ came and presented it. I got him to present it here. He said that's what the evidence shows. And lots of people went – bloody hell. So those two things together if you like shifted people to the point where OK this is how we want to do things now. It's more scientific or solid than that, but it was useful.

Would you have a copy of that?

You can take this one if you want. Or I can email it electronically if you prefer.

I'm happy to have that.

Take that one. I've got loads of electronic ones. The detail of that is…

It's OK. It just gives me an indication.

… of how many kids were involved and I've got all of that.

If you had that, that would be helpful as well.

I don't like that very much because I didn't like the test.

What time do you need to be away… ?

We'll get chucked out at quarter to, so we've got about 10, 15 more minutes.

Right. I haven't actually got beyond Question 1 yet. Perhaps we could continue this discussion when I come back?

Yes we could, if there's anything more…

You've covered some of this stuff I think. My next question would have been 'what's a good mathematics lesson?'. What do you consider to be a good mathematics lesson?

God that's a hard question.

Or could you describe one?

I could describe one. What do I hate, by contrast. If I walk into a mathematics lesson – not as a one-off because live in the real world. Are there any times where any teacher – period 5 on a wet Thursday afternoon isn't going to say, here are the exercises, get on with them. Of course. You live in the real world. You can't have brilliant lessons all the time. You're human, overworked etc, and sometimes people fall back on all sorts of things and I think you have to be quite tolerant of that. But is that what you aspire to as the best? No. So when I walk into a lesson and I see kids sitting on their own, in rows, not talking to each other, just heads down and doing individual work, and that's the diet, that's not a good mathematics lesson, as far as I'm concerned. There's a place for practice and consolidation. For me, that's not the classroom. They can do that somewhere else. The classroom should be a place where students are

engaging their brains in grappling with mathematical ideas and concepts in one way or another way, and fundamentally that means *doing* something.

Doing something, OK.

Actively. The doing might be me and you sitting here talking and working on a problem. It doesn't necessarily… tangibles help, obviously [this is not help], there's all sorts of other tangible resources. They're often helpful, but you don't need them, you can have a piece of sh___ paper, you can have some cards, you can have a piece of paper that you're jointly working on. But fundamentally, a good mathematics lesson for me is one where I'm talking with someone else.

Dialogically then.

Dialogic, pupil-to-pupil talk. Whatever label you want to put on it. I want one where the majority of students are engaged in that process at least for significant parts of the lesson.

So it's a lesson with people talking.

Yes. Most of the time. Less teacher talk. Lots of pupil talk. And engaging in grappling with something mathematical. That can be all sorts of things. What it is, doesn't matter, but they're doing mathematics. They're doing some mathematics. It might be they're exploring something, investigating something. It might be that they've already learnt something and they're trying to apply it to a new problem. It might be… there's 101 different things it can be, provided… I can't see a good mathematics lesson… maybe there is the rare one, but the general one for me has to involve dialogue of pupils and them doing some actual mathematics in the course of the lesson, and the teacher shouldn't talk too much.

What would too much be?

I'll tell you… this is a silly story, but it's true. K__ wet herself over this one. The last OFSTED visit we had here…

When was that?

Three years ago.

Three years ago.

There were some issues in the school. The maths got very nice… they said nice things about maths in the report. And the head _____ (01:35:44) we had rows, because him and the chief inspector decided to visit my A-level lesson.

Sorry, what?

Him and the chief OFSTED inspector decided to come to my A-level mathematics lesson. So I thought, sod this, I like taking risks. So I got some details and put them all together. Eight or nine kids. We'd done in the previous lesson some stuff about forces. I drew some diagrams on the table with special pens you can write on the table with. We use them all the time. And the kids don't do graffiti with them, and they wipe them off with baby wipes. It's all very nice. It's good for doing graphs and things. And I threw them some problems – can you draw me some force diagrams on the table and then convince each other about the best method. And literally the head popped in and I went and sat over there, just listened the whole lesson, I didn't say a word. And the last five minutes of the lesson I came over and said I seem _____ (1:36:44) asked you what you said about that. The whole lesson, the kids were stood up on their feet, drawing, talking, discussing, arguing and I think I said three sentences in the entire lesson. I don't think the head knew what to make of it, it was outside his comfort zone. Fortunately, the woman from the OFSTED inspectors loved it. Couldn't stop talking about it for the rest of the day. And was gushing about it to the head. And she wrote it on the front page of the OFSTED report as an example of a good thing she'd seen. So that's quite nice, because the head has now left us alone for the three years. It's a silly

story on one level, but in a sense… did I do very much? No, I facilitated. I'd set up a situation and had enough confidence in the kids and there was enough mathematics inherent… I would have intervened if necessary, but I intervene very little - minimal. But that for me that was the best thing – they were doing the learning. I was…

There you go. Obviously, they must be used to that.

Yes.

Otherwise that doesn't work. Just to say just get on with it then.

No, those kids – a lot of them I'd taught since Year 7.

So that would have been clear to the… to any perceptive…

Yes. The kids were completely used to it. [?They were unfazed by it.] For them the idea that they were responsible for the mathematical discussion was completely natural to them. You couldn't do that artificially. It was completely obvious, this was the normal experience of the kids, they expected to come into a classroom, be posed some mathematical questions, which you have to carefully construct, but then the main responsibility was then on them to discuss and argue and explore those. I was there at the appropriate point, if needed, to guide and help. But the main responsibility was them. I'd set the situation up for them and now it was their responsibility to do the mathematical thinking, with me there as a sort of nudge guy to probe as necessary. But for me that's a good lesson. Because you can't get that overnight thought. It takes a lot. But even in Year 7… for me I'd say… [*brings out documents*] this for me is a very good lesson and everybody in the department quite likes it now. Because all you do – and it depends on how much role play you want to do. Some of us do this. We set up crime tape across the doors and gets the kids out, I put the lights out, scatter some books and things across the floor, and the kids – these are Year 7s – and say oh there's been a crime. Somebody's broken in. Quick let's tidy up, blah blah blah. Then, the only thing we say… we get some giant hand-prints and stick them on the wall and say there's the only evidence we've got of the culprit. And there's lots of measuring equipment around – rulers, tape measures etc. In groups, you have to create some wanted posters for what the culprit might look like but it has to contain a description. And the mathematical justification. And then we just let them get on with it. And it's great. The weak kids are looking at their hand and they'll go "it's about three times my hand" and then they'll go measure their height, and very simple proportional reasoning. More advanced kids will measure their hands, but they'll decide – shall I measure here, shall I measure here, do I get the same answer if I use different measurements, I'll get decimals, do I need to think about what the multipliers might be. And then some of them, you'll go to them and just ask the question OK, so in a group of four… but that was using *your* hand, what happens if I use *your* hand, or *your* hand? So when they do that, they find they get different answers. So OK what mathematics might you use then to… I don't want four different answers, I want one. So then most of them will start thinking about averages, which kind of average, how would you go about, how reliable is that. So you can have in one lesson all kids working on a task which is… some of them it's just like one, two, three, that idea of when it's three times bigger. Which is a big mathematical idea, that idea of multiplicative not additive, because they've been posed a question. So that hand is so many centimetres bigger than your hand, so your hand is seven, that one is 17… you have to pose the question. The questioning is important. So I'd say well that hand is 17, 10cm longer than yours, so presumably that means the culprit will be 10cm taller than you? So you're thinking of an additive relationship. But even the weakest kids know there's a problem with that. And if you talk to them and question them, usually they'll get it. So if I say the hand is twice as big, would it be 5cm taller? No, it would be double my height. So what might happen when it's three times? So you're beginning to get, even with quite a weak mathematical kid, they're engaging in trying to get a grip on

that idea of multiplicative versus additive. But with kids who are more comfortable operating with a wider range of mathematics, they can be sitting there doing all sorts of calculations, averages, is the median better than the mean. But they're all working together in teams on the same problem. And I love that lesson. You have to have a whole set of questions ready to probe and target at different kids. But that's a good mathematics lesson because all students are engaged in real mathematics, and developing real mathematical ideas in a mixed attainment setting, but in a way that they're all engaged essentially in the same task.

Sounds good. Sounds like they're… Does everybody set it up the same way? Or do people do slightly different things?

Slightly different. That one – mostly people do it the same way now. These ones people do differently. It depends who you are. This is again proportional representation. There's a lot of development… we use… I don't know if you know Harry Potter.

No I don't really. *[laughs]*

There's a magic potion in Harry Pottery films which changes how you look. And you can show them the clip. And the recipe is in the film and in the book. So we give them these clues. There's lots of literacy in this and the kids have to sort out… the clues are mathematical. So they have to work out the correct recipe from the clues. The number of this is half the number of this. It's all magical ingredients. That's quite a… we usually get there in the end, there's the actual recipe. There's a discussion about how we use these. It's all multiplication and things like that. But then you pose the question well OK that's for four people, what if we want it for a different number of people. Some people do ask straight like that, some people do that with all sorts of role play and dressing up. Me and K_ have been known to dress up in green robes and wigs and things like that, and bring _____ in. This is Year 7s.

Oh yes, I understand.

But that's optional. Some people go completely mad on it. Some people just do it straight. It doesn't really matter.

It sounds good. I'm sure the kids…

The kids like it. That's the same thing. There's the original. Which one looks right as an enlargement and which ones don't? Even the weakest kid can sort out which ones are right and which ones are wrong. We've got these laminated. They sort them out. Those are right, and those are wrong. And then the obvious question is why. How do you know? What makes… that looks right, and that looks wrong. That looks wrong, and that one looks… so you have to measure. What is it about the ones that look right that's different.

(PART 2)

0:00 - 03:36

When I was at school, maths has always been my first love. Always.

Where was your school? You said Durham.

A good old-fashioned community comprehensive in Durham, a comprehensive education in the 1970s worked – that was good. And then after that I went to university - Queen Mary's, just up here. Did a degree there. Then I did a PhD in maths there.

Did you!?

And then I had to weigh up about what to do, about whether to go into academia, that was attractive at one level. Or do other options. I wasn't that keen on going into academia, because I know when I was doing the PhD – it didn't come easy to me, in the relative isolation of that work. It was enjoyable, and I enjoyed the maths, but it was a very limited degree of social interaction involved in that.

Yes well you see where I am, we used to have a really vibrant mathematics education centre, but they destroyed it. The institution has destroyed our centre. So…

So even then I was weighing up – that wasn't a road I'd… you know, I'd enjoyed that but it wasn't a road I wanted to go further down, but I wanted to do something else. Teaching had always interested me, partly because my dad's a teacher.

Oh right, where does your dad teach?

Primary teacher. A mining village in Durham.

He must be retired by now?

Yes he's retired now. He became head there, but he was a head in a small school, so he was always in the classroom when he was a head. There were three teachers in school.

I've been to schools where they had three teachers and one of them doesn't teach!

Oh he taught more or less full-time right up until when he retired. So I'd always seen that as something I was interested in. I've always had a high value on education, as you probably know, from where you are at the moment, in the mining communities of Yorkshire and the North East, there was always a very high value put on education, very high value. When I grew up, the most important thing you ever got told by your grandparents was get an education so you don't have to go down the pit. And that was…

There aren't any pits to go down now.

There were then. But there was a high value then put on education. It had always been something that had attracted me. When I was at university, because I was quite good at maths, I used to regularly end up in the run-up to the end of year exams basically running mini-tutorials and seminars for some of my fellow students. I remember the end of Year 3, nobody really understood tensor calculus, which you have to do if you're doing general relativity. I remember having to teach about 15 people and I thought actually I'm quite enjoying this, it's a nice thing to do. I feel good about doing this. According to what they were saying I wasn't too bad at it, either. So I thought that's an option – maths teaching could be, for all those reasons. Then I had a bit of an interregnum however.

But you could have done that at university? You could have taught at university level?

I could have done, but then something else happened – basically, the miners' strike.

06:22 – 10:58

Then 12 years ago, my son was born. And that was then a turning point, when you've got a young kid. Then the idea of roving around… I'd get up one morning, go into the office and phone up my partner and say I won't be home tonight, I'm in Paris, and I'll be back next week some time. Or I'm not coming home tonight, I'm in Liverpool and I'm up there for the next three days. That's hard to do when you've got a kid. I'd been doing that for a number of years anyway. And I missed doing maths. A lot, in fact. So I thought I need to do something… this is a good time in life to weigh things up and decide what to do, so I thought OK, I'd always wanted to do something in maths and teaching, so this is the time to do it. So I did it. I went and got trained.

Where did you do…

Goldsmiths. The PGCE at Goldsmiths, which was very good. Do you know Wendy Troy?

I may have met her some time in the past. I know her name.

Very, very good in my opinion. Funnily enough, she trained A__ who works here as well.

Oh right OK.

And S__ who's left now, but she actually trained the three of us. She's very big on, I suppose, conceptual understanding using history, bringing issues around social justice into the classroom. So she's from that kind of philosophy. So that was fine by me. Then I got a job at St___ up the road. That was alright, for a few years. And then I got a job here. And I love it. I'm very lucky. I'm one of the – not the few people, but one of those lucky people who can honestly say I actually look forward to coming into work every day. I can't remember a day when I didn't enjoy being in work. Even with all the rubbish that's going on at the moment. Honestly, I walk home every day thinking that was enjoyable, I enjoyed that. Probably because I haven't been teaching that long! I'm in my 50s but I've only been teaching eight years, so I haven't had that 20, 30 years of… That helps a little bit, because I came into it relatively late. So it means you don't get that… And also I'm lucky here, because the old head, and even the new head… we get a lot of freedom. Nobody tells me what to do. H__ is the deputy head. She's the line manager for maths, the one you just met. She's fine. She doesn't like the head either, by the way.

Well I gathered that from the conversation.

She's the deputy head. And H__ within reason obviously, and as long as the results are OK, we get through things like OFSTED, which we did fine last week. So as long as everything is fine and we tick all the right boxes as well, they basically leave us alone. So we get an enormous amount of autonomy, if you want to use that kind of language. And as you know, where you've worked, having a high degree of autonomy is something that's…

That's the difference I find between university and schools. I can… there are very few people who can tell me what to do, but there are some people who try. And we just… well, I mean, those of us who are in the union say we don't have to do that, but some of my colleagues have been teachers, they just do as they're told and they never question it. Quite problematic. They just do things because people tell them. No, you don't have to do that.

You may well have picked up that we've got a very strong union group here. So they're very cautious about telling us to do anything. Which is good. Obviously, there's a game you have to play, because at the end of the day, GCSE results, A-level results, OFSTED inspections… but as long as we're meeting those. There's a game you have to play, that's what I was doing when you came in, with all the levels and things. You have to play that game. But as long as we hit all of those things, nobody ever interferes that much in how we do it, so it's relatively… compared to most schools I'd say we have a relatively high degree of autonomy. So that's nice.

11:48 – 1:17:00

As long as our results are OK, the head here wouldn't dare say that. I think he personally agrees with setting. But I know from conversations with him that as long as we meet all the right results, there's not a cat in hell's chance he would dare say that, because… He hinted at it once, a couple of years ago when he first came, and I just said well I wouldn't go down that road with you, then you're going to have to start looking for a whole new set of maths teachers. And as you know they're in short supply in London. So he dropped it ever since then.

The research evidence shows that all attainment teaching is better for the middle and lower attainers and it doesn't do any harm to the higher attainers. So in this country, we're so… there's such a belief in… there are certain people who can only do certain things, you know. So, fixed ability thinking. It's so prevalent.

If you talk to K_ or M_ we very strongly think that where it's done reasonably well, over time it can actually be beneficial for the kids who end up achieving very highly. That's certainly the evidence – the limited evidence - we've got from what we've done here, it's that the so-called

most able students, to use the kind of labels the school puts on them, do very, very well. A_ for instance, we had OFSTED in, and their key focus was challenge and stretch for the most able students. So they were in our Year 10 lessons, they interviewed me and K_ for an hour and a half, looked at everything we did in the Years 7, 8, and 9, and – I'm not supposed to talk about their verdict until they publish it on the website, so don't publish any of this before the next five weeks.

Don't worry. This will take at least six months to get through this.

But let's just say they were more than happy with what they saw, more than happy with what they saw in terms of stretch and challenge for the most able. And what I'm very confident about – for example this year I'll tell you know that I'd be shocked if we didn't get 20% A and A* for GCSE, which if you look at the national figures is significantly above. More schools… at GCSE there's a thing called an AQA level 2 certificate in further maths. It's a bridge between GCSE and A level. It's very good. In most schools what happens is that the only kids who get entered for that are the two or three dead certain A*. So what happens is they get to the end of Year 10, and they're going to get an A* in maths, so then in Year 11 you teach them this. It's the elite top 2 or 3. We've never entered less than 35 students in each of the last couple of years for that. Between 35 and 50 students. So we put the whole chunk of kids, and basically said look it doesn't matter, this will help you and it will then mean it will then prepare you better if you want to go on and think about doing maths post-16, so in terms of stretching the most able, I'd say we had probably more kids in this school get access to the higher level maths, because that's going beyond GCSE, probably than any other school in the country. This year we had 35 who did it.

You've got a PhD in mathematics. K__ has got a mathematics degree, hasn't she?

[?Yes]

M__ has got a mathematics degree.

And B_ has got a maths degree. All of our staff have maths degrees.

All your staff?

Yes apart from A__ who's got an engineering degree.

Well I had an engineering degree. I got a maths degree later on.

It'd be me, K_, M_, B_, N_, F_. They've got all got straight maths degrees.

That's unusual.

That is, yes. But then partly because we put a lot of emphasis on finding and recruiting people who are mathematicians. Quite deliberately.

It makes a big difference.

Find people who are passionate about mathematics. And it's not just something they're doing as a job, but who genuinely and passionately say that is something that makes them tick. And getting a team which, for example quite often… this is an anecdote but it's an illustrative anecdote. One of the things that was most enjoyable last year… Two anecdotes. One was there was a very difficult problem, which we'd found on this _____ website. It involved… it wasn't immediately obvious how to do it, and we had a load of Year 11s, bright Year 11s, who stayed back after school to do some revision for their GCSE, and one of them had found this problem, and me and K__ started looking at it. And without even being aware of it, we started working on it together.

[Interruption by pupils]

And then slowly we suddenly realised there were about 15 Year 11s all standing round, almost like an audience, and were fascinated at this process of two teachers who are mathematicians, grappling about… maybe we should try this strategy and find out, that didn't work, try this…

and a couple of them started joining in… for about two hours. We had to get chucked out of the building. But you know they could see teachers grappling and enjoying doing maths, well that inspired the kids, and that happens… that was a long one, but that happens quite often, the kids can see that their teachers are mathematicians who enjoy doing mathematics. I think it does make a big difference finding… because if you want to communicate to the kids and inspire them about mathematics as something they can be passionate about, and buy into and enjoy and it can be part of life. It's not something you just do to pass an exam.

That's the trouble with [?our] students. They're so exam focused now, you know.

We try not to have that here, and we try to communicate to the students, so that does mean the staff have to embody that, that actually mathematics is more than that. Some of them think we're all crazy.

That's alright.

That's fine. I just think it makes a difference if you can have a staff which – you don't all have to have maths degrees – but they all have to have that feeling about mathematics. It has to be something that burns in them, and that they communicate that, and it's visible and obvious to students. If you talk to our sixth formers… I mean our A-level results were very good this year and were last year as well, and that's one of the reasons, it's because… [?you get into a different world] with the sixth formers. But they see that all the time every day and they really buy in. They become inspired by mathematics. In terms of the mixed attainment, that's really interesting with the case study. J__ who started off, when I first came here, she was in Year 7. It was my first year. She was in set 3. At the beginning of Year 8, she was in set 2. And it was only at the end of Year 8 that she was doing… we got rid of setting but then she moved. For Year 7 that was the year we got rid of setting. It was only when she then moved into a mixed attainment class that she then flowered, she went on to get very high GCSEs, stayed on to do A-level, she's going to get straight As and A*s in maths and further maths. And she's just this week, it looks like she's going to get a place at Oxford. She's just gone for an interview. There's this programme they've got where it's slightly outside the normal UCAS.

So she was a sort of middle achiever and then she…

She certainly was, into Year 7 and 8. She wouldn't have been in the top set. And it was only having mixed attainment at the end of Year 8 and Year 9 that created the conditions which… and of course it's not cause and effect. You can't reduce her success down to that one change. But it's interesting that had she been locked into rigid setting, there is an argument that she would probably never have got the chance to show what she could do. And now she's going to leave here with fantastic grades and go on to become a mathematician of some kind. I do think it makes a difference, the staffing. I wouldn't employ anybody here unless they had convinced me they were passionate about maths. That's my first criteria – convince me that maths is something that you're excited about. We'll find out if you can teach and do all that kind of nonsense and do your tracking and data and blah blah, and if you can't, we'll teach you how to do that, but the one thing I can't teach you is to be passionate about maths.

That's interesting. There's this huge shortage of mathematics teachers.

I know.

We have people who are applying to us who have no mathematics qualifications beyond GCSE. And for our PGCEs, I mean they've got the grades but they think oh well there's a shortage of maths teachers, perhaps I can teach mathematics, and we wouldn't. Formerly, we wouldn't have taken those sort of people on, but I think other universities did… and I don't have anything to do with the PGCE, but we run a subject knowledge enhancement course which used to be really good. It used to be really good. It's not… well, I don't know.

Actually it's not true, you don't have to have a maths degree. N__, you can interview her later on. She did a degree in maths and drama.

Maths and drama.

Which is the interesting combination.

That's a good combination if you want to be a teacher.

She has some fears about teaching top end GCSE and A-level, understandably, but that's something we can support her with over time. But she's absolutely fantastic at Key Stage 3, partly because she brings all that stuff from drama into the classroom, and also now what we're hoping as part of her professional development, there's a drama teacher who used to work here, she's now gone freelance, but absolutely fantastic teacher. So we're working with her and N__ on a project that over the next couple of years. This external drama teacher will come in and work with N__ about how to use drama in the maths classroom, and develop some materials for that.

You might be interested in a project Hilary has been involved with. Have you heard of Complicite? They're a theatre company, based in London I think. But H__ and this guy called Mark Boylan – you may know him, you may not. He's one of my colleagues who works for Sheffield Hallam. They're working with Complicite on exactly that sort of stuff.

Well tell Hilary to send me an email, because we've got that… N__ is very good at that but S__ - I don't quite know what her formal title is. She goes around schools doing drama, mainly in London.

Well they've had a project which was funded – not hugely funded – but maybe £50,000. I don't know the figures. But they've got another bid in for a much larger project with Paul ____ and someone else, which is about £400,000, so …

Well if they're interested tell her to drop us an email.

Yes I will do.

Because this is something that we're… mainly to support N_. One of the things we put a lot of emphasis on here, is also retention. If you put a lot of effort into building a team who are passionate about maths and at least [?an outline of a] shared view of how to teach maths. There's no point doing that, if you don't keep them. So for example when A__ decided to leave and we said me and K__ want to be joint heads of maths, we went to the head as a package. You either get both of us and pay for us, or we both go. And so he paid for it. But someone like N__ we definitely want to keep. She's quite new, but we've given her responsibility… she's doing a masters. Again, we're supporting her in doing that, and her masters is going to be looking at [whether you] can do mixed attainment teaching effectively at Key Stage 4. So we've deliberately set up next year, Year 10 – we're splitting the year group. Half is going to be taught in sets, and half is going to be taught in mixed attainment classes. And she's doing that for her masters – gathering data and doing a proper evaluation. So that's supporting her professional development and getting her masters, but it allows us to experiment in the school. Keeping N__, giving her some responsibility, but giving her those opportunities is important. The same with N__. She's very good. She's an NQT this year. She's really impassioned about drama, so we've given her that opportunity to work with somebody outside and have a chance to develop that in the classroom. That keeps her happy but also we get some benefit in bringing some creativity and imagination into the maths classroom. So we're constantly looking for opportunities. How do you build a team, keep it enthusiastic, happy, creative, and keep some stability, is quite important.

The Complicite stuff now I remember – they're dealing with primary school, but actually, I don't know what the new project might be… I'll find out.

[?Tell her to drop us an email.] (26:40). I know this one that S__ and N__ are doing _____ gave them last week. We've given them our Year 7 scheme of work and now they've gone away to basically think, and at some point just before the summer holidays, me and K__ are going to meet with the two of them and say OK have you got any ideas about what we can do to support you. And the school has agreed to pay S__ to come in and [?within reason, and work in] the school supporting that. I think all of the things are important. It's hard, because… even like B_. B_C_ - it might be worth interviewing him, because he's from Australia, and he's an art teacher.

An art teacher, OK.

But for various reasons he left and went back to Australia, he's very good with the kids. And we trusted him, so we've basically because I_ has been off ill for a long time, and we asked for him to come and work as a maths teacher on long-term cover. Because he's passionate about education and he likes maths. So we've supported him. B_ is not going to teach A-level and he's not going to teach the top set in Year 11. But anything else he's fantastic in. So you don't have to be a maths specialist, but you have to enjoy maths. And B__ does, and he works at it. And he'll sit around and play with maths the same as anybody else. So it doesn't depend on – it's not like you have to have a maths degree, but you have to be somebody that enjoys maths.

Good. I'm sure we've talked about this quite a bit. Because you teach in mixed ability, all attainment, my question is have you ever experienced any additional pressures as a result of this? From anybody?

Yes, because… both from management and from OFSTED and the prevailing culture, the pressure is always that you should set. Allegedly that's better.

That's the common-sense belief in this country.

But we're quite robust about that and challenge people. If you were to argue that, you would have to engage in a heavy debate backed up by evidence. So for example when that report came out where the headline thing was OFSTED and Wilshaw say you should set.

Which one was that?

Oh, Key Stage 3 – The Wasted Years. It was an official OFSTED report about a year and a half ago. Basically saying that in secondary schools, Key Stage 3 and [?first years in maths and English] is wasted, we repeat too much of what's done in primary school. We don't stretch the most able, blah blah blah. But actually, the press release was always 'Wilshaw says you should set'. I remember it, so we didn't wait. We obviously went in… me and K_ spent a ridiculous amount of time reading all these things and reading the educational research. So I went straight to the head, gave him a big fat dossier like that, and said actually that's not what the report says, because if you read the report what it said was that where it's done well, mixed attainment – he called it mixed ability – teaching works well. The problem is most teachers can't do it, therefore you should set.

Yes I remember the report now.

So I said… I gave the head a dossier that gave all the evidence, or a summary of it. Since well if you want to have an argument about this, you'll have an argument. I don't think he's ever read it, he just put it in a drawer.

I remember in about 1996 before Blair got elected for the first time. His mantra was education, education, education. The Labour Party was then saying you [?should] put children in sets. And that's what they said in the early years of their first government. Actually, it tailed off after a long time. After people began, after they began looking at it properly, it just died away.

I remember talking to Jo Boaler and she said she was called in and had a series of meetings with Gordon Brown and people about all this and all the evidence that she used. So they did

start listening a little bit. We get a little bit of pressure, but to be honest not that much, as long as the results are OK.

As long as the results are OK.

It's like being a football manager. You live or die by your results!

Yes. OK _____ (31:22)

That's the problem. The pressures are very mild. And as long as the results are OK, it's fine.

What, are you saying _____ Northern Ireland _____ one-nil to Wales and ____ and Germany, so, for them that's results.

As long as our results are fine, those pressures are not… I mean, the pressures are there, but the trouble is, unfortunately, because of the exam factory thing in schools, it's a bit like football. It's a results business.

You're in a neoliberal climate, I'm afraid.

If you're winning the game, they'll leave you alone. If the results ever start getting problematic, I suspect those pressures would intensify a lot. But that's not where we are here at the moment. The results are fine. Last year the GCSEs were 13% above national average. 74% A* to Cs. 75%, sorry, so it was 63%, so 12% above national average.

That's pretty good.

OFSTED have just come in and are about to say some nice things. And that's [?helped us] with the mixed ability. Have you seen any of the learning journals, or did K__ last time? (32:43)

Somebody did – it may have been you or K__.

It might be worth having a look at some of them in some detail. OFSTED particularly like those.

Did they? Where did that idea come from?

We sort of made it up.

Because we use them at Sheffield Hallam. The same sort of thing – for a couple of our modules we're using learning journals.

[Background noise intensifies from here]

Where they come from… they came from partly that idea that when you get to higher levels of education, you take some responsibility for your journal, when you're doing the PGCE you keep a journal of some kind. It's quite normal at that level of education. We went into a very good school which does mixed attainment at Key Stage 3. Me and A__ and R__ visited a school - _____ College in Cambridge. It's the Silicon Valley school. All the kids there – their parents are either in Cambridge University or working in spin-off industries. So you can imagine the kind of family and social backgrounds. So it gets fantastic results – outstanding gradings and blah bah blah. Not in Key Stage 4, but in Key Stage 3, there's a _____ a little team who are quite good about _____ within Cambridge University about doing mixed attainment teaching. So we heard about this, we asked if we could come for a visit. And they had – it wasn't a learning journal – but they had this distinction between a book where the kids did their rough thinking work, and then the book where they did their neat work. We thought that's interesting. That was one of the reasons… then the discussion was, OK, that all works nicely in this _____ leafy Cambridge. That will never work _____ (34:40) and we wouldn't do it here. So putting all that together and saying how are we going to do it – we just then said let's put some of these ideas together. I could show you the old journals from three years ago and how they've changed. I've got some of them. _____ but it was that idea of giving the kids more responsibility for summarising their own learning. There's literacy involved in that obviously. And we had to fight quite hard with the kids at first about the process. That first year was quite a battle. But over time now the kids just take it for granted. From Year 7

right through to Year 13. That idea that it's your responsibility to do what we call learning notes reasonably regularly. And summarise what it is you think you've learned. Like you do at university. I think that doesn't do any harm, to do that right down to Year 7. And now the kids just take it for granted that that's what you do.

[Interruption in classroom]

So it was an idea that we sort of distilled from lots of sources and then have developed it, but the kids like it and it works quite well, we think.

So it's been going for several years?

This is the third year now, so the current Year 10s were the first Year 7s, so this will be the fourth year. And it's changed and evolved a little bit over the years. But the general idea… you might be doing an activity or you might be doing thinking work on a white board or a rough book. But then somewhere separately is where you do you have some responsibility for summarising your learning… in a serious and sensible way, where you might… [?put down] examples of what it is you need to make sure you [?retain]. Sometimes in the same journal they'll have their assessments as well, which are all formatively marked rather than summatively. They don't get any numbers for those, or grades. That was an issue in the OFSTED… because English mark all their bloody pieces of work with something out of 20 or a grade. And OFSTED inspectors said why don't you do that in maths? We very politely said, reminded them of the research about [?formatives] and _____ (38:04). But that's [?an internal argument] within the school and it sort of defeats the object.

Do you ever mark _____ assessments (38:12).

That's one of the things we tried, one of the things we're trying to do actively in maths. We do it… nobody who starts work here in the maths department will get away with not reading. I would just give them… have you read Jo Boaler's *Elephant in the Classroom?* And if they haven't I give them it and say you need to read that. Not because that's got everything in it, but it's a useful easy way into some of these arguments. Then we regularly throw research papers and things at people. So for example, the government commissioned [a report] on assessment without levels, which came out a few months ago. Everybody in maths has got a copy and read it. Not everybody in leadership, which they should have done. But we regularly throw things at people. Does everybody read them all the time? Probably not. But I'd say half the maths staff read quite a lot. So when there was this big thing about Shanghai, they had these people come over from Shanghai. Me and K__ did a lot of digging research on that, and put a little dossier together with different background articles, research and what happens in schools in China in general and in Shanghai in particular. There was a study that went from Britain supported by the National Centre for Excellence in Teaching in Maths, visiting schools.

Yes we're evaluating that.

So we put all that together in a dossier and I gave it to every math teacher. Have all of them read it? Probably not. But have three or four of them read it? Or dipped into it? So at least a creates a culture where a greater proportion of your staff are engaging with these issues. And having sensible conversations about them. And even if they don't read all of it, the fact that they know that _____ (40:08) people, and have taken the time to read it, that gives them some confidence that you sort of know what you're doing. Whether you do or not is another question. I think it's important under management, all that, as well. So in terms of those pressures. I always give dossiers. The number of dossiers I've given to the head. But again that sends a message that – whether you agree with what we're doing or not, it's not just we've made this up on a whim. People are engaging seriously with research and evidence, so there's a purpose behind this and they're doing it for a well-thought-out set of reasons. If

you don't agree with that, well fine, but come and have a proper argument about it, but you're not going to get away with…

Telling you what to do just because that's what we believe, on the basis of no evidence whatsoever.

That's not going to work, and they know that. And it gives staff confidence as well. All of our staff know that. They know that we will defend quite robustly what we're doing.

Good. Moving on. A slightly different question. A bit broader. What do you believe the purpose of education is?

Oh my god that's a very broad question.

Well, [?I've just been thinking about this] and I was talking to H__ a bit about this and she said perhaps you should be asking people another question – what do you believe education is for? And I thought I'll just try it and see. I know it's a huge question.

I'll say what I think. There's two things to say. What I think education *should* be about, and then an understanding of the contradictory role of education necessarily that we live in at present, and what the means. I think education should be about primarily is enriching and liberating the human personality and spirit.

That's a pretty philosophical answer.

It is, yes. And education should be something which is not seen as something that happens… that you're just the object of, that happens to you, something done to you, when you're in your school years.

That's that the part of _____ model _____ (42:37).

It should be something in which you're an active subject. Obviously when you're very young, there's a limit to how much you can be the active subject in that process, but the older you get, the more you become the active subject of education and that's something that spills over and continues way beyond formal learning, into the rest of your life. And the purpose of formal schooling should be to encourage and develop and stimulate [people] to become the active subject in education for the whole of your life. What's that famous phrase – 'nothing human is alien to me'. I can't remember who said that.

I don't know.

It's a famous quote from somebody. For me, it's getting people to the point where they get to adulthood that they have access to the broad range of human achievement, and want to continue that as part of what makes them human for the rest of their lives. That's my ideal. In fact, I want people to leave… yes appreciate art, literature, music, being physically healthy, but also appreciating science, mathematics as well, and not in a functional way, but this is something that's part of being human, is to be interested in these kinds of things.

I think I may [?intervene that] (44:07) being educated is being able to question the world _____.

That's the second thing I'm going to go on to – and I agree with that. And the more you get people to do that, the less likely they are to then simply to accept things that are handed down from above. They feel an equality. Because they have this richness and ability to [think] if I don't know it yet, I'm open to learning and I want to learn it, and I'm capable of thinking, capable of learning it, and therefore I won't simply have to bow down and accept and question authority or expertise, I can challenge, question. You might tell me something, you might know more [than me] about this but I'm perfectly capable of thinking about that, if necessary going away and learning some more about it, and questioning. So that's what I think education should be about, and wish schools saw their primary purpose as how they facilitate that development in people. That's an idea. Is that the function education performs? – No. It's contradictory, isn't it, because whether we like it or not, formal education plays a structural

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role in the modern, industrial capitalist society. They need people to be able to read, write, use ICT in order to do the jobs that are around. That's a necessary. They have to have formal education. Michael Gove might think that's the only kind of functional education – I don't know, [?Keith Joseph] or somebody like that.

Gove is a funny…

He is funny actually. He's a bad example.

He's got sort of… he's an ideologue but he's got some odd…

He thinks we should know about Pericles and everything as well, so yes he's a bad example. But the people who bang on about the three Rs are all that matter – for them it's that purely functional side of education.

We need more mathematicians. For the country's sake, not for their sake, not for the love of mathematics, but because…

But even some sections of business don't think like that. The CBI for instance – they're quite interesting. They want people who can work in teams, who can think creatively, think outside the box. Even some sections of business understand that if you have a narrow focus in education on the three Rs, to use that label, that's not good enough for the modern world. So in some sections of corporations, business understands that, that they have to have a slightly broader view of education. But all of that is really… even that better version, it's all about a narrow economic vision. You train people to have the skills necessary to do jobs and so on. But if you're working in education, you don't react to that by doing the opposite. It's not that I don't want students to leave school without those skills! Just because I don't agree with that philosophy…

We are where we are…

[?Just because you say that], we'll have the diametric opposite. Of course you have to be part of that process. You can't escape from it. That's the reality of education. And of course I don't really agree with exams. You can't escape from all of those things. It's not possible. But I think it's important within those structures to still find the small spaces to find the opportunity to challenge, fight, and create little… in whatever way you can, to inject into that struggle a different vision of what education should be, while accepting that there are limits to that process because you can't escape from all the other features. But if you don't have a different vision, and you don't struggle, ultimately you'll surrender to their vision.

So you think that's what you're doing here. That's what you're trying to do here.

Trying to.

To build a sort of slightly different ethos…

While recognising the limits. You can't wave a wand and wish away all of the structure and all of the other pressures, the social realities, that's not possible. But what you can do is to struggle and fight to push back a little bit against that, to create little bits of space. And _____ (48:35) getting little bits of success, without overstating them, you can't ever succeed completely. But is it worth it? Yes. I think. Because the alternative is to surrender and sell your soul. And if it helps keep teachers sane, and it does in our department, and if it makes at least some kids leave with a slightly wider, better version of what education could and should be about than they would otherwise do, then it's worth it. The little things. And some of it's in the classroom. One of the things I really love that we do here is the residentials that we take students on, which we blag the money out of the head for, because there's always money for maths and English intervention. That's where the money is. But they're not really about maths and English intervention. They're about trying to model for the students a different vision of what education should be about. And I'll show you some of the quotes from students. Actually

I'll give you that, because it's interesting to read what the students say about it. Because that's really me and K_ and M_ who do those.

Where? Do you take them away for a weekend?

Sometimes three days, sometimes two days. We do it always with the sixth form, and originally got funding from the head for the most able Year 11s. This year we took the whole of Year 11 – on different ones. Different… you have to dress it all up. This is _____ intervention, blah blah. It's a lot of garbage. That's all dressed up. We take them to a youth hostel. Usually members of the public are there as well, so about 40 kids, but we share the hostel with members of the public. They're on holiday. And we use… and it's usually somewhere where there's no mobile phone reception, no TV, nothing. And [?we say to them] we're here to do maths. And you might think kids would think oh my god that's the last thing we want. But when we get there, the first thing we say is this is not school, we're not policemen, the normal rules don't apply. First-name terms. And then we say we're here to help and we want to suggest lots of different activities. It's not just about learning maths. We do lots of maths as well, but we do lots of other things. Loads of cross-curricular stuff. And we give them almost complete freedom. No rules, no bed time, nothing like that. And we give them choice. And you'd think this bunch of kids… and we do lots of… we always say that… the one we usually go to is _____ Hill. So there will be times when we'll say right the next three or four hours, it's your choice, do what you want. If you want to do maths, we're available for that. If you want to revise some other stuff, you can do that. You have to be prepared to be a bit flexible. So some of them are doing French. I'll say right you're starting to speak reasonable French, so the next three hours we're doing to just walk around the countryside and we're going to talk French. Some of you are doing history – there's an Iron Age hill fort, so let's go for a walk there and then we'll talk about it. You have to have teachers who are prepared not to be frightened to delve into other subjects. So they're doing rivers in geography, and there's some lovely meanders there. So we say let's go down and look at that in practice, let's see…

Where is this?

Down in the South Downs. We do lots of cross-curricular things. Then we do… we always do loads of walks. We say right, where can we go this afternoon, we've got lots of choice. You can do this, this, this and this. And then _____ and you can do that mad thing – so you can see the beach down there, that's seven miles away. We can walk there, and then it's seven miles uphill all the way back.

That's quite a long walk – 14 miles.

It's a very long walk. And then we leave the room and say we're coming back in half an hour, tell us what you're going to do. Without exception every time they all vote to do a long walk. We say right you can do it, but you all have to manage it. Because there isn't any other way to get back up here, than you walk the whole lot. And the kids are fantastic. Sometimes we sit up until 3 or 4 in the morning with them. Or all night. One time we were up all night with them. They sit there doing… and some of the social and cultural stuff. Most of the girls – you probably noticed – all the Muslim girls, they all wear headscarves.

Do they all wear headscarves?

I'd say 90% of them, yes. And there a lots of kids here – I've never seen their hair, because that would be seen as… Well, on the residentials, 10 minutes after you get there, suddenly the head scarves start coming off. And that same evening, it's really lovely, you've got kids – black, white, Bengali, boys, girls, all sitting around in their pyjamas, all the girls in their pyjamas with hair out in front of members of staff, just having a nice time, chatting to each other. And it's really interesting. The social mixing. They'll just be normal teenagers. They would never be allowed here to mix with… in the evening, the Bengali girls won't be allowed to mix with boys

outside the family. And they certainly would not be allowed to sit and socialise with white girls or black girls or black boys, and that's really lovely – it's a really nice atmosphere. But we try to use those residentials really to model a different vision of what education could be like.

Sounds great.

And the word the kids always use is freedom. We asked them to give some anonymous feedback. I'll show you some of the feedback. It's really nice. But what's interesting is… and then they all choose to do loads of work. And they get quite enthusiastic about it. I'll put the video on if I can find the video. We do a maths relay – at 10 o'clock at night usually and they get in teams and you come up and you get the first question. And when your team brings the right answer to the first question, then you get the second question. And it's a race. And almost always what happens is members of the public who are staying in the hostel ask if they can join in. But that's good for the kids. They're having to socialise and negotiate how you can have a nice time and do all these kind of things, do maths, do learning, sit up late at night, but they have to do it in an environment where there other members of the public who have never met our kids. That's socially a nice thing to do. And they never disappoint you, the kids, never.

Good.

That's what I think about education. I have a vision of something different but you can't… you have to then fight for that within the current structures, and do as much as you can. And not always succeed. But you do little bits sometimes.

Yes. You do what you can, I suppose. Alright. So you've had your all attainment / mixed ability teaching for how long now?

We started doing it five years ago.

Five years ago.

Five or six years ago. But the initial one was really more getting rid of sets.

Were the children [?aware of how you organised these]?

Yes. But there's been a long process of simply getting rid of sets and putting people in forms, if you like, mixed attainment classes, that's only the start. Then developing how to teach effectively in those classes, that takes a long time. And that's still a work in progress.

OK.

What I'm really saying is that getting rid of sets isn't… is the beginning of a journey about what kind of pedagogy and teaching approaches are effective in mixed attainment classes. And that's a process of… that takes a long time to develop.

So you're still learning.

And there's still massive unevenness in the faculty over that. And there are real challenges in that. I won't [?belittle] the challenges – the challenges are real. Just because we think it's right and some of the evidence suggests it's right, does that mean it's easy? Of course not. Does anybody have all the answers about what works well? No. And it takes a huge amount – to do it well, in my opinion, it requires creating the right kind of tasks for students to work on, which work well in mixed attainment classes. And that's not a simple or easy process.

So how does that process happen then? How do you enable that to happen?

Through a huge amount of work doing collaborative planning and development.

Where do you find the time to do that? That's…

We fight for as much time as possible in the school – which we do get some. In the timetable next year, every second week on a Tuesday afternoon the school closes early, so we get Tuesday afternoon for collaborative planning. And that's [?by negotiations] and we try very

very hard to create blocks of joint PPA time on the timetable. So the teachers who are teaching Year 7 – what we do is doubling up, so in the six Year 7 classes, we try to get it so that three teachers teach all of that, so we have two Year 7 classes each, partly because that reduces their planning and workload, because they've got two parallel classes, but essentially they're teaching the same things. And it's a _____ (58:34) team, with three of them, and we try to get it so that they have at least an hour block together on the timetable each week to meet and plan collaboratively. [?And do we get what we want] – no, but we're going to get quite a lot of that. But that requires lots of attention to detail about who's free when. P_ is in charge of the timetable so she's working with us quite actively to make that happen. Also, you do lots outside of normal time. It depends what you like doing. Me and K_ spend an enormous amount of time doing that – thinking and working on different… M_ does quite a bit as well. B___ does quite a bit.

Who's B__? Which one is she?

She's the young Polish woman. She's not in a good way to be honest, she's upset about some family stuff. It's hard to find the time. Besides, I know in the summer holidays me and K_ will spend a week working or something. We get little bits of funding. We've got some funding from the National Centre of Excellence in Teaching Maths as part of this national collaborative reasoning project. They pay the school to cover us. So we're working with some teachers from other schools to develop a new unit of work for Year 7 on logic sets and venn diagrams, as part of the curriculum. That's very much… we get covered. We've had three half-days this year. And we're now pulling that together and we'll trial it next year. It takes about two years, I would say, to go through a process of creating some good quality things on mixed attainment classes. I don't think you can start from a single resource. I think you have to start from a unit, to use that language, a sequence of a couple of weeks of learning. What might that look like? What way would that work well in a mixed attainment class? What's the mathematical journey – different students [?who want to take it], and thinking about the structure of the lessons, what works, what tasks work well. It takes an awful lot of time. But it's worth it, because if you spend the time doing it well, it lasts. And the kids like it. In Key Stage 4, the kids are very well aware of sets, because you don't have a choice, they know if they're in Set 1 doing the higher, or if they're in Set 3 doing this. So the kids are fairly well aware. They're also quite well aware there's a lot of fluidity though. We make a big point of that in Year 10 that they know very well that we don't really agree with sets. We're not very shy about sharing this with the kids. So they know perfectly well there's an enormous amount of fluidity. And we make sure there's lots of scope for people moving if necessary. So next year we're going to try to do this experiment where some of the Year 10s we're going to keep in forms. I guess before then the kids are aware they're in forms, I think they just think it's normal. Partly because it happens in English as well. So it's a normal experience for them that they're taught in forms.

So what happens when they get to Year 10 and suddenly they're not with their people who they were with? Not suddenly, but…

To be honest, some kids like that. Some kids think right, now I'm doing the GCSE, I need to be in the top set, or this set or… because that's what their siblings are used to, that's what they're expecting, there's the expectation that you need to know if you're doing a higher or foundation. So I'd be lying if I said some kids didn't welcome that when they get to that stage.

What about parents? Do you get anything coming back from parents?

Not really, no. There's a lot of trust by the parents. Round here, the parents are very trusting.

That's one of the things that Jo Boaler, not Jo Boaler…

We have a very good relationship with the parents and community, and there's a lot of trust. So we don't feel any great pressure from parents or any of those kinds of things. Again, as long

as the results are decent. You buy – that sounds very [like a] commercial transaction – you win trust. The kids are happy and the kids are leaving with good results. Lots of them are staying on to do sixth form and A-levels. That wins you a lot of trust. Some kids miss it. I think next year will be interesting, because we want to do that experiment where we want to keep at least three of the Year 9 classes in forms of all attainment. That will be interesting, because that's what we've set up as an experiment – I don't know what's going to happen. How will those kids react when they realise that they're in Year 10 and they're being kept in forms? They might just say, oh that's just a normal continuation of what we're used to. But they'll also be aware that there are other classes in Year 10 that are in sets and have no idea. It's a risk. But again if you play safe all the time you never learn anything, so that's a bit of a risk, to say how's that going to work. It's bound to create some discussion and dialogue, both between teachers and with students. We'll see.

There's a juxtaposition there.

Obviously there's a… the truth is we wanted to change the whole of Year 10, but lots of staff are not comfortable about that.

Why are they not comfortable? I mean it's working in Years 7 to 9, so what's the problem with Year 10?

Because they're worried about the GCSE, that when it gets to that level, you know what the exam they're going to do at the end of Year 11 is and therefore at that stage you have to then move into… the ones who are going to be doing the highest, the ones who are borderline and the ones who are going to be doing the foundation.

So, it's to do with exams – the worries?

I think mainly that. And the feeling that OK in Year 7 you can get them working on deepening their understanding but I guess in Year 9 you can feel that some teachers are thinking, come on, the kids now need to.. you can feel the difference between the weaker kids and the stronger kids. So there's less of an argument about mixed attainment in Year 7 or in Year 8. In Year 9 you can feel that there's a lot of teachers who are still not convinced about it, and certainly aren't convinced yet about… they feel the gap is wider in Year 9 between what kids can do, and therefore that means we have to start moving towards setting and we certainly think that in Year 10 we need to do that.

You could take the position that… it's [?been interesting that because there's been setting] in Year 7 and Year 8, the reason why there's a bigger gap is because the kids who are the higher attainers, who is everyone is so concerned about, they're actually much better, so what's the problem?

We've had that discussion, but one of the things we're very insistent on is that we have to convince and show people, not just tell people. So, we're hoping that by modelling – look, this is how it can work in Year 10, by the end of Year 10 what I'm hoping is that – not by the end, but by halfway through – the evidence might be that both in terms of the engagement and happiness of the kids doing mathematics, but also the hard measures of attainment and tests and things like that, that increasingly over the course of next year… M__ is going to be doing this as part of her masters… that we can show to people, well people see it day in day out anyway, that people will do what they did before when [?they used to look] at some of the Year 7s – oh actually it does work. It's alright. If that happens, the hope is that the following year we'll roll it out to the whole of Year 10.

But you get variation between years as well. Some years perform better than other years. So, is this a good year to be starting this?

What it will come down to… I know exactly what will convince people, are the top end of the mixed classes doing as well as the Set 1s. That's the gamble. That's what will convince people. Nobody would have a problem about the middling and the lower attainment kids. Their argument will really be about the top sets – will the top sets who are set or the kids who are

the higher attainment ones in the mixed classes – that's what everybody, including the management, will be looking at. The truth is Colin, [?and I'm not going to repeat this], it's not a fair test, because I know the teachers who are teaching in the different classes, so I suspect I know what the outcome of that's going to be. But if it wins the argument, it wins the argument.

It's usually the other way around. You have practically sell your soul to get anywhere in terms of not setting.

I'm reasonably confident that this time next year we will have just marked the end of Year 10 exam and we will be able to say look there's the mixed attainment classes, there are the set classes, you tell us what your conclusion from that is. And I'm hoping the conclusion will be OK this has to be what we do. But I might be wrong.

Yes. You'll know in a year's time one way or the other. Even that, one year – is one year enough?

No it's not, but in terms of… can we win enough of an argument to convince everybody that that's what we should at least try to do for a few years.

Next year will be the first time that you've done it, so you'll be not quite sure what you're doing to some extent.

And the teachers who are doing the mixed attainment classes are the ones who are most convinced that's a good way to teach. Me, K_ and M_ are doing the mixed attainment classes. These things are a process. It takes time. It may be that we have to retreat if it's… we'll have to see. There's always that tension. In Year 11, it's much more difficult because of the pressure of exam preparation, and as long as they do separate papers you are preparing the kids for quite different papers. It's very difficult to get away from that, once you hit Year 11. Because remember Year 11 will come in September and in reality you only teach 'til Christmas. After that it's just exam prep. And even then in December they've got a high stakes mock exam. So the pressure of the whole of Year 11 is just exam prep and you're prepping the kids for quite different papers. It's hard to escape from that pressure.

Unless you get rid of exams at GCSE.

That would be a good idea.

They don't do it in quite a lot of countries.

It's a waste of space. The kids all stay 'til they're 18.

I was just thinking, what's the point in them anymore?

Here, for example, I'd be quite happy at 16 to say I don't need an exam, teacher assessment will tell me whether you're capable of doing maths to A-level or not. The exam tells me nothing. For the [?internal] candidates. I could tell you now in Year 11 which kids… if all those kids came and said can I continue and do A-level maths, I can tell you now which kids I would say yes to and which kids I'd say no. I don't really need an exam to do that.

Right. Well we're just about done I think, nearly. Anything you haven't talked about that you think might be relevant?

Oh god. Mixed attainment.

We've talked about the school, we've talked about what your philosophy is, you've talked about moving things gradually forward, about the teachers, about their commitment to mathematics, about the community at large, perhaps.

To get teachers and kids – this sounds very philosophical, but fighting for that idea that mathematics is something that can and should be part of everyone's life. And everybody is capable of accessing it in some way.

So you shouldn't have a situation where people say 'I'm no good at mathematics' or 'I hate mathematics'. At the end of five or seven years here, they should be saying – ideally they should be saying 'I love mathematics', or at least 'I…'

The more students that say they like mathematics and enjoy it, and that they feel it's something they can actually do, the better. I think that keeping that centre stage, despite all the compromises and all the other rubbish, that mathematics is part and parcel of what it is to be human. Finding in different ways to keep that spirit alive among teachers – because if you don't keep it among teachers you'll never get it. If teachers don't have it, you'll never inspire kids to have it. And fighting to get the… our department were asked to come up with…

[?A motto]

It's stupid, but all departments were told they had to do that. So we haven't put ours up yet, we might have to at some point, but the one we've come up with, which actually people agree with, is 'Inspiring the mathematician in every student'. So that sums up quite accurately what I think is important. We have to feel mathematics is something we're inspired about and our role is to inspire the mathematician that's there, one way or another, potentially within every student. Does that mean there aren't big differences in how good people can be in maths? Of course not. That's not to say that everyone is the same. They're not. But everyone can enjoy mathematics or access mathematics in one way or another. And I think that fighting to keep that alive – it's a team project.

Would you say you were a team here?

Yes.

And you spent years building a coherent team.

And I think probably next year we'll be stronger. You can feel it's getting tighter in the team.

Would you say people actually chose to work here, in mathematics?

Or… head-hunted.

OK. Head-hunted. How do you head-hunt someone? It's difficult.

It's not that difficult. I phoned up K_, because we'd worked together. I phoned her up and said do you want to come around for dinner and let me persuade you why you should come and work at L_P_. So, that's how that worked!

How did you know her again?

She used to work in G_ G_, the neighbouring school.

And you worked together on the Tower Hamlets...

We worked together doing a thing on proportional reasoning – we just invited maths teachers from other schools to come and work together, and she was one of them. And the fact that she was one of the two or three who worked for a whole a year and a half together. At the end of that, I just said I want you to come and work here. And A_ and H_ trusted my judgement enough to say yes. And then we very, very, very deliberately put a big emphasis on taking a lot of PGCE students and then within that identifying ones that we think are…

Fit in with your ethos.

That's where M_ came from. N_ and B_ and F_. So we've now got half the department who are people that we trained as PGCE students, going through NQT. And the fact that they want to stay, that's also interesting. For all that we've chosen them, actually they do want to stay. And I hope if you ask them, they'll say that they feel valued and supported. But you can ask them that. With F_ I taught her – she was one of my first students when I came here.

F_.

You haven't met her yet, but the first year I was here she was in Year 11, so I taught her GCSE maths. But that's quite nice. And that's actually not a bad role model for the kids, that somebody who was a student here has gone off, gone to university, done her PGCE and now is a maths teacher in the same department. That's not a bad thing. That's quite nice.

As long as not everybody is doing that, I think.

No, but having a student from this community who's now come back… and that's also a nice model for the kids.

You too can be…

Yes.

Good.

- END OF RECORDING -

Appendix 2:   Transcript of Bob's interview

INTERVIEW (one to one)

Duration: 88:05 minutes.

KEY:

- Interviewer questions in **Bold,** Interviewee in Regular text.
- Indecipherable text: _____ (timecode)
- Transcriber's best guess: [?word / phrase]

As I said it's a semi-structured interview so it's more like a conversation, I like to think.

Yes.

That's what it is like, actually. I've got some questions and I've got some prompts for more questions and we'll just see how it goes.

Yes.

Can you describe L_ School and in particular can you describe the mathematics department here?

L_ School is a secondary comprehensive under the control of the local authority. It's got a wide variety of students coming here with a wide variety of prior attainment. It serves five distinct areas. One of those areas is one of the most disadvantaged areas in the South East. And that tends to be where our Pupil Premium students come from. We have 40% Pupil Premium students.

In terms of the maths department, the maths department when I arrived was a very traditional department. It taught in a very traditional way.

When say traditional, you mean…

I mean textbooks. Textbook teaching.

Was it all textbook teaching? – or virtually all textbook teaching?

Yes the majority of teaching was textbook teaching. As I understand it… I mean I haven't got…

Obviously you weren't here.

Yes. But there were plenty of piles of textbooks around. The teachers taught in a traditional way because obviously I observed them in the first year I was here – the majority. It was very much instruction, exercise, plenary.

Chalk and talk.

Yes, and that was it. All year groups were set - rigidly. They were in parallel groups from 1 to 5.

You say it was 1 to 5 – they were set in set 1 to set 5?

Yes, 1 2 3 4 5, set vertically. Two sides of each year group.

So there were 10 groups, two parallel sets?

Exactly. In each year group. And interestingly, just before I arrived B__ & H__ did a survey of all Year 7 students and their attitude to maths. And the department that I had led in another school in B&H came out with - 'do we collaborate, do we discuss, do we explain our reasoning' – 'almost every lesson or every lesson'. And the results here were 'hardly at all'. So the two schools were at the opposite ends of maths experience for students. So I knew from that survey that it was almost the opposite of what I was aiming to achieve.

So why did you come here?

Why did I come here!? *Laughs*

That's a leading question actually, but…

I've worked in B&H for – let's think – 15 of the last 17 years. The other two years were out in the countryside in West Sussex. So they were the choices really. I mean once you get out of B__ there's schools…

I mean – why did you leave your previous school?

Why did I leave my previous school? I left my previous school because I had some issues with the headteacher.

OK fine. It wasn't…

The headteacher allowed me… It wasn't what, sorry?

I was going to say… you made a positive choice to come here?

Oh no I did make a positive choice. As the heads of maths, as an experienced head of maths, there were a number of choices I could have made. But this school in terms of its demographic was similar to the one I had been in and served the disadvantaged community – in inverted commas.

So you did make a positive choice because of the demographic.

Exactly. And the nature of the school – the comprehensive nature of the school and the fact that it wasn't an academy for example. Those kinds of… it kind of matched the school I was at previously. It was a push and pull factor – the two factors.

So this school – the intake is from five different areas?

Yes.

One of which is one of the five most deprived areas in the South East.

Yes.

That tells you a bit about the intake and the catchment area but what about the actual school itself? What is it like? What is it like to be here?

I mean, I haven't found it a particularly creative place. In a way, I was spoilt by the other school – not under the current head – I hope none of this gets out! – the previous head when I was there before. It was one of the most creative schools I'd ever taught at. And I had licence and was stimulated to explore new ideas and try new things. I don't necessarily think those forces were at work here when I arrived and certainly three months later – less than that, within two months of arriving, OFSTED came and said the school Required Improvement and it certainly wasn't creative and stimulating. I'm not exactly sure, I haven't quite got the temperature of the place in terms of creativity and stimulation and so on, but when OFSTED came here, it was closed down and there were certain rigid procedures that we had to go through to make sure that we got through the re-visit two years later, which has now taken place and we didn't get through.

You didn't get through?

No. It still Requires Improvement.

Right. So who oversaw those procedures?

The leadership team.

The leadership team. It wasn't – the LEA didn't come in and… ?

Oh they've been heavily involved as well, yes.

OK. So, OFSTED come in, say the school Requires Improvement and then things are closed down a bit, is that… ?

I don't know what it was like before, but certainly in my previous school – which was 'Good' – we didn't have the rigid procedures that developed here. For example, we have to have data on all our classes available for visitors. We have to have lists of students that we're concentrating on, and we have to have profile sheets that show the interventions we're

carrying out, for all visitors when they come in. So all these kinds of demands started being made. I'm not sure it was necessarily what the leaders of the school would necessarily have wanted, but they felt that it was necessary.

That increases the demand on you and members of your department then.

Absolutely, yes.

So instead of having to concentrate on what you really want to do – the teaching – you're having to do other things.

Yes. It's interesting. I also filled out a survey today – a 60-second survey from the Mathematical Association, an online survey about retention and recruitment. And the issues around recruitment and supply teachers and ensuring supply teachers have got cover lessons – that, plus the demands made by the leadership team, conspire in a way to ensure that the things that we should be focusing on – or I should be focusing on as head of department – get pushed down the agenda. So, those two things – the demands from leadership and the recruitment problems – mean that teaching and learning, structuring classes, discussing student progress, is more difficult, I would say. There's less time for that.

So you've had this couple of years and during that time the head has changed again?

Yes, the head went. Perhaps under pressure. I won't speculate too much about that on record. He has been replaced by someone else.

Someone that doesn't necessarily share the same sort of vision as the previous… Did the previous head have a vision?

That's interesting. He never expressed a vision to me. But when I pushed for mixed attainment teaching in Year 7, in maths, I mean the following year he then implemented mixed attainment teaching across Year 7 and 8, across all subjects. So I don't know if he felt his days were numbered because he left three months after doing that. I don't know if he got an inkling of that, but I've got the feeling that philosophically that was his preference – mixed attainment teaching. But he never expressed that in so many words.

But he wasn't opposed to it, obviously, he introduced it.

Yes it's interesting – because when I arrived I had been given an undertaking that we would have mixed attainment teaching in maths in Year 7 in the first year of arriving here. But it took a year to get it and I had to make a threat that I was going to leave if the promise wasn't honoured. In that year we had very interesting discussions, especially with the deputy head, around mixed attainment teaching – and we had to present evidence and he brought some papers. It was an interesting discussion – but it wasn't a discussion I necessarily wanted or expected. And maybe looking back he was the blocker – the deputy head.

The deputy head?

Yes the deputy head might have been the one holding it back and requesting more information. Interestingly he left at the end of the first year.

The deputy head has gone as well?

Yes. He left at the end of the first year – that deputy head – because he was so disillusioned with the OFSTED process, when OFSTED came and put us in Requires Improvement, he was so upset at the way he was treated and the way the school was treated, that he left. He left the country, in fact. He left the country and is teaching abroad. He's a headteacher abroad.

So…

Laughs. I tell you, in Requires Improvement schools it's all happening.

I know. It's not very nice, is it.

No, it's not.

So you're here. You've introduced all attainment teaching into Year 7.

Yes.

How's it going when you do that?

Ah, well, we had to go through some training processes. And ensure the staff were comfortable teaching mixed attainment. So we had a core team of five teachers.

Out of eight?

Maybe more – maybe 10 at that stage. About half the department. So we had three people if I remember correctly – three people were very committed to mixed attainment teaching. And two were prepared to give it a go.

OK so there were three – you, H__ and...

Yes, H__ and me and another lead professional, who was on a part-time contract.

And two other people.

Two other people who were – I'm just trying to think who the fifth one was, but the fourth one definitely needed convincing, but was prepared to give it a go. And other people weren't prepared to give it a go. Initially anyway – they needed to see it could work. I understand that, because I'm new and I'm coming in and I'm saying – oh, I'd been here a year – I'd say 'we're doing this'. You know, reasons need to be put and evidence needs to be delivered. So I understand what they were saying.

Yes, but... if I was in your position I would try to do quite a lot of CPD before I actually did it so that...

Yes absolutely, of course. I mean, H__ prepared the lessons, so the lessons were there, and we discussed the lessons. It wasn't a question of collaboratively planning lessons, which we hoped to do, and which we would have developed and moved on to if we weren't leaving. It was more like this is a good way to teach mixed attainment classes, let's discuss this model and then let's reflect on it afterwards, rather than let's all prepare together initially. Yes.

So you and H__ were the drivers of that?

Yes.

And prepared the initial resources with the aim of eventually getting more people involved in doing that?

Yes. Exactly.

So the burden wasn't all yours and H__'s.

Yes, but we were very committed to that project so we wouldn't have minded if it was.

Sometimes...

You're right – you have to get other people involved so they become committed to what they're doing, yes.

No I just meant sometimes it's just that the workload becomes so horrendous, if you're trying to do everything with just two of you, it becomes...

Oh well, you know.

You're prepared to do it.

I'm prepared to do it and I think H_ is prepared to do it as well. Well I know she is because yes it's just something that we believe in. So we put our resources into that. But you're right – if that's the point you were going onto – that to convince other people they have to feel that they're part of the process as well. And we never really moved on to that second stage, in a way. We haven't – whereby everyone teaching mixed attainment classes are contributing to the resources and to the development of different styles of lessons. So, that's something we haven't really got to, unfortunately. And that partly is... after the first year, a lot of staff left

and we had a new intake, as it were, who were interested and younger and more committed to mixed attainment teaching, but also, being inexperienced, they probably didn't have as much to offer, in a way, in terms of collaborative planning. So, in a way, even though we got it going a second year, it was a second first year – second year one again, if that makes sense.

Because so many people left.

Yes exactly.

Were any of the people who left – were they resistant to what you were doing?

Yes.

They were. Very resistant?

No, no. They didn't… they made a choice. They never vocalised their resistance or their disagreement in formal meetings. Only one ever said to me 'I don't want to teach mixed attainment classes'. And I made a temporary compromise with him, because I needed staff – I didn't want him to leave, so I said OK I can guarantee you another year when you won't have to. And I'll give you all classes that are not mixed attainment classes – in 9, 10 and 11.

Did he have a particular – it was a 'he'?

Yes.

Did he have a particular reason for it?

Philosophically – yes it was a philosophical – well he didn't really give an explanation or justification, but it was a philosophical view of what maths teaching is. And maths teaching is better, or children learn better, in sets, where they are in with other children of their own ability. That's basically what he was saying. If he verbalised it coherently, I think that's what he would have said. And that was the… when I described the original system as traditional, that's what it was. He was part of that. And the others – they didn't say that, but I think part of the driver for them moving on was that they could see the way the department was developing. In fact, interestingly, the guy that said 'I don't want mixed attainment teaching' and then left at the end of that year, after the first year we tried it, he is now coming back next year because he's heard that H__ and I are leaving. Yeah. It's quite clear that he felt that way, I think. I think we can infer that, yes.

Odd to come back, mind you.

Odd to come back? Ah, well, even odder in a way because he was a student here.

He was a student here!

He was a student here.

You mean he was a school student?

Yes he was a school student here. Interestingly, there was another member of the department who'd been a student here. So we were facing years of tradition, years of 'this is how you teach maths'. Not just, you know, the practice in the department, but actually people's expectations from their school days.

There's some research that shows that people tend to teach the way they've been taught.

That would be consistent with what we found here, what we found when we arrived. People – two people – who had been students here, I suspect were teaching in exactly the same way they'd been taught here. So, that was effectively – someone had been here 13 years, so that's effectively up to 30 years of teaching that way. Or being taught that way. So it was quite an ask. As I said, the survey – the B&H survey – showed I would say some of the most regressive practices were going on here, in terms of how students are expected to learn. So, yeah. It was a tough nut to crack! *Laughs.* It was a tough nut to crack.

You introduced it in Year 7, you've got five people committed to it, or mostly committed to it.

Yes.

And it worked?

Yes, it did work, in Year 7. By the end of Year 7, the gaps that are very very large – too large in Year 11, that have opened up over the time of being setted from Year 7 into 11…

You mean between the pupils who had a Pupil Premium and the pupils who didn't have Pupil Premium?

Yes, well, I said this earlier and I'll say it again. We found Pupil Premium students who had achieved a level 5 in primary school had slipped down to set 4 out of 5, because… I don't know. Because of a perceived attitude, I suspect, to learning. And maybe behavioural issues as well. So the Pupil Premium students were packed into the bottom sets, regardless of their starting point. I've forgotten what your point was.

I was just asking about Year 7 and you said the gap…

The gap. The gap by Year 11 was - and still is unfortunately – huge, against the national average. But, in that year, in that Year 7 where only maths had mixed attainment teaching and learning – the gap didn't open, or opened by a few percentage points in perhaps three or four classes. I mean, our main focus was to ensure the gap didn't open. And it didn't. So there was evidence there that we were having success. Progress generally in line with national averages, which for this school is… well, I don't want to say 'good', but… oh alright it is good then. I mean, if we were at national average by Year 11, we wouldn't be in Requires Improvement. So yeah.

So Year 7 was a success and then you rolled it into 8 and you've had problems in Year 8 because of staff shortages?

Ah, our main problem was that the headteacher, having seen this in maths, just in Year 7, declared/decreed to the school that all classes in 7 and 8 would be mixed attainment teaching and learning, in all subjects. And didn't give any training or any justification in the lead-up to that decision or the implementation of that decision. And it came quite late in the school year, this notification to other departments, so they were left scrambling around trying to cope with that with very, very little guidance. Interestingly, not many of them came to maths to say 'what could…?'.

What have you been doing?

Yes, exactly. There wasn't even the idea that they should see us. It was a very strange kind of decision and it was made stranger in my mind by the way the classes were set up, so that each Year 7 class and each Year 8 class stays together and goes around the school as a block, and visits each subject – the same 25-30 students visit each subject over the day. And in Year 8 especially it's led to some behaviour difficulties because problems in lesson 1 drag on through the day and get magnified, and social issues expand. It hasn't worked very well.

So keep them all together as a form group, basically?

Yes – if it had been a form group, that might have worked better, because you would have had a focal person.

It's not a form group?

No. So you would have had a focal person, a mentor or a form tutor, who could take ownership and control of those 30 students. But the form groups are different to the eight classes in Year 8 and 7. So you've got eight – we call them mentor groups – eight mentor groups and then a different eight classes that go around all day long. I'm only the head of maths – I didn't have much of a say in this. I did obviously make comments.

It seems strange to me that you wouldn't just keep them in their form groups, if you were going to have them in the same group all day?

I wholeheartedly agree. And we made that point.

So whose decision was that? Was that the headteacher?

Yes it was the headteacher. The senior leaders. They've done that. I said to H__ before it happened, before the year started, this could be a great advantage to us but it could also be harmful, because if mixed attainment teaching is shown not to work in other subjects, then we're going to get dragged into that. And it's mixed attainment teaching that's going to fall into disrepute in a way, and it's not necessarily… and we've got no control over how this is going to work now. Whereas obviously in maths, we had direct control. So now… on the one hand it was good that the headteacher took this decision but it was very bad the way that he then followed it up, and it's been negative in terms of the experience of the school, unfortunately.

So that head left?

In inverted commas! *Laughs.*

Well, he's not here anymore.

He's not here anymore, let's leave it at that. Yes. And he informed us one day and was gone the next, presumably with some cash in his back pocket – I shouldn't say that, but anyway. Let's leave that.

It's really odd what happens in schools sometimes, because a friend of mine… it happened to a friend of mine who is a deputy headteacher of a primary school. She was just… she wasn't even given a chance to say goodbye to her class. She was just ushered out of the premises.

[Subsequent segment discussing former colleague not transcribed]

The trouble is, local authorities almost feel like they have to act tougher than an academy chain, otherwise they're worried the academies will move onto their patch. It's almost like they're copying the behaviour of a chain.

Anyway, it wasn't very nice for her, but she eventually got back into teaching but it took her a while. She did some supply teaching and you know if you're a good supply teacher then people start offering you jobs.

Exactly.

When I stopped being a full-time mathematics teacher, I was doing an M.Ed. for a bit and I did some supply teaching as well, and I mean… supply teachers vary hugely. Some people are just there for the money and…

Yes. I've known many supply teachers this year.

And people I would say who are like me who are reasonably decent supply teachers.

Yeah yeah.

And if you're like that… schools would offer me… 'do you want a job!?'. I said well actually no I'm _____ (29:13). I did spend quite a lot of time in some schools. I was in and out of several schools for a couple of years [?until I got] a full-time with Sheffield Hallam. It was interesting being a supply teacher because you do see a lot about how schools are and how they work. One of the things that I find most – I don't know – encouraging, disappointing – was that whenever I was working full-time nobody ever said thank-you for anything, but they used to say thanks!

Overlapping – indecipherable

Oh really, doing extra, a little bit extra?

Thank you for coming and doing supply for us.

Yes it's funny. We had a supply teacher who I last worked with 17 years ago in fact. He's a full-time supply teacher and he speaks similarly. He'd plan lessons and yeah we wanted him. Because he did that, and he'd mark the work, and so on. But some supply teachers – you don't see because they just drift in, pick up the work on the desk, and drift out again. Yes.

Right, OK. A slightly different question. Could you describe what you would consider to be a good mathematics lesson.

Oh! Well I'm very interested in inquiry learning.

What do you mean by inquiry?

OK, well there's a website I've created where it's all available for view. OK, it's called Inquiry Maths. Let me get that in! *Laughs.* Whether it ends up in any research or not… it's called Inquiry Maths.

A good maths lesson follows the procedures that Polya described that a mathematician follows, for me. And he talked about maths having two sides – an inductive side of exploration and plausible reasoning, and a deductive side of rigorous proof. And an inquiry, as I conceive of it, starts with students' questions and conjectures from a stimulus that the teacher gives. It then moves perhaps to a phase of exploration and conjecture and generalisation. I should say, in that phase all this sort of practice stuff and this fluency stuff – the skills that are required to make progress in exploration phase - come in then. If students need to be taught those, then there is a mechanism in this model that I've created where they can ask for instruction or explanation. So, then it might develop into some kind of reasoning. And in the older years in secondary school, you might get into some kind of formal proof of the generalisations that the students have made. There's a feature of the model which uses cards, so currently I've created a set of 20 cards and students have the opportunity to regulate the inquiry. So they can choose a card. They all get to choose a card, to decide in what direction the lesson should go. Once we've done the questioning phase and the observation phase from the stimulus, we look at the questions, we think about them, we talk about them, and then we decide on the direction that we'll go. So there's some cards, for example – 'find more examples'.

They're sort of prompts, are they?

Yes – well actually I call the stimulus the prompt, and I call them regulatory cards – not necessarily to students but they allow the students to regulate the lessons. So they participate at another level, in a way. They participate in – OK, if I was a mathematician at this point – they don't necessarily explicitly say 'if you are a mathematician', I would just say what do you think we should do from here? – to force them to think about how to direct their learning. And the aim is that they become more independent, they take initiative, they become more creative, and they participate in directing the lesson as well as doing the maths. The procedures and the skills would come into the lesson probably in the exploration phase when they might have to add fractions. So the stimulus might show the adding fractions prompt. For them to develop that further, they have to know how to add fractions. So they might say OK there's a card – ask the teacher or another student to explain. So they might select that one, a pair of students might select that one, and then I would say why have you selected that? Because we don't know how to do that.

So this is a bank of 20 cards they can just select, they can choose one of those?

Yes. In Year 7, we're talking about Year 7, there might only be six cards. There'd be a reduced selection. And they would participate in directing the lesson. And the lesson might spread over three or four lessons – the inquiry might spread, yes.

For me, there's a kind of phase where students can question and from their questions you can assess very accurately their level of understanding. What parts they understand and what they don't. So that's important. That's a key element of a good lesson – the teacher and the students are communicating and each can see what the other knows and what they don't know. And there's an opportunity for students to direct their learning and it's supported through these cards. So that for me, those two elements are very important in a good lesson.

So the students have a say in directing the way a lesson goes.

Yes. People say to me – you just want an easy life, you don't necessarily want to do anything. But I would say that for an inquiry, I might prepare for three or four different pathways that students might choose to take. So if they say they want an explanation – if sufficient numbers say we want an explanation and a significant minority say we don't necessarily need that, then the teacher employs the significant minority to teach the majority. So there might be some kind of co-construction of that knowledge, using the resources already in the room, the knowledge that students already have. So it's a very flexible way of working, depending on where students are at, and what they're asking for. Other students might say, no I'm very comfortable with this and I want to explore and find some more. And the challenge, the new procedures I'm going to learn will come later perhaps, as I change the prompt and think about extending into different areas of maths – maybe multiplication of fractions, say, or whatever, in the adding fractions case. Yes – I don't know what your question was again, but I'm enjoying the answer.

My question was how you would describe a good mathematics lesson.

Yes, so there's an element of co-construction.

Students are working together.

Again, there are cards where they can choose. So they can say 'I want to work with my neighbour' – I think there's a card that says that in the most recent 20. Normally in the starter pack there's one that would say 'I want to work with my neighbour' and sometimes if students choose that, they're showing signs of anxiety because they're saying, hold on, this is too open, I don't really know what's going on here, I need the security of my chum to work with, so I can work out what's happening. So sometimes that's a sign of anxiety and I might need to reassure the student that they're doing the right thing or whatever – everything's fine. Yes, so co-construction of knowledge and the direction of the lesson.

In an inquiry-based lesson.

Yes, in a good lesson. I'd want that level of communication I think, and that level of flexibility. It's combining 'skills-based learning' (in inverted commas) with induction and deduction in terms of Polya's model of how maths is.

His problem-solving model.

Well he called it a problem-solving model, but in how to solve it, I suppose you'd… it's been kind of interpreted as problem-solving in that he uses certain heuristics, but in his other books – Plausible reasoning and Plausible inference and deductive reasoning - I can't remember the titles – he talks more about mathematical reasoning I think rather than heuristics in how to solve it. So I think for me – see, this is quite controversial. I would say problem-solving and 'reasoning' (in inverted commas) are different things.

OK. So what's the difference?

Well, maybe not for the mathematician, because mathematicians get problems and they work round them. But in schools, they're different things, because a problem typically has got one answer. I'm talking about a GCSE paper. It's got one answer, it's got one starting point, it's got generally perhaps more than one method to arrive at the answer.

I see – you're naming problem-solving as understood in school mathematics is a rather limited thing that's perhaps not what Polya means.

Yes, in a way. In the United States there's a website called the Open Middle where it's a very defined starting point and a very defined end point, the one answer, and the middle is open. And the way I'm interpreting what teachers are saying at the moment, what they're saying anyway, is that Polya's heuristics would fit in there in the open middle. So you'd look for a similar case – I can't remember what it actually said – the other things that he said. And that's

kind of contained in the open middle. You'd bring in the strategies or the heuristics in there, into that middle part of the problem-solving process. But mathematical reasoning for me is far more open than that, and it might have multiple entry points. So in an inquiry for example, people make different observations about the same thing. And often it's about combining those observations on that same journey and then actually you might have a very open start and all work in the same direction in the middle but end up in different places. So, mathematical reasoning isn't necessarily a very confined problem and there's one answer. It's far more open than that. In terms of problem-solving and reasoning, I like to keep them distinct, because I think problem-solving and the way teachers are interpreting it, is in the GCSE paper format of – closed, maybe a bit open with different pathways, one answer.

_____ (41:45) I hear what you're saying, yes.

I mean, I've got into trouble on social media, not trouble but I've had various people say well we don't agree with that. And obviously there is a crossover, because it's mathematical. But I like to distinguish between mathematical inquiry and problem-solving. And interestingly, other people have had this problem as well, because a maths teacher in Yorkshire somewhere – I can't remember – she used to have a website called problem-solving or a collection of problems and resources for teaching problem-solving, and initially she said Inquiry Maths will be one of my main five sources for these problems that I'm going to put on the site. But then it was quietly dropped when she realised – I don't mind – she quietly dropped it when she realised that the prompts that I create and use don't fit neatly into that problem-solving scenario. They are kind of stimuli…

You mean as understood by most school mathematics teachers?

Exactly. So it was interesting. She couldn't fit the stuff that I do into her interpretation of a problem.

Are you familiar with John Mason's work then?

Oh yes, yes.

That would fit into your inquiry-based learning?

Yes. What did he call it? The internal regulator, I think?

I don't know…

He was talking about thinking mathematically.

He just talks about conjecturing – that's the main thing I know.

Yes, so there would be a process initially of questioning and, potentially, depending on the experience of the students in doing this kind of stuff, conjectures might come out at that stage. But oh yeah I see that – I see there's a connection there. I think that connection will be repeated in another 10 cases, or whatever. So yes there is potential for that.

Good.

That's the perfect maths lesson. *Laughs.* I shouldn't say that. All this stuff about OFSTED's definition of… you need a good assessment, you need a bit of this, you need a bit of that. What I've seen that lead to in the past, as an observer as the head of maths, I've seen people chunk lessons to get each aspect in. So you find it very difficult not to grade a lesson – well, in the old days, when it was graded – as outstanding, because it fits everything in. It's got an element of this, an element of that, and an element of that, and it's all done very well, so it must be outstanding. And yet the lesson is very clunky, students don't necessarily get involved in it, they just passively move through the different phases. So, inquiry tends to put it all together in a kind of organic process, I suppose.

The students are actively involved in the learning process.

Yes. And assessment comes in not because someone has got a checklist – point 5 – but actually comes in when it's needed and when it's natural.

And you have evolved this over your teaching career? 12 years?

Yes 2004 I probably started this, thought about this. It all started – actually I was very hostile, very hostile to the national numeracy strategy. And the three-part lesson.

Well actually… I'm not sure. Did they ever say there should be a three-part lesson because… ?

They did.

They did?

Yes. Well, by 2007/2008 they were saying oh no no, we never said that, you can have five or six. But they did, they did. In fact, I wrote an article in Mathematics Teaching in 2007 about this. It was called "The Almost Sum of Lesson…" – it was about lesson objectives but I quoted the fact that they had said this.

Oh, I think I've seen that, yes.

The Almost Sum of Lesson Objectives. Or called similar – I can't remember. Yes – they did say that. Oh yes, that's right. I thought, right, I've got this lovely starter. And it took over 10 minutes to do the starter. And it ran the whole lesson. It ran the whole lesson – and teachers have this experience, everything clicks.

I've had starters like that before. Why stop? If it's working well.

Exactly. So what this whole thing that I've tried to create is harnessing that and designing for that to happen – trying to create that situation where there isn't that time pressure, where students have got the chance to take their interests further if something grabs them. I should say that I try to design things that will grab them and then we have the time to go off. Yes. Boom.

So, a good lesson actually might – as you said – last a week.

Yes, and it might involve… some people walk in and say well it's an inquiry lesson and say hold on, you're teaching them stuff. And I say, yes, this isn't about discovery, I'm not expecting them to discover anything, we're exploring, and if they need knowledge, they will go out and find out.

You're a resource.

I'm the closest resource so they'll ask me to explain it to them. Great. And they're in charge of that, and they're far more motivated to listen. It's like a mathematician – Andrew Wiles I think – I haven't read the book, I should have read the book. When he solved/proofed Fermat's theorem. He wasn't an expert in one field that he needed, and he went out and spent hours and hours educating himself. So that's kind of an analogy to a classroom where students require a skill that they get.

That's fine – it's interesting. And so you've done that here as well – tried to do that here.

Yeah, we do two every half-term in Year 7.

OK. A slightly different question. Why did you become a mathematics teacher?

Laughs. Oh, goodness. Well, the truth is, I was travelling in Europe, I came home, it was the end of August. I was staying with my mum. I didn't have anything to do and I had no money and she saw an advert in The Guardian from Keele University, and she said – look son, they want maths teachers. And it's a two-year course.

Oh right, the two-year PGCE.

Yes, the two-year PGCE because my degree wasn't initially in maths, my first degree. And she said – you get two years as a student, and they're going to pay you a couple of thousand or whatever it was in those days. Why don't you get out of here, and go to Keele? And I did.

What year was that?

'89. Within a week I was having an interview and within another week I was moving up there.

OK. That was your initial impetus.

I always thought I might be do something in teaching. I thought I might be able to make a fist of it. It wasn't like, oh no I never meant to do that. My mother was pushing an open door. I was quite happy with that idea. It wasn't necessarily something I would have gone for, but she...

When I left school the last thing I wanted to be was a maths teacher – or any other sort of teacher – because the school I had been to… I went to school in Northern Ireland. There was a bit of a bullying culture at my school. The teachers were – not all of them, but a lot of the teachers were bullies and I thought I don't want to be any part of anything like this. But later after I'd done some work for five or six years I thought actually it might be different if I did it, you know. It doesn't have to be like the way it was.

Exactly.

So like you I actively chose to work in schools in what would be called challenging circumstances these days. I didn't particularly want to work in leafy suburb schools.

Exactly.

But it's hard work.

Yes. But that's something… yes in terms of social conscience, that's what I wanted to do. So, on my PGCE course I met Mike Ollerton. I think that was his first year he was teaching as a university tutor. He was still doing part-time school. And well, I keep telling him, it was inspirational, and off I went, under his…

Under his tutelage.

Under his tutelage. And, well interestingly – and I've told him this – for about 15 years I didn't contact him, in this whole development of Inquiry Maths because I felt that if I'd contacted him, I'd have heard that voice again. And actually I wanted to create something. I'd been influenced by him, obviously, for some years, and I thought right I'm just going to move away now and I'm just going to think what I can do separately from that. I wasn't conscious of this, but I did… there was a period of 10 or 15 years when I didn't contact him. And it's only in the last two or three years that we've started talking quite regularly again. And I've written on the site – the differences between investigations and inquiries. And he's known for investigations. And that's what he taught us. So I would say that an investigation and an inquiry are distinct – very distinct.

What's the difference?

OK. I would say an investigation is a discovery process and often – and this comes from the SMILE material as well – often it only involves the inductive process of spotting a pattern and discovering a rule from the pattern. That's the end. So the aim is the discovery of Pythagoras' theorem. There's a SMILE sheet we were using the other day where you've got right-angled triangles and squares on each side. And you count the area of the sides, tabulate the results. You notice that the square of a and b sums to the square of c and you write that all down, p + q = r on the sheet, and there we are, done. And you've discovered Pythagoras' theorem. So it's a discovery process.

What would be the deductive bit then?

There isn't one. That's the point I'm making. There isn't. So, you know…

But there might be.

There might be! There might be, but in most investigations, there isn't. For example, cross-overs. How many cross-overs if you lay lines, if you draw lines _____ (53:48) maximum cross-

overs. So very rarely _____ formula on the table, where's that come from? Can we prove that always works? Well that would be very difficult, but it's the discovery of the formula. And that might be written in words, or it might be – the algebraic form might be introduced. So I would say that's limited.

So you've…

You see, the discovery in an inquiry - Pythagoras' theory. Here's an inquiry on the side, actually. Pythagoras' theory is not assumed, but it's brought into the inquiry in the service of understanding the prompt. So it's like the knowledge that might be brought in, that might be required by students. It's not the end point to be discovered. It's the knowledge that we might use in our journey in our inquiry pathway to answering the questions that we started with at the beginning. That knowledge comes in in a different way – it's not a "a-ha!" discovery at the end of the process. It's introduced consciously - required on the part of students and introduced consciously perhaps by the teacher. So that overcomes this whole issue in investigations of – oh, I haven't made the discovery and I don't know how to make it, and are you going to tell me or not?

I take your point, yes.

Often you can get there, don't you.

[?Just carrying them] forward, yes, because they're stuck on a particular point.

Yes but what used to happen when I taught investigations – perhaps I was doing it the wrong way – in inner London, earlier in my career, I used to have two or three kids go "ah!!! – I can see, sir, I can see it!". And the rest go - eh?? Like that. It all became quite awkward at that point, because you'd have some discovering what they had to discover, and some not seeing it, and some getting anxious, and it never seemed to work for me. So I think an inquiry has a potentially more collaborative… and the aim is different.

It's interesting.

I'll send you the link if you want to read…

Yes, yes that would be helpful.

OK I'll do that. I've got your email. That hasn't answered your question. How did I get into teaching.

You've sort of told me, OK, because your mum told you too.

Laughs.

I think there's a bit more to it than that, so what was your journey? From Keele University to here?

To here?

You know, how did you meander to…

Well I went to inner London and I was ripped apart. In I__ G__ school.

When you say you were ripped apart…?

By the students!

It was hard work in that day.

Hard work! No, I was… I had medical support and I was in this right old state. Nothing serious, but I had to go see a doctor for whatever, the stress I was under. What happened was, I did my training in Keele. I went into some very lovely schools in the local Staffordshire area. I did my training in W__ which is in Cumbria which was a department that Mike Ollerton had taught in and recommended me to go. So I travelled 200 miles to do my teaching practice and moved away again from Stoke to see this wonderful discovery school, although by the time I got there it had changed, very rapidly, since Mike had left.

It wasn't so wonderful.

It wasn't so wonderful, but it was very interesting and I really enjoyed it, so I don't regret that in any way. But then I thought – right, now I'm going to go and change the world and save the world, and I'm going to go to inner London. And it was completely different to anything I'd experienced. And the Year 10 class I taught snapped all the pencils in the lesson before, because they knew that I was coming in – they took all the coloured pencils and snapped them up and came in with plastic bags, and every time I turned round to write on the board, snapped bits of pencil rained down on me. And it just went on like that for a year. And the second year got a bit better. And then I left.

Then I went abroad. I taught history, because I could speak English as a native obviously – I taught history, and I taught in an inquiry way, actually. And then I thought, ah, that's interesting. Because I really enjoyed that sort of style and the collaborative approach. They were very mature students. It was a private school unfortunately. That's all I could get work in. And I thought, they got some exceptionally high marks in their IB exams, and I thought this is great, how can I bring this into the UK state education system? This inquiry approach, collaborative co-construction of learning and so on. How does that fit into an hour-long lesson in comp? That's what I'm trying to answer – that question.

And – sorry to but in – but interestingly, inquiry is different in maths to other subjects. That's what a lot of inquiry teachers in primary school don't understand yet. And a lot of the discussions I have with inquiry teachers on social media around the world, they're teaching in primary, and it's cross-disciplinary inquiry. So maths comes in as part of wider inquiry. And I'm saying, the inquiry I'm doing is different to that.

Because it's in mathematics.

Yes it's mathematically specific inquiry, so I'm trying to find how we get the method of maths into secondary classrooms, in an hour-long chunk.

Sorry, I broke in there.

No, I was just going to say – you went abroad, and then you came back again, presumably. Obviously you must have come back.

Then I came back, worked in supply for half a year, settled in B__. Stayed in B__ as head of maths. After two years, got a head of maths role.

Two years after you came back?

Yes.

So that was in the early 90s?

2001.

How long were you abroad for then?

Six years. Taught abroad six years.

Just trying to see the timeline. You did your PGCE in…

1989-1991. '91 to '93 I was in I__, '93 to '99 I was abroad, '99 to 2001 I was _____ ?postholder (1:00:48) for a bit. 2001 – around here, they were already having difficulty finding a heads of maths, because when I went I was the only candidate in a very prestigious school for this area. I was the only candidate and I was shown round by the head himself, round the school, and basically offered the job there and then. That was a really good experience, because he was part of the school's… hold on, the SSAT specialist schools - ___ academy trust. He was leader of the Leading Edge schools and that was just great. He was part of the 2020 vision that they were working on.

So my ideas then flourished, allowed me to develop these ideas that have been germinating in my mind. That was a very, very productive period. That's the formative period of what I now call Inquiry Maths. Yes.

From 2001…

2001 to 2007. 2007, he left.

The head left?

The head left, to be head of W__ Academy which was sponsored by W__ School. So that was quite a prestigious move, with A_ S__, in W___. So I then thought right OK, I've done my time, done my service to the community, I'm moving out to…

(overlapping 1:02:25)

Yes exactly. Where students behave. I shouldn't have said that. Yeah, didn't enjoy it at all.

No?

No. Came back to the same school, by which time the head has changed. He and I didn't see eye to eye. I left and came here.

OK. Yes I can't say I enjoyed my time working as a head of department in a ____. I didn't enjoy it that much at all. I liked working in London. I didn't much enjoy working…

Were you head of department in London?

No, no – I was a head of department in Huddersfield.

And why didn't you enjoy that?

The people I was working with didn't share the same ethos as I did.

The leaders or the staff - or both?

Staff.

Staff, right.

I never had any… I thought when I arrived… I want to say I thought when I arrived it was a mistake, but I thought hmmm OK, [?I don't want to be] the person who leaves here first. Five and a half years later, I was the person who left. They'd all been there forever.

You left first, after five and a half years?

Yes.

Laughs. Oh dear.

Yes. It wasn't a good experience, so…

That's a very tough challenge to take on though, if everyone has been there for a long time before you arrived.

It wasn't a very… with hindsight, and hindsight is a wonderful thing, I should have left after two years. By then I knew I was just banging my head against the wall. But there you go. That's life. After that I decided to do my masters and just do supply, so I did that for a couple of years, and then Sheffield Hallam started offering me work, so I did supply half-time, and half-time at Sheffield Hallam, until I got a full-time job there, in 2007.

It was absolutely great for about seven years. Absolutely great. I enjoyed working there. I thought, I'll just work here.

See out my days.

Yes, I did actually, but a couple of years ago, things changed.

Why, because of the government's changes to teacher training?

No. Well, there was that, but was that sort of… I could have / did live with that. It was to do with… we had a new head of faculty and then he appointed somebody who is the new head of… we have an Institute of Education now.

The Dean?

No, she's a director. He's the dean. She's the director of Sheffield Institute of Education, and I don't like her at all. I don't agree with her. I don't agree with what she thinks.

Give me one thing that she…

Well, she cut our resource for a start.

But that's not ideological, is it. That's…

It is partly ideological.

Go on.

It is partly ideological in that… I'm recruiting for an undergraduate route where people can do an undergraduate degree…

A four-year degree?

Well it's three actually.

H__ did one like that, yes.

You get QTS after three years, provided you pass everything of course.

There's a similar course at University of Sussex.

So they cut our… the students get less [?rights]. There's all this rhetoric about, you know, being more student-friendly and all, but at the same time they're doing the exact opposite. I just disagree with that whole thing. The direction of travel, I think it's called these days. I completely disagree with the direction of travel the university is going in, and teacher education in particular.

So they're cutting your resources to give to another route, or just to cut costs?

This is where the changes come in, right, because we are subsidising - the undergraduate routes are subsidising School Direct.

Ah, OK. And that's the government pushing, isn't it.

Yes. So Sheffield Hallam is… and we have a lot… well, secondary have only about… we've got 70 mathematics undergraduates.

Really? That's a lot. You mean over three years?

Over three years. But that's falling. It's [?gone up]. I managed to recruit 32 last year, which was good. But this year we'll be lucky if we get 20. But mind you, now that we're forced to come out of the EU, those things might change. Because whenever there's a recession, mathematics recruitment goes up.

Exactly, exactly!

Overlapping – indecipherable

It might do you a favour. So, you get a degree, a first degree and QTS. That's a very good deal then, isn't it, because you normally have to do that over four years.

Yes, there are arguments for and against. So, in Year 3 you get a £9,000 bursary, right. And then at the end of that year you've got QTS and in your fourth year and earning – what does a newly qualified teacher get, £24,000 or something. So, OK. But if you do a maths degree or some sort of other degree which has got a high mathematics content, about 50%, then you can get your degree, and the government will give you a bursary of up to £30,000.

Wow, indeed.

And that's tax-free.

That's shocking. I mean, I was talking to someone who was doing School Direct this coming year, and she knows two other people from her course who are also doing School Direct just for the money. They've no intention of going into teaching. It's just…

It's a good deal. If you get a first degree, it doesn't have to be in mathematics, it can be in some heavily… engineering or something like that. I did an engineering degree originally. You get your 1st or your 2:1 or even your 2:2 and you get £20,000 and if you get a 1st, £30,000. Tax-free. So that's worth, £40,000

before tax, you know. OK, so you've got a year when you've got a bit of stress, but if you have no intention of doing it, it gives you another year to not be… I don't know. I wouldn't do it.

You're cheering me up. You're cheering me up because, in my position, I've done a masters as well and studying for a PhD – I've always questioned myself whether I should actually be full-time in secondary schools, and hold to that, which I've tried to hold to. Very difficult doing that and studying. And whether I should go into university teacher training or whatever. And in fact people from B___ have approached me and I've said no. Approached me to apply, not approached me for anything else. And I said no. So all this is good – you're unsettled by it at the moment. Or you don't like the direction of travel.

Well, there are particular circumstances at Sheffield Hallam University, OK.

Well what you're saying I've heard from other people in terms of the development of university courses. And not the de-privatisation, but the…

The de-professionalisation do you mean?

Ah, yes… or the way the School Direct works. There's almost a feeling from the government that universities are going to inculcate this kind of permissive message about teaching in progressive ways.

If only that were true! I wish it were true that we had more influence on the students we have. Because we have a three-year undergraduate degree, we have obviously a bit more influence, but, you know, people make up their own minds.

Well, that is true. In my course I remember that it was split. When we went into Mike Ollerton's courses we either loved him or hated him. And it was quite down the middle.

I would say the same was true of my course. I did my PGCE in 84/85 and I loved it, right, because my degree was an engineering degree, and it was just like a ray of sunshine after that. I did it five years later, four or five years later, but I thought I really enjoyed my PGCE. I thought - I've made the right choice. So, yes.

Yes. I enjoyed it, but it was fortuitous that I ran into Mike. And other people would say it wasn't fortuitous. So the problem with the government as I see it, and universities, is that they want everyone to go in one direction. Whereas what used to happen, as I understand it, there was more freedom. So a personality like Mike Ollerton can teach his way, and no-one would necessarily dismiss that, and there would be no pressure for him to change. I'm talking about when I was there – 25 years ago – and we also had a more traditional sort of approach from another lecturer. So, yeah, I see it as a quite... they wanted us to teach in a certain way and they wanted teachers to be taught in a certain way, or trainee teachers to be taught in a certain way. That's just the impression I get. This whole mastery agenda is obviously coming online, in for secondary. It's becoming rather all-pervasive in primary, unfortunately. And I think they're just waiting to mount the attack on us.

You don't like mastery then?

Ah, not the way it's taught, no.

Oh I would have seen it as an opportunity to do something different rather than just having…

Yes well I've got into _____ (*background noise obscures* 01:13:17) about this because he claims that inquiry can be incorporated into a mastery style of teaching. And I wholeheartedly disagree. So we've had an exchange on blogs I've written – he's written something replying to something I wrote and then I wrote…

[Interruption]

How many questions have you got left? We're only at question 1! *Laughs.* I told you I could talk forever!

We're nearly done actually.

OK good – 10 minutes, 5 minutes?

10 minutes at most I'd say.

I see mastery and inquiry very differently because – just very briefly, one sentence: mastery is directed by the teacher, the teacher sequences the learning in very precise small steps. Certainly the Chinese teachers that I've observed – two now – have done that. That's everything I've been told about the Shanghai model of mastery. That's what happens. I'm interested in students having a say in the direction of the lessons, as explained earlier, and that is the complete opposite of a tightly controlled, teacher-led, sequenced lesson. So I see mastery as it's presented here and my inquiry model as very different.

I haven't read… all I've got are general impressions about mastery, right, and I think it means many different things to many different people. My personal interpretation of that is that it gets away from this endless thing we have in this country about differentiation. We continually differentiate for the children rather than have them…

[Interruption in classroom]

Yes, [?some if not most all of mastery] gets you away from that approach where you think you have to… we separate children by perceived ability.

There is that element to it, but it's because in primary all the students have to move through together. That's the aim. If a student doesn't achieve a sufficiently good understanding of something, there has to be remedial action straight away. That's the Chinese model. Then if the student still doesn't get it, it's their responsibility – or their parents' responsibility or their guardian's responsibility – to make sure they do get it. So the mastery model is that everyone moves through together.

It seems to be better than sort of telling people they've only got a fixed amount of ability, whatever that means.

I agree with you. I still think you can say even with differentiation, you don't have to couch it in terms of, you know, your ability goes to there and that's why I'm giving you the easy sheet. I'm just uneasy about it, to be honest. I'm uneasy. I know what happens to the children that don't keep up in China.

What happens to them?

They get shipped out and go to special schools and are never seen, and are not entered into PISA exams because someone… There was a teacher in Brighton who got to visit and that was her experience. So, I'm uncomfortable with that approach.

I'm sure all that happens. It just seems to be an opportunity to get out of some really bad stuff that happens in this country.

Yeah yeah I agree, but what people are saying is that this is good, because if everyone stays together, everyone gets the building blocks at the right time. As maths is a subject where you have to have the brick below before you can learn the brick above…

You see, I don't necessarily agree with that.

I don't agree with that at all. This worries me, you see. It's justified through the building block model. For me…

That's one of the reasons why people think that you have to set in mathematics – it's because mathematics is hierarchical and you need one thing before another. I don't agree with that either.

Well, exactly. So this whole thing about moving through together is everyone gets the brick at the right time. That makes me uneasy.

I hear what you're saying and I'll think about that.

And the idea of everyone turning up in secondary school and we know that they can all do exactly the same things at exactly the same time at exactly the same method… you know, also concerns me. That's problematic for me, because actually we learn – students learn – from each other. And I learn from them when there's something different going on. And I'm challenged when I see something unexpected. So, it's just… as I said to someone else, you can see a set of automatons coming through - *[makes sound effect]* – on a production line. And we just keep them moving through the next year of mastery.

I had _____ (1:19:27) in those sort of terms, but…

I know what you're saying though, because people are talking about mixed attainment. They're saying we should have mixed attainment lessons, but they're not talking about it how I would talk about it. They're talking about everyone should be at a uniform position. Same position and all move through together so that the bricks are built at the right time. And all that stuff concerns me, because that's not my view of maths and learning. *Laughs.*

I think we'll have to move on to the next question.

Yeah, please!

I asked H__ this and I asked ___ this. Because you organise differently from most of the rest of the country in terms of not grouping by ability, OK, have you come under any pressures, additional pressures, because of that?

We've had some issues with parents of… well, from their position, their children are very 'able' at maths and they're concerned that they're in classes with people that aren't very 'able'.

Here? That happens here?

Yes. Not in many cases – we've had a few who need reassurance that their cherished one is being challenged at the right level. Interestingly we've had problems challenging the middle ability at the right level, because we're very conscious of the 'top end' and making sure they make the progress that they're capable of, and in a way we kind of over-emphasise that to teachers perhaps. And also we've got support in classrooms for 'level 2', 'level 3' students (in inverted commas, in terms of levels). And the middle in the way we've structured it – you know, in research, as I understand it – do better in mixed attainment groupings rather than setting situations. They haven't made as much progress perhaps as the two ends, because we're over-compensating. We've read the research and over-compensated at the top end, the top attainment end. So it's been interesting. We've taken on board the research but then over-compensated. Well, the research that we've read anyway.

So there's been a bit of pressure from parents, but in terms of within the school?

No, not at all. Well, sorry, did we just go through in the interview that we had a year with the deputy head? Yes we had a battle – we did have a battle. There was scepticism – no doubt about that. But, you know, I can understand – it was a healthy debate. There was a healthy discussion. And we got the right result, so I can be magnanimous now, but, you know at the time it wasn't so pleasant, because I was becoming frustrated having been given a guarantee. But we had the debate and that's exactly how it should be. Interestingly, when the head said everyone goes to mixed attainment, we didn't have that debate and we should have had that debate. That would have been very constructive to make sure everyone was on board and understood what it was about, and the philosophical roots to it, as I see it, the reasons for it.

So it was a bit of…

As I explained earlier, staff as well. Some staff who were here before – some of the established staff – weren't keen either. So yes it's nothing that I wouldn't expect and have not had before and couldn't handle, in a way.

Now the new head has come in and said no we're not having that anymore.

Sighs. Yes.

What happened?

I'd already decided to go, because…

Had you?

Yes. With the head going, and us getting Requires Improvement again, and the results not moving at the top end because they'd had five years of this setted situation – we hadn't changed that. We hadn't been able to change that for them as they worked through the two years they'd gone through and done SAT exams under me, as it were, under my leadership. They still suffered, I think, from being set from day 1. So we didn't get… the results were the same as the year before, the same as the year before that, so you do the same, you get the same results. The changes we made hadn't had time to work through, but I knew the governors weren't happy. In fact, they appointed the head… one of the reasons they appointed this head is because she'd previously been a head of maths.

She'd been a head of maths?

She'd been a head of maths. So I knew that whatever I felt philosophically, educationally, if I was going up against a headteacher – not going up against her – discussing with a headteacher who had been head of maths and had done it her way, and me being, as you said, in a minority, in terms of mixed attainment and my ideas, inquiry and so on, I know that's definitely the minority in UK schools. I knew there were going to be some issues. So, time to go. Pastures new. Find another school. They've got mixed attainment in Year 7 and so we can build on that.

So that's H____. Bit of a change, moving to London?

[?Go back to London] - I've just got to get back there and see if I can do it. See if I can teach, after the initial two years. *Laughs.*

I'm sure you can.

Let's see.

It's changed quite a lot, I think.

Yes, yes.

My last question. Do the children ever say anything about their groups or about how they're organised? Or is it just…

No, no.

It's just their parents – one or two parents occasionally?

One or two parents of the 'high end' – high attainment end.

That's what the research shows actually.

Yes. No other parents…

Parents are the problem. Not parents of low attainers. It's the parents of the high attainers.

Yes.

The people who think their children are ahead.

Well, exactly. I can't remember one student making a comment about the way the class was structured. No, not at all. No. Well, you know, they take it as natural. If they come in Year 7 and they're in mixed classes or all attainment classes.

But some of them must have been coming in from primary schools where they were being set? Have they?

We say to them, this is a new start. We say to them, you might have been in sets before but show us what you can do. This isn't about us judging you. You show us what you can do, you

make the progress you're capable of. So, yes, over to you. You're responsible. We're not going to pre-judge, we're not going to say that you're this or you're that. We've got the data from primary. But over to you. We put the responsibility on them. So yes I suppose they see it as just natural – the way it is.

Good. Anything else that you think you might not have covered?

Well only that my reasons for mixed attainment are the philosophical reasons of social justice and giving everyone a chance and putting the responsibility on the students, giving them the opportunity to show what they can do rather than me say 'this is what you can do' and bad luck whether you think you can do anything else, you're not going to get the chance. So, for me, it's about those reasons.

Social justice.

Social justice, yes. Exactly.

Great.

That's a nice place to stop. Social justice. Yes.   `- END OF RECORDING -

Appendix 3:   Pete's story

Pete has an educational background as his father was the headteacher of a small primary school in a mining village in County Durham and perhaps unsurprisingly, education is always something that attracted him. At the time he was growing up people in the 'mining communities … in the North-East … put a very high value on education'. He says

> *When I grew up, the most important thing you ever got told by your grandparents was get an education so you don't have to go down the pit.*

As a teenager he attended a 'good old-fashioned Catholic comprehensive' on the outskirts of Durham in the 1970s. The school was attended by working-class children from the mining community and was led by a headteacher who was a 'good old Labour Party man'. Pete particularly enjoyed his experience in English and mathematics classes, recalling that those subjects at least, were taught in mixed attainment classes until years 10 and 11. Even at this early stage he engaged in helping those whose understanding of mathematics wasn't as highly developed as his own. He found working with other children a positive experience, his own mathematics didn't suffer and the children he worked with benefited from his help.

After school Pete went to university in London to do a mathematics degree. He self identifies as 'being good at maths' such that he would

> *Regularly end-up in the run-up to the end of the year exams basically running mini-tutorials and seminars to several of [his] fellow students … [Once towards] … the end of year 3 … [he] remember[s] having to teach 15 people and … [thinking] … actually I'm quite enjoying this, it's a nice thing to do. I feel good about doing this. According to what they were saying [he wasn't] bad at it either.*

Following on from that he did a PhD at the same college. However although he enjoyed the mathematics

> *he wasn't that keen on going into academia [as it] didn't come easy … he didn't enjoy the relative isolation of that work … the very limited degree of social interaction involved in that.*

He considered teaching mathematics but then the miners' strike happened and he became very involved with journalism and left wing politics such that it was twenty years before he thought about teaching again.

Over the next twenty years Pete's had a job, which was unrelated to mathematics, that could take him a long way from home, sometimes at very short notice. However, when his son was born Pete realised that now he had a family he would need a more conventional sort of job, one where he wasn't required to be away from home much of the time. He still loved mathematics so weighing everything up he decided to do a PGCE and train as a mathematics teacher. He obtained a place at a London University College where the tutor emphasised conceptual understanding, the role of history and issues around social justice which was fine with him. Pete's own secondary school experiences predisposed him to mixed attainment teaching.

> *The tutor encouraged people to think and read and explore. And the more I read, and the more I went into different schools … the more I became convinced that both philosophically but also in terms of evidence, the*

evidence that setting was an effective way to teach wasn't high. And that there was at least good evidence philosophically … that there could be a better way to do things.

After gaining QTS Pete took a job at a school in East London. Before he took the job he understood that the school taught mixed attainment at KS3. He thought

This sounds good, mixed attainment, I'm reasonably convinced now from what I've found out and read about, so it would be good to get a chance to try it.

However, he found the reality was rather different. Although the students were taught in form groups they were organised within the classroom in a similar way to many primary schools: there was a red table who used the red book, and a table using the blue book and one using the green book. He became increasingly unhappy about this and in his second year, seeing a job at a nearby school which was a promotion, he decided to apply for it. However, he thought

I'll make it clear where I'm coming from and more or less say if you want to give me the job, what I'd like to do is use lots of collaborative activity-based learning … [like] … the Standards Unit. And I'd like to, at least in Keystage 3, work towards … mixed 'ability' or mixed attainment.

Pete got the job. The Head of Department's attitude was if that's what you want since you're responsible for Keystage 3 you do it for Keystage 3 and see if it works. Despite major opposition to the introduction of mixed attainment by some of the staff, Pete drove it forward, persuading 'three or four other people to go along with'. Mixed attainment was introduced into year 7. Pete did everything including writing a scheme of work with all of the lesson plans and all of the resources. During the first year one other teacher became quite enthusiastic which Pete found very helpful.

By the end of that year several members of staff remained unconvinced but

the ethos was better among the year 7s, the kids were starting to enjoy maths, there was less disaffection, and the lessons were getting a bit more interesting. So, people suddenly thought – not everybody, but quite a layer of people … maybe this is worth looking at.

The Head of Department was convinced and made sure people couldn't block it. Mixed attainment was rolled forward into year 8. Although the classes in year 7 and 8 were mixed attainment the teachers were free to teach in any way they liked, they didn't have to use the resources provided.

Only in a minority of lessons with a minority of teachers did something else begin to happen, but it was enough … by the end of two years having been through it more people began to be convinced …

At the end of that year mixed attainment was pushed into year 9.

During the first two years there had been some staff turnover, so the mathematics department was able to recruit some teachers who shared a mixed attainment ethos. One of these was Philippa who Pete describes as a key appointment. He had worked with her before. She had taught at another local school and they had worked together outside of school on a booklet on proportional reasoning.

We spent a year working on it, to use it as a model of how to teach
mathematic's concepts in a … mixed attainment setting.

They had put a lot of effort into it, working on it and trialling it in school but it had been worth it as the students 'really liked it and the mathematical learning was very good.' That unit had helped other teachers to appreciate what Pete and Philippa were talking about. The appointment of Philippa 'sort of put that heart in the faculty.'

The mathematics department had developed a policy of taking 'lots of PGCE students' with the aim of recruiting them if they shared the same ethos and a suitable job came up. Three quarters of the department now shared the same philosophy, agreeing broadly with the department's way of teaching.

Nobody wants to go back to setting in Keystage 3. Not a single person … so
in a sense we've convinced enough people that there's now a settled ethos
in the department that in year 7, 8 and 9 people … prefer to keep mixed
attainment classes. They feel it works.

This philosophy encompassed not only that of embracing mixed attainment teaching but also a belief that mathematics teaching was a fundamentally creative and collaborative activity where people including teachers were expected to work together. A lot of emphasis was put on no one planning alone.

All planning is done collaboratively. We have time set aside where people …
meet regularly … there are some units we've made and there are some
good resources but … we've agreed collectively after lots of discussions, we
have broad scheme of work, we're not very prescriptive about the detail,
but let's create some lessons and units. Put the emphasis not on creating
individual resources or lessons, but creating whole units that make
mathematical sense, of a journey …

Pete said they were confident enough in their own mathematics that they didn't refer to the National Curriculum but after departmental discussions decided what the students needed to know by the time they got to GCSE. They had gotten rid of lots of content but also taught material that either wasn't in the curriculum or was taught at A Level including some topics from graph theory which were accessible at any level. They were interested in getting the students to understand the big ideas, the big concepts in mathematics so they concentrated on 'securing a feeling for number in year 7, they did a lot of geometry and algebra in year 8, going further in year 9. If they thought the mathematics was accessible to the year group they included it. One of Pete's guiding principles was to ask

Does this make mathematical sense to you? … Do you think, if your kids
learn this, it's going to equip them to become better mathematicians and
be able to think mathematically? If you do let's play with that, let's explore
it and let's talk to each other about it and see if it works. And the proof of
the pudding is - does this end up with kids being able to function
mathematically across all of the attainment ranges? And obviously as far
as upstairs is concerned, and the kids are concerned, does it lead to better
outcomes? There's always that accountability. But so far the evidence
we've got is that it works by and large

In the year 9 curriculum they had included some spherical geometry which some people had thought would confuse the students but Pete said

By doing both simultaneously, their understanding of and retention of the plane geometry … is much higher because its more interesting and engaging.

And because set theory was back in the GCSE curriculum they had introduced that in year 7 so that it was just another part of the students' learning. Pete said although it might sound like hard work as the teachers had to work collaboratively on developing the materials they liked it.

People feel some ownership, some creativity and it's all collaborative - nobody does this on their own. It's all teams of twos, threes, sometimes fours working together. … people like the fact that it's not isolated … partly because the first year Philippa was here, me and her modelled that all of the time.

Pete and Philippa had got to a point where they had worked together so often that they had reached a level of trust such that they were confident that if they planned the broad outline of a series of lessons they could confidently split the lesson planning between themselves so that each would only have to prepare the resources for half of the lessons. As time had gone on this type of working had developed in the department

There's more of that where people are working together and developing that kind of trust, where you discuss some things in detail but other things you get a common language and a common approach. It evolves naturally … over time your workload gets reduced because it's a team.

Pete thought he might not have been able to sustain this method of working if it had just been him. The arrival of Philippa who shared his approach and his philosophy had been 'more than helpful'. And now that the Head of Department had decided to move on he and Philippa had extended this approach into the leadership of the mathematics department. They had applied to lead the department jointly.

We modelled this collaboration by insisting to the school that we're not having this hierarchy any longer. Me and Philippa will be joint heads of faculty … so now we just share everything with everybody.

They had consulted the rest of the mathematics team on issues such as the timetable and the budget, not that everything was plain sailing.

It doesn't mean you don't have arguments with people … but the point is at the end of the day, if you try and force people to do things it's not going to work. You have to convince, persuade, show … but at the end of the day, there isn't a short-cut. It will only work if people want to work here, within this ethos and feel that they're a valued part of the team.

During the time that mixed attainment had been introduced no-one had left the department because they disagreed with the current environment although some people had left because of other factors such as having children. The young teachers who had come wanted to stay; they were happy with the mathematics department even if things weren't quite as satisfactory higher up the school. The department's ethos wasn't simply about mixed attainment teaching but also about 'what mathematics education should be about, what teaching should be about'.

The department had recently taken part in some research on the teaching of fractions in year 7 with another school in the Local Authority where the children were in sets in mathematics

classes. The results had shown that children at the top of the attainment spectrum in both schools had made progress but the middle and lower attainers at Brierley Grove had made much better progress than those at the school which setted. However, the students who had made the best progress were the high attainers at Brierley Grove.

> *What's interesting, that's true of every class … Every single class without exception - the same pattern*

Pete said the classes where the greatest progress was made were the classes where the teachers were most involved and most convinced by mixed attainment teaching - it made a difference - but even were teachers weren't so involved the same pattern occurred.

> *I'm not claiming this is any great piece of research but it certainly helped convince people here … the effect it had … was to convince people in here that … because the fear that was always expressed was if you do mixed attainment teaching, it'll be okay for the weaker and middle kids but you'll hold the top kids back.*

Before the research at least half of the department were convinced that the research would show the opposite to what it actually showed, that the high attainers would do worse when they weren't in sets. Pete got the Head of Department from the other school to come and present the findings. He said,

> *People were shocked when they saw it. … [it] shifted people to the point where okay this is how we do things now … it was useful.*

Pete strongly believes that mixed attainment done well, is of great benefit to the students and says the evidence is that the highest attaining students do particularly well.

The department had had a recent OfSTED inspection in which 'their key focus was challenge and stretch for the most 'able' students'. The inspectors were 'more than happy with what they saw'. Moreover, Pete expected that the current students sitting GCSE this year would achieve at least 20% A/A*which was significantly above the national average. The department also entered students for an AQA level 2 certificate, a bridging unit between GCSE and A Level. Most schools entered only those students they were confident would get an A* but Brierley Grove never entered fewer than 35, telling the students the results didn't matter, the experience would help them post-16.

Another worry of teachers was about producing lessons that engage all of the students. Pete and Philippa had modelled the teaching of this unit and people had been convinced once they had seen what it could look like.

> *You can have lessons which engage all kids where there's kids of different attainments working together and they all bring different things to the tasks of whatever you're working on, and they may be working at all sorts of different mathematical levels, but they can learn from that and it can make them feel that they're capable of learning mathematics and the buy-in becomes very high.*

Pete and Philippa didn't tell the other teachers just how much work they'd put into making the lessons work as people needed to have some 'physical, real examples in front of them' but once they were convinced it could work, then the teachers were willing to give it a try and work a bit harder to make it work for them.

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For Pete a good mathematics lesson entailed a lot of talking, not by the teacher but by the students engaging and grappling with something mathematical.

> *It might be they're exploring something, investigating something. It might be they've already learnt something and they're trying to apply it to a new problem … the general one for me has to involve dialogue of pupils and then doing some actual mathematics in the course of the lesson and the teacher shouldn't talk too much.*

However, this wasn't something that just happened. Starting in year 7 Pete said that you built up the expectation of the students that they would

> *come into a classroom, be posed some mathematical questions, which you have to carefully construct, but then the main responsibility was then on them to discuss and argue and explore those.*

The teacher would be there to guide and help them if needed but it was the students who had to do the mathematical thinking. The students would all be working in teams on the same problem, some would have more mathematical tools more readily available and the teacher would need to have a

> *whole set of questions ready to probe and target at different kids … all students are engaged in real mathematics and developing real mathematical ideas in a mixed attainment setting, but in a way that they're all engaged essentially in the same task.*

In the coming year the department was planning to trial mixed attainment in year 10. There were going to be 8 classes, three of which were going to be taught in their form groups, the others were going to be set. The tutor groups were going to be taught by Pete, Philippa and Akhila who were all strongly in favour of extending mixed attainment to Keystage 4; the other teachers were nervous about this because of the potential effect on GCSEs. Pete was fairly confident that there would be a positive outcome but he didn't know for definite as it was uncharted territory. If it worked the rest of the department had agreed that mixed attainment would be extended to all classes in year 10. Pete had not yet written a Scheme of Work but he was looking forward to the challenge over the summer. He thought it would be fun and they would enjoy it.

The latest GCSE results in mathematics had been excellent having improved to the extent that they were now above the national average in terms of A* to Cs. An added bonus was that this cohort had been the first to have experienced mixed attainment from years 7 to 9. Pete acknowledged that the results had not improved simply because of this, other factors were at work in the school but said it hadn't done the mathematics department any harm. Mathematics was now the most popular subject at A Level.

Pete describes himself as

> *one of those lucky people who can honestly say I actually look forward to coming into work every day. I can't remember a day when I didn't enjoy being in work. … Honestly I go home every day thinking that was enjoyable. … I'm lucky here … we get a lot of freedom … nobody tells me what to do. As long as the results are okay, we get through things like OfSTED … as long as everything is fine and we tick all the right boxes as well, they basically leave us alone. … there's a game you have to play … but as long as we hit*

> *all of those things nobody ever interferes that much in how we do it, so …*
> *compared to most schools I'd say we have a relatively high degree of*
> *autonomy.*

Pete said that they'd had a deliberate policy of finding and recruiting people who were mathematicians and in fact all of the staff that had been recruited were mathematicians. They looked for

> *People who are passionate about mathematics … not just something they're*
> *doing as a job, but who genuinely and passionately say that is something*
> *that makes them tick.*

Pete thinks it is important to the students that they

> *can see that their teachers are mathematicians who enjoy doing*
> *mathematics … because if you want to communicate to the kids and inspire*
> *them about mathematics as something they can be passionate about and*
> *buy into and enjoy and it can be part of life [and] it's not something you do*
> *to pass an exam [then] … that does mean the staff have to embody that,*
> *that actually mathematics is more than that.*

He wouldn't employ anyone unless he was convinced by them that they 'were passionate about mathematics'. It was his first criteria.

> *Convince me that mathematics is something you're excited about. We'll*
> *find out if you can teach and do all that kind of nonsense … and if you can't*
> *we'll teach you how to do that but the one thing I can't teach you is to be*
> *passionate about maths.*

As well as recruiting teachers who were passionate about mathematics Pete said they put a lot of emphasis on retention:

> *If you put a lot of effort into building a team who are passionate about*
> *maths and at least have a shared view of how to teach maths there's no*
> *point in doing that if you don't keep them.*

So, for example, although Akhila was quite new they'd given her quite a lot of responsibility and were supporting her in her masters which was focused on trialling mixed attainment in year 10. This was also valuable to the department as it allowed them to experiment.   They were also giving Jean, who was an NQT, opportunities to develop her interest in drama by working with someone from outside to bring some more creativity and imagination into the classroom.

> *So we're constantly looking for opportunities. How do you build a team:*
> *keep[ing] it enthusiastic, happy, creative and keep[ing] some stability is*
> *quite important.*

Half of the team were ex-PGCE students who fitted in with the department's ethos and had chosen to stay. Pete hoped that they felt valued and supported. He felt the team was getting stronger with more teachers either choosing to work at Brierley Grove or being head-hunted to work there.

Pete had also employed Fred, who was trained as an art teacher, as a long term supply to cover for a teacher who was off on a long term illness. Pete said Fred was

not going to start by teaching A Level or top set in year 11 but anything else he's fantastic in. So you don't have to be a maths specialist, but you have to enjoy maths. And Fred does, and he works at it. And he'll sit around and play with maths the same as everyone else. Now we have supported him to develop his subject knowledge to the point where he is starting to teach A Level too.

The department did come under a bit of pressure as the prevailing culture was that you should set 'as allegedly it was better'.

We're quite robust about that and challenge people. If you were to argue that, you would have to engage in a heavy debate backed by evidence.

The pressure was there but the GCSE results were excellent. As long as that continued to be the case Pete said they'd be left alone. However, Pete said

If the results ever start getting problematic, I suspect those pressures would intensify a lot. … the trouble is, unfortunately, because of the exam factory thing in schools … it's a bit like being a football manager. You live or die by your results.

Pete thought the previous headteacher who'd been in post a few years was in favour of setting. He had broached the subject when he'd first arrived but had been disabused of the idea as Pete had suggested if he was to go down that path he'd be looking for a lot of new mathematics teachers who were in short supply in London. He'd dropped that idea and hadn't mentioned it since.

Pete thinks it is important for the department to engage with government reports and academic research both as another way of coping with these pressures and so that they can keep up to date with current developments in mathematics learning and teaching. He regularly gives the mathematics department staff papers to read but is realistic about how much people will actually read.

I'd say half the maths staff read quite a lot. … [it] creates a culture where a greater proportion of your staff are engaging with these issues. And having sensible conversations about them … even if they don't read all of it … that gives them some confidence that you sort of know what you're doing.

He also compiles dossiers on research evidence which he gives to the head. He believes it

sends a message - whether you agree with what we're doing or not, it's not just we've made this up on a whim. People are seriously engaging with research and evidence, so there's a purpose behind this and they're doing it for a well-thought-out set of reasons. If you don't agree with that, well fine, but come and have a proper argument about it.

When OfSTED had produced a report on Keystage 3 – The Wasted Years, he and Philippa had read the report and done some research on mixed attainment. The newspaper headlines said 'Wilshaw[54] says you should set'. They went to the headteacher and said

Actually that's not what the report says, because if you read the report what it said was that where it's done well, mixed attainment – he called it

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[54] Michael Wilshaw was the chief HMI at that time.

mixed ability - teaching works well. The problem is most teachers can't do it, therefore you should set.

One of the features of mathematics learning at Brierley Grove was the use of *learning journals.* Every student had to keep a *learning journal,* the idea being that the students should take 'more responsibility for summarising their own learning'. They had originally taken and adapted the idea from a school in leafy Cambridgeshire which organised its students in mixed attainment groups in mathematics at Keystage 3. At first it had been difficult and the first year had been 'quite a battle' but 'now the kids just take it for granted.' Over time they had taken ideas from other sources and the learning journal had evolved over the years but the department thought it worked quite well. The students had to take 'responsibility to do … learning notes reasonably regularly.' More generally education wasn't something that happened to you, it had to be 'something in which you were an active subject'.

Pete thinks that there are two aspects to education. The first is that

education should be about primarily enriching and liberating the human personality and spirit … that the purpose of formal schooling should be to encourage and develop and stimulate people to become the active subject in education for the whole of your life. … it's getting people to the point where they get to adulthood that they have access to the broad range of human achievement and want to continue that as part of what makes them human for the rest of their lives

The second aspect is being able to question the world. This entailed 'being open to learning', being 'capable of thinking' and so not just accepting authority at face value but challenging and questioning and not simply accepting 'things that are handed down from above.' He would like it if schools saw that as their primary purpose but is realistic enough to know that the function of schooling is to 'play a structural role in the modern, industrial capitalist society.'

Pete doesn't agree with a philosophy that says students only need those skills necessary for the economic needs of the country; he thinks that this vision of schooling is too narrowly focused and even though students need those skills and should leave school with them a different vision is required. He thinks

If you don't have a different vision, and you don't struggle, ultimately, you'll surrender to their vision. … you have to fight for that within the current structures and do as much as you can. And not always succeed. But you do little bits sometimes.

But he is realistic about what is possible.

You can't wave a wand and wish away all of the structure and all of the other pressures, the social realities, that's not possible. But what you can do is to struggle and fight to push back a little bit against that, to create little bits of space. … Is it worth it? Yes, I think. Because the alternative is to surrender and sell your soul. And it helps keep teachers sane and it does in our department, and if it makes at least some kids leave with a slightly wider, better version of what education could and should be about than they would otherwise do, then it's worth it.

One thing Pete particularly enjoys are the residentials he organises for the sixth formers and year 11. It enables the teachers 'to model for the students a different vision of what education should be about'. The department takes about 40 students away for two or three days to a youth hostel usually shared by members of the public and without access to social media, or TV. The normal rules don't apply, the teachers and students are often on first name terms and they are free to go to bed when they choose. Although they are there to do mathematics, the students can do other subjects if they want to so according to Pete

> *You have to have teachers who are prepared not to be frightened to delve into other subjects.*

Despite the freedom Pete says they all do loads of work and are quite enthusiastic about it. Pete says 'they never disappoint you, the kids, never.'

Changing over from setting to mixed attainment classes had taken a long time because that was only the start of the process.

> *Developing how to teach effectively in those classes, that takes a long time. And that's still a work in progress … getting rid of sets is the beginning of a journey about what kind of pedagogy and teaching approaches are effective in mixed attainment classes … that takes a long time to develop.*

The department put a big effort into collaborative planning and development of the 'right kinds of tasks for students to work on, which work well in mixed attainment classes.' The department worked with the teacher who did the timetable to try to create 'blocks of joint PPA[55] time on the timetable, the school closed early every second Tuesday freeing up time for collaborative planning and the teachers did lots outside of normal time. Pete reckoned it took two years to create a good quality resource for a mixed attainment class.

> *I don't think you can start from a single resource. I think you have to start from a unit … a sequence of a couple of weeks learning. What might that look like? … what's the mathematical journey [for] different students? … what works, what tasks work well. It takes an awful lot of time. But it's worth it, because if you spend the time doing it well, it lasts.*

When the students get to year 10 they are put into sets but the sets are fairly fluid with a lot of flexibility for students to move around. Pete and some of the other teachers make it clear that they are opposed to sets but some students like it as it's a signifier that now they're entering the GCSE stage and you need to know whether you're doing the higher or Foundation examination:

> *I'd be lying if I said some kids didn't welcome that when they get to this stage.*

There was a lot of trust between parents and the school. The mathematics results were good and as long as that continued and their kids were happy Peter couldn't foresee any problems.

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[55] PPA - time set aside for **teachers** during their timetabled teaching day to allow them to carry out planning, preparation and assessment activities.

Year 10 was going to be different next year as three of the forms were continuing as mixed attainment classes. That would be a change from the current situation. Pete wasn't sure how these students would react as the majority of their peers would be setted.

> *If you play safe all the time you never learn anything, so that's a bit of a risk, to say how's that going to work. It's bound to create some discussion and dialogue, both between teachers and students.*

The reason for the trial of mixed attainment in year 10 was that the majority of teachers were worried about extending mixed attainment into year 10 because it was the start of GCSEs. Indeed, Pete thought that although the teachers were convinced about years 7 and 8 some of the teachers weren't very happy about having mixed attainment in year 9 because the gap between the lowest and the highest attainers was already quite wide and they would probably prefer setting. He said they preferred to persuade people by showing them that mixed attainment worked rather than just telling them it would work.

> *We're hoping by modelling - look this is how it can work in year 10 … what I'm hoping is that - not by the end, but by halfway through - the evidence might be that both in terms of engagement and happiness of the kids doing mathematics , but also the hard measures of attainment and tests and things like that, that increasingly over the course of next year … we can show to people … actually it does work. If that happens, the hope is that the following year we'll roll it out to the whole of year 10.*

Pete was reasonably confident about the outcome as the teachers who were most in favour of mixed attainment teaching would be teaching the mixed attainment classes. He described this as an 'unfair test' although it would be more likely to fail if any of the classes were taught by someone who wasn't convinced. The outcome would be decided by the performance of the highest attainers - if they did better in the mixed attainment groups that would convince everyone including management, but he still thought it was a gamble.

He thought that rolling out mixed attainment to year 11 would be much more difficult because of the GCSEs. There was very little teaching time, only the first term and even then, there was the pressure of the mock exams.

> *The pressure of the whole of year 11 is just exam prep and you're prepping the kids for quite different papers. It's hard to escape from that pressure.*

I later learned from Pete that the evidence from this trial was very convincing- that students of all attainments made more progress in the mixed attainment classes – and this was especially true of the highest attainers, contrary to expectations. This allowed Pete and Philippa to convince both teachers and school leadership to extend mixed attainment to the whole of year 10 this year. He reports that it already seems completely natural to both students, who prefer this way of learning, and teachers, and he says it would be difficult to imagine going back.

Further to this Pete and Philippa are thinking about keeping teaching in mixed attainment in the first term of year 11 – as this is teaching. Post the December mocks they are thinking of moving to what "exam preparation" classes for the last term – as that is really what you is happening in that term. However the department needed to talk through this a little more first.

Pete thinks that now the students stayed on to 18 GCSEs were a waste of time especially as he knew which students would benefit from doing A Level mathematics, 'I don't need an exam to do that.'

In addition the department had also found a knock on effect from their teaching at 11-16 to A Level. The school has very high recruitment (given the school size) to A Level maths, and in particular students who have come to enjoy maths a lot but may not have been the highest attainers at GCSE are doing it. For example they have several students who got a grade 5 at GCSE doing A Level maths who are doing really well- because they love the subject and work at it- including one who was of course to do Foundation GCSE until a month before her GCSEs, but who started really loving maths, and now is doing great at A Level.

For Pete mathematics is something that should be part of everyone's life. He doesn't believe everyone can access mathematics equally but believes everyone can access and enjoy mathematics in some way.

> *The more students that say they like mathematics and enjoy it, and that they feel they can actually do it, the better. I think that keeping that centre stage, despite all the compromises and all the other rubbish, that mathematics is part and parcel of what it is to be human.*

However, he believes that if teachers don't have that spirit then you'll never get it

> *Because if teachers don't have it, you'll never inspire kids to have it. [The department's motto is] 'Inspiring the mathematician in every student'. So that sums up accurately what I think is important. … fighting to keep that alive - it's a team project.*

Appendix 4:   Bob's story

Bob always thought he might do something in education, but it was no more than a vague idea. Returning home from a trip to Europe at the end of the summer he had completed his first degree he was at a loose end and was just drifting about, having no definite plans. However, his mother had other ideas. She spotted a two-year PGCE[56] in mathematics at a well-regarded midlands university and encouraged Bob to apply.   In Bob's words

> *… she was pushing at an open door. I was quite happy with that idea. It wasn't necessarily something I would have gone for but … in terms of social conscience that's what I wanted to do.*

Within a week he had had an interview and was on the course.

During his time at Midland[57] University Bob encountered a tutor who he describes as inspirational and who greatly influenced his thinking as a mathematics teacher, both at that time and throughout his subsequent teaching career. This tutor espoused a discovery method of learning which, according to Bob, his fellow students either loved or hated, there being no middle ground. At that time the tutor was comparatively new to teacher education and was, in fact, still working part-time in school. He so inspired Bob that he undertook one of his teaching practices in the tutor's old school despite the school being a considerable distance from the university.

On finishing his PGCE Bob was fired up with enthusiasm for teaching mathematics and like many young teachers

> *thought now I'm going to go and change the world and I'm going to go to inner London.*

He looked for and obtained a post in a challenging[58] north London comprehensive. However, at this point in Bob's story things started to go a little awry. Bob's teaching experiences on his PGCE had been in 'some very lovely schools in the local … area'. While this may be a good preparation for teaching in close proximity to the university it is not such a wonderful preparation for teaching in a school in challenging circumstances. Teaching in such schools can be demanding both emotionally and physically. Bob describes an incident which illustrates some of the difficulties he encountered, one which clearly made a considerable impression on him.

> *The year 10 class I'd taught snapped all of the pencils in the lesson before, all the coloured pencils … [and] came in with them in plastic bags, and every time I turned around to write on the board, bits of pencil rained down on me (laughing), and it went on like that for a year, and the second year got a bit better and then I left.*

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[56] Two-year PGCEs in mathematics were run by a limited number of universities and were an attempt to increase the number of graduates suitable to train as mathematics teachers. The first year was devoted to the study of mathematics in order to increase the subject knowledge of the students to a level where they could be competent mathematics teachers while the second year consisted of a traditional PGCE.

[57] All proper names are pseudonyms.

[58] A school in challenging circumstances would typically be a school with many children from poor families who have disadvantaged backgrounds.

Teaching in circumstances such as this takes a toll both emotionally and physically and Bob needed some additional support outside of school during some of the time he worked there.

Having decided to leave Bob went for a complete change. He obtained a post abroad in a private English medium school and spent six years there teaching history to comparatively mature students using discovery approaches. It was during this period he began to think about how this type of approach might be adapted for teaching mathematics in a state comprehensive in England.

Returning to England in the late 90s he obtained work as a supply teacher before eventually deciding to settle in a town on the south coast of England.   After a relatively short spell working at first as a main scale teacher and then as a teacher with a responsibility he applied for and obtained a post as a head of mathematics in, what was, a quite prestigious school for the area. He stayed at this school for several years and during this period he began to develop and put into practice his own ideas on discovery teaching in mathematics. He describes this time as being very important in developing his ideas. The school environment encouraged creativity whilst the headteacher was supportive leaving Bob to get on with running the mathematics department as he saw fit.

Bob is interested in a style of mathematics learning and teaching that is derived from the procedures that Polya suggested, a style which incorporates both deductive and inductive elements. The style is not purely discovery learning but also incorporates the teaching of relevant skills required to make progress. Bob says

> *The aim is for them to become more independent, they take initiative, [they are] more creative and they participate in directing the lesson as well as doing the maths and the procedures and skills would come into the lesson probably in the exploratory phase …. [it] might spread over three or four lessons. For me there is a … phase when students can question and from their questions you can assess actually very accurately their level of understanding. … a key element of a good lesson [is] that the teacher and the student are communicating, and each can see what the other knows and what they don't know and there's an opportunity for students to direct their learning …*

Bob has been developing his teaching methodology over a period of many years. To support the students in their work he has designed a series of card-based prompts which he calls regulatory cards which assist in the co-construction of knowledge between teacher and student, and student and student. As an example, he says one card says, 'I want to work with my neighbour'. He suggests one reason a student might choose this is because she might be feeling a bit insecure and would value the reassurance of a friend. The cards can also give the teacher the opportunity to reassure the student/s that they are doing the right thing and everything's fine. He thinks mathematical reasoning is an open process which can have multiple entry points, that people can make different observations about the same thing, that 'often it's about combining these observations' and

> *that mathematical reasoning isn't necessarily a very confined problem, [with] … only one answer, it's far more open than that.*

Bob disagreed with the National Numeracy Strategy and in particular the three-part lesson. He has designed his methodology so that students have the opportunity to 'take their interests

further if something grabs them' and to create opportunities for both teachers and students 'where there isn't that time pressure.'

Having run the mathematics department successfully for six years Bob decided to move to a school away from the coast. However, he did not find this move a particularly rewarding or satisfying experience and after two years moved back to his previous school. Unfortunately, for Bob, the headteacher changed and the new headteacher did not see eye to eye with Bob who decided it was time to move on to a new school. Looking at his options Bob decided to apply to Shortvalley as the demographic was very similar to his current school; it was comprehensive with a substantial pupil premium[59] intake (>40%). However, before accepting the post Bob negotiated an agreement with the headteacher that he could introduce all attainment teaching in year 7 which providing it was successful could be rolled forward to later years.

Bob's reasons for organising teaching into all attainment groups are

> *The philosophical ones of social justice, giving everyone a chance … putting the responsibility on the students … giving them the opportunity to show what they can do rather than me saying this is what you can do and bad luck whether you think you can do anything else!*

Despite this agreement with the headteacher there were a number of obstacles which Bob had to overcome before all attainment teaching could be introduced into year 7, and it wasn't until the September of his second year that Bob was able to introduce all attainment teaching. The first obstacle took the form of a deputy head who was sceptical about all attainment teaching. To overcome his opposition Bob had to produce evidence on the effectiveness of all attainment teaching.

> *We had a battle … there was scepticism, there's no doubt about that, I can understand that, that's a healthy debate … we got the right result, I can be magnanimous now but at the time it wasn't so pleasant …*

A second obstacle was introduced a few months after Bob took up his post in the form of an OfSTED inspection which placed the school in the *Requires Improvement* category as a result of the lack of achievement on the part of the students with a pupil premium. The response of the senior leadership team in the school was to impose a number of extra demands on the teachers including additional monitoring and target setting for the students. This extra burden shifted Bob's focus away from the preparations for the introduction of all attainment teaching. However, the OfSTED inspection caused the deputy headteacher to leave removing one obstacle although another one had been created.

The 'ability' grouping practices used in the school prior to Bob's arrival were markedly different from the more usual 'ability' grouping practices and are described in Sarah's story. The mathematics teachers at the school when Bob arrived had little experience of teaching in anything other than a very traditional manner, something that served the pupil premium students very badly. Students with a pupil premium who arrived at Shortvalley having achieved a level 5 at the end of primary school

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[59] Pupil premium - a designation of the coalition government: The pupil premium is additional funding for publicly funded schools in England to raise the attainment of disadvantaged pupils and close the gap between them and their peers (DfE 2016)

had slipped down to [set] 4 out of 5 because of a perceived attitude, I suspect, to learning and maybe behaviour issues as well and so the pupil premium students were packed into the bottom sets regardless of their starting points.

The teachers' pedagogy was quite traditional and very text book based. Bob's evidence for this was his observations of the teachers in his first year, the piles of textbooks lying around the department and the results of a survey of mathematics teaching by the LA prior to Bob's arrival which

showed that some of the most traditional practices were going on [at Shortvalley] in terms of how students were expected to learn.

Many of the teachers had been at Shortvalley a long time and, one of these teachers was 'philosophically' opposed to all attainment teaching. At the end of the first year the teachers 'could see the way the department was developing' and some of them left. Another teacher was opposed to all attainment teaching and indicated he would also leave if he was required to teach all attainment classes. In order to keep him in post (because of teacher shortages) Bob negotiated an agreement with him that he would not be required to teach all attainment groups but, in any case, he left at the end of the second year. Bob said

We were facing years of tradition … it was a tough nut to crack.

So, despite his desire to introduce mixed-attainment teaching in year 7 Bob knew he could not simply impose this. He needed the cooperation of at least some of the previous members of the department to implement it. As there were two parallel groups of five classes, five teachers were needed to teach year 7. As well as himself, Bob could count on two lead teachers, one of whom was Sarah, who were committed to all attainment teaching with an additional two others who were willing to give it a go.

The introduction of all attainment teaching into year 7 was successful in that the gap between the middle-class pupils and the pupil premium pupils opened up by a comparatively small amount when compared to previous years. As a result of this the mathematics department rolled all attainment teaching into year 8.

Having introduced all attainment teaching at Shortvalley the mathematics department had had a few problems with parents who thought their children were very 'able' at mathematics and needed reassurance that their child was being provided with an appropriate level of challenge despite being in a class with students perceived as being less 'able'. However, the mathematics department's main problem had been with the students currently achieving in the middle. They had been aware of research into all attainment and had overcompensated those at the top end and the bottom ends of the attainment levels and not paid enough attention to those students in the middle.

This positive outcome for mathematics led the headteacher to implement all attainment teaching across all subjects in the school in years 7 and 8. This decision was taken at a very late stage in the year and without a proper consultation of the teachers involved.

we didn't have … [a] … debate and we should have had that debate. That would have been very constructive, to make sure everyone was on board, and understood what it was about … the reasons for it.

The teachers, thus, had very little time to prepare their teaching for the coming academic year. Despite their lack of knowledge, the teachers did not approach the curriculum area which had

already begun to successfully implement all attainment teaching, i.e. the mathematics department, to learn what they had done. Bob thought it was good that the headteacher had introduced all attainment across years 7 and 8 but at the time he thought that it could go one of two ways for mathematics: it could either be advantageous or it could be harmful. If all attainment was shown

> *not to work in other subjects [mathematics] was going to get dragged into that, [he thought] its mixed attainment teaching that's going to fall into disrepute in a way and we've got no control whereas obviously in maths we've got direct control.*

The latter turned out to be the case. Surprisingly, the teaching groups in years 7 and 8 were not taught as tutor groups but instead the students were placed into different groups which stayed together throughout the school day. These groups were organised according to a system devised by the Special Needs Department so that the SEN students could be effectively supported. Heads of department had very little or no input into either the allocation of students to groups or who would teach the groups. Although all attainment groups they were very unbalanced. At least one group had a majority of students with a pupil premium, many of whom had behavioural issues: in mathematics this group was assigned to an NQT. The make-up of the groups caused problems for members of staff and led to a widespread belief that all attainment did not work because of the increased difficulties involved in teaching these groups.

The mathematics department also suffered from staff shortages throughout that year as some mathematics teachers who left could not be replaced and Bob had an extended period off work due to a mishap out of school. This led to an unfortunate and undesirable situation where some year 8 classes were taught by a succession of supply teachers who were not capable of teaching the all attainment classes effectively furthering the impression that all attainment teaching didn't work.

A few months after introducing all-attainment teaching to years 7 and 8 the headteacher left. Later that year when the school was re-inspected by OfSTED it failed to get out of the *Requires Improvement* category. During Bob's time at the school all attainment teaching had only just progressed up to year 8 and had not begun to affect year 11. The GCSE results had remained much the same which was hardly surprising as moving away from ability grouping and implementing all attainment throughout the mathematics department was a long-term strategy and could only come to fruition after several years. Bob said the top end

> *had five years of this setted situation … we hadn't been able to change that for them … the two years we'd gone through and sat exams under me … they'd still suffered … from being set from day one … so the results were the same as the year before and the same as the year before that, so you do the same you get the same result … the changes we'd made hadn't had time to work through …*

Indeed, the climate today in education is one of instant fixes and instant improvement. At this point Bob decided to move on as he was aware that the governors were seeking to appoint a headteacher to sort out the 'mathematics problem'. The headteacher appointed, had been a former head of mathematics and Bob knew she would have her own way of running a mathematics department which was unlikely to include all attainment teaching as it was very much a minority activity in mathematics departments in the UK. The new school he was

moving to was in Inner London, where he'd last worked in the early 90s. The school had all attainment in year 7 and he was looking forward to the challenge of building on that.

Final Word

Bob has a masters degree and is currently studying for a doctorate. He has considered moving into teacher education but realises that

> *'the government [wants] … universities to … go in one direction … [that]*
> *they want us to teach in a certain way and they want teachers to be taught*
> *in a certain way or trainee teachers to be taught a certain way …*

The current emphasis on mastery teaching in primary schools is the antithesis of everything he believes teaching should be. He is

> interested in students having a say in the direction of the lesson … and that is
> the opposite of a tightly controlled teacher-led sequenced lesson … mastery is
> directed by the teacher, the teacher sequences the learning in very precise
> small steps …

He understands that there are people who think mastery has opened up an opportunity for all attainment teaching, but their understanding of all attainment is not the same as Bob's. He says their approach

> *is justified through the building block model … [where everyone] … is*
> *moving through together … and everyone gets the brick at the right time …*
> *and the idea of everyone turning up at secondary school and they can all do*
> *exactly the same thing at exactly the same time and exactly the same*
> *method concerns me … that's problematic for me because actually we*
> *learn from each other and I learn from them where there's something*
> *different going on and when I'm challenged or when there's something*
> *unexpected … you can see a set of automatons on a production line and we*
> *just keep them moving through the next year of mastery …*

Reference

https://www.gov.uk/guidance/pupil-premium-information-for-schools-and-alternative-provision-settings

Appendix 5:   Sarah's story

Despite being 'a young carer' on free school meals Sarah was successful at school unlike her husband who left school with no GCSEs. (He later obtained a PhD). She thinks

> *the school system lets down certain types of student which is … why [she] feel[s] strongly about … mixed attainment.*

Her background is working-class, and she identifies with children who have a pupil premium

> *that's … a bit like the maths thing. I was free school meals, so was my husband.*

She thinks of herself as a creative person but her experience of learning mathematics at school, had been typical of most secondary school children in England in that

> *Maths wasn't taught creatively, it was very text book, it was like … the teacher would model how to do something and we'd all answer thirty questions on how to do it … I wasn't interested in it.*

Because of this she had concluded that she

> *wasn't any good at maths … ridiculous but I genuinely believed that … I would say, 'oh I'm no good at maths'.*

As a result, she had achieved less in mathematics than in any other subject and said

> *I began to convince myself I'm not a maths person … I'm English and Humanities and creative stuff … I really do think that … I never would put my hand up to answer a question in maths class, never …*

Her first degree was in sociology. She had 'never wanted to be a maths teacher' stumbling into mathematics teaching by accident. She had applied for a behaviour inclusion job at Chancellor School but was told

> *'Oh, you didn't get that job, but we have got a space in the maths department' and I hated maths at school, absolutely hated it … but then I thought I need this job, so I took the job.'*

Working with the mathematics teachers at Chancellor School transformed her views on mathematics and mathematics teaching. Her experiences as a teaching assistant

> *supporting Bob's lessons and other teachers … that had bought into his ethos …*

led Sarah to decide to become a mathematics teacher. She said

> *never in a million years did I expect to be a maths teacher … I definitely thought it was my worst subject at school, definitely [but] I wish I'd been taught maths this way when I was at school …*

She enrolled on a degree course in *Mathematics with Education* continuing to work in school as a teaching assistant, studying part-time and attending the local university. Initially this was one day a week but increased to two days in the final year. On getting her degree, she

enrolled on an in-school GTP[60] programme, working while she gained Qualified Teaching Status (QTS).

After qualifying as a teacher, Sarah taught mathematics at a number of schools in challenging circumstances[61] in her Local Authority. This was a deliberate choice on her part; it was what excited her and what she wanted to do. She says

> *It's important for me to work in this sort of school and I want to help these sorts of students that I think have a lot of potential that is often not realised because things like behaviour and attendance and other things get in the way.*

She says the experience of many children is they leave such schools

> *with very few qualifications … are labelled lower ability and actually they've got … untapped things that they could achieve*

All of the schools Sarah taught at had some mixed attainment teaching apart from one school when she was a main scale teacher. Eventually she became Head of Mathematics at Knapper School.   She was 'really, really happy there … [it] was going to be my forever school'. Unfortunately for her after she had been there for three years teaching students in mixed attainment groups the headteacher changed. Despite GCSE results in mathematics increasing from 45% to 65% during those three years the new headteacher decreed that the mathematics department re-introduce 'ability' grouping forcing Sarah to move on because she did not agree with setting. She says

> *I cannot lead a department as Head of Mathematics and promote setting to a team because I am fundamentally opposed to it, so I'd always be saying I don't agree with this …*

She moved on to Shortvalley School as a Lead Mathematics Teacher because Bob Brown, who had been the Head of Mathematics at Chancellor School, had just been appointed as the Head of Mathematics. She looked forward to the opportunity of working with Bob again as she knew he was also committed to mixed-attainment teaching and was intending to introduce it at Shortvalley.

When Sarah arrived Shortvalley School had a diverse intake. The Local Authority had recently closed another school serving Sparrow Vale, a large deprived council estate. The pupils had transferred to Shortvalley, substantially changing the character of the school from a predominantly middle-class school to one which now had 42% students with a pupil premium[62]. Apart from Sarah and Bob who had only been at the school a matter of months, the mathematics department consisted of teachers who had all been teaching at Shortvalley for five years or more. Some of these teachers felt that, since Shortvalley had been 'forced' to take students from Sparrow Vale, the character of the school had changed. These teachers had preconceived ideas about the Sparrow Vale students and felt that they didn't belong in the school and, as such, were unwelcome. Some of their own children had been in the top sets and their concerns appeared to be focused on these children. One teacher, in particular, the second-in-charge, was concerned that children like her son should not have their school

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[60] GTP – graduate training programme – trainees worked nearly full-time in school while following a programme, validated and moderated by a HE institution, in order to qualify for Qualified Teacher Status (QTS)

[61] School in challenging circumstances -

[62] Pupil premium -

experience tainted by poorly behaved children. Hence when Sarah arrived the organisation of the 'ability' groups seemed to be all about protecting and nurturing the highest attainers and the middle-class students. She describes the 'ability' grouping at Shortvalley as having two odd features. The first was that the top sets had fewer students than the lower sets: all students in the top sets were expected to get A*/A so there were only twenty students. As the school contained more students on the C/D and D/E borderlines the middle sets had more students than the top sets; this meant Set 4 had twenty-eight students. The second odd feature was that some of the teachers taught the same sets in all of the years.

Shortly after Sarah arrived the school was inspected by OfSTED[63] and placed in a category, *Requires Improvement*, partly because of the poor progress of the students with a pupil premium. These students, who were predominantly from the Sparrow Vale housing estate, were concentrated in sets 4, 5 and 6 with only a smattering of such children in the upper sets. This set-up was clearly not helping the students with a pupil premium as they were not making the sort of progress expected. However, a number of other factors also impinged on these children's progress: some were young carers, some came from families with low aspirations and low expectations, some of their

> *parents had bad school experiences and supported their child by … not buying into the school's behaviour policy … attendance is often poorer.*

Poor behaviour in the lower sets wasn't being addressed and if a student was behaving badly in the upper sets and not performing well in exams despite having the potential to be a high attainer the teacher would say 'they couldn't do the maths, they need to move down a set'. This resulted in

> *very disengaged, disaffected groups of children with teachers that had very low expectations of what they should be doing and how they should behave.*

The teachers in the lower sets would also teach them very differently. There would be no problem solving or reasoning because the teachers believed they couldn't 'cope with that, they'll behave badly'. Sarah's view was that the approach of these teachers was that

> *the best way to get them to behave was to give them something they could already do, to get them quiet, to get them on task.*

It was hardly surprising the children weren't achieving given this approach. Once a child had ended up in one of the lower sets they had little chance of moving out of these sets.

In their first year Sarah and Bob had only a limited opportunity to change things as the timetable had already been decided before they arrived. Nevertheless, as Head of Department Bob began making some changes. He and Sarah swopped some classes as he had been allocated all of the set 4s and she had been allocated all of the set 5s. In the second year the top sets were made bigger, and hence much broader in terms of attainment, than the bottom sets and mixed attainment was introduced in year 7. These changes were instrumental in persuading some of the mathematics teachers to move on such that during the two years after the OfSTED inspection the personnel in the maths department completely changed. Despite this, only one teacher left explicitly because of the change to mixed attainment; the others left for a variety of reasons including promotion in other schools, moving out of the state sector, returning to Ireland, emigrating to Australia and, one because

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[63] OfSTED -

he had a disagreement with the head teacher. The teacher who left explicitly because of the change to mixed attainment said he was philosophically opposed to mixed attainment although he had no experience of it either as a pupil or as a teacher.

The headteacher, when Sarah arrived, also felt passionately about the students from Sparrow Vale and what the school could do to help them succeed. In Sarah's third year at Shortvalley he introduced mixed attainment into years 7 and 8 for all subjects but left shortly afterwards. However, the introduction of mixed-attainment teaching had not been properly thought through. In Sarah's view there were a number of major problems. One problem was that the school had failed to construct mixed-attainment groups that would work, the Senior Leadership Team failing to understand that mixed-attainment grouping didn't mean you could just stick any students together, the students needed to represent a range of prior attainments. The make-up of the teaching groups had been determined exclusively by the SENCO[64] who wanted all the students with SEN to be put in one group so that they could be supported by SEN staff. Teaching groups, although mixed-attainment, were very different and varied in size. Another problem in mathematics had been that the classes were taught at different times meaning that it was extremely difficult for both teachers and students to change groups. In addition, Sarah and Bob had no control over who taught which class meaning one teaching group consisting of nearly two thirds of students with a pupil premium, some of whom had significant behavioural problems, was assigned to an NQT.

The OfSTED re-inspection in April later that year found the school still *Required Improvement* with the lack of progress of students with a pupil premium in mathematics being one of the factors contributing to this. As a tentative explanation Sarah suggested that two teachers who had been teaching year 11 classes but had already secured jobs elsewhere had, perhaps, not been properly focused on their classes. She said these classes which should have been 'safe' ended up underperforming with the results way below what the class teachers were predicting. Although she did not suggest any mal-intent on the part of the teachers she wondered why their predicted results were so high.

According to Sarah in the year the OfSTED re-inspection took place there were multiple issues in mathematics. Throughout the year there were staffing problems as several teachers left in September with a further teacher leaving at Christmas; in addition, some staff were off with long term illness. This particularly affected year 8, as all classes had needed cover teachers during the year, leading many support staff to conclude that mixed-attainment didn't work completely ignoring the issue of the lack of continuity of teaching due to the excessive use of supply teachers. Sarah said the mathematics teachers were convinced by mixed-attainment However, she thought that they might have been influenced by her and Bob.

Sarah is passionate about mixed attainment and mathematics teaching. In terms of her own thinking about mathematics teaching and learning she is influenced by the work of Carol Dweck. She believes that students need to leave the mindset of being a level 3 or 4 or 5 behind and instead focus on what they have achieved so far and what they can do next. In order to help with this and so that students could see visually the progress they were making Sarah imported and adapted the concept of 'learning journeys' to Shortvalley from Knapper. She believes a good mathematics lesson should involve problem solving, reasoning and peer learning. Students need to get used to the idea that you learn through contributing through comments or questions and that even if you can't get all the way to the end getting partway to

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[64] SENCO - special educational needs coordinator

a solution is worthwhile. They need to be trained to understand that helping someone else also helps you as explaining something to another person deepens your own understanding.

Her preferred tasks are low threshold/high ceiling tasks with multiple entry points, where everyone is essentially doing the same thing but from different aspects, approaching the task in different ways. There is less teacher talk with the class generating the responses that move the learning on. The work is collaborative with the students supporting each other through talk and questioning with little input from the teacher at the front. The teacher's job is to help the students move on, training them in how to do it so that eventually it becomes part of the classroom culture.

Sarah thinks that it is important that the students are

- not fearful of making mistakes
- not fearful of asking questions or believing others perceive them as silly
- that part of the process of learning is asking questions, making comments, testing whether or not they're true.

She believes that these sorts of lessons enable you as a teacher to see where the students are and that 'because they are sharing in the class discussion the students learn from their peers'. Even if all the students haven't understood everything Sarah believes that

it's richer for them, they've taken part in the discussion and been exposed to it … they've been part of the conversation, all contributions are equally valid.

Having circulated during the lesson she knows where students are at, how developed their ideas are and so uses her own targeted questioning to develop the students thinking. She says

The kids think it's random, they don't know why I'm picking certain students first, I know, that's how it works … [because] they were all doing slightly different things.

Sarah thinks adapting to mixed-attainment isn't a problem for most students. At Shortvalley some previously high attaining year 7s had been concerned as they were no longer in the top set, which they had been in in primary school. However, once they realised how the lessons worked and that they would not necessarily be doing the same as everyone else they quite liked it. Sarah said that high attainers were potentially more stretched in a mixed- attainment class than in a top set because they were looked for challenge in a mixed-attainment class but in a top set they just accepted what they were given as they were happy to be in a top set. The students in mixed-attainment classes became more independent learners. However, she said it would be a different story with the current year 8 because of the lack of teacher continuity. The year 8s had experienced too many cover teachers and consequently hadn't been challenged. This was true of all attainment levels.

In Sarah's third year the governors appointed a new headteacher with a remit to sort out mathematics. She had a mathematics background and had already decided the school would be reverting to 'ability' grouping the following September and that included the mathematics department. Even before the appointment Sarah had decided to leave as she knew the writing was on the wall because of her experiences at Knapper School. She had hoped to stay at Shortvalley more than three years, but she felt strongly about it

If you're part of the leadership of a maths department you have to believe
in what you're saying, and I don't believe in setting by attainment so that's
a pressure … it's made me move on … That's how seriously I take it …

Sarah had investigated all the secondary schools in the LA in which she was working and further afield but had found no schools teaching mixed attainment mathematics in the vicinity. Consequently, she had decided to get a job at a school a considerable distance away, a school which she would not be able to commute to but where she would need lodgings during the week, only travelling home at the weekends. She says, 'I basically chose the school for the headteacher and the vice-principal.' The school where Sarah has got a new job is led by the ex-headteacher of Knapper, her old school.

Appendix 6:   Philippa's story

We're really lucky as a maths department … we still fight for an ethos about mathematics.

Philippa loved mathematics at school, so she decided to study it at university. However, the style of teaching, at the midlands university she chose, did not play to her strengths; at school, she had been 'a big fish in a small pond' but arriving at university she realised she 'was a tiny fish in a large pond'. Sitting in lecture theatres being told stuff didn't work for her; there was no 'space to explore' but in any case, she thought she should 'just get it'. It wasn't that she didn't enjoy the maths but she 'found it really difficult, it was the first time [she'd] found maths difficult.' It had been a confidence thing, something which didn't begin to be properly rectified until the third year when she'd taken a mathematics education module which enabled her to reflect on her learning and begin to understand why she'd been finding it hard. The education module had been based around one of John Mason's books and focused on investigations in the classroom. Although she enjoyed mathematics and was good at it, it made her wish that she'd been taught mathematics like that: she thought that there were many people who didn't enjoy mathematics and it was probably down to the way they were taught. She loved mathematics even more now than she had done previously.

She'd become a mathematics teacher when she was 'very young'. Looking at the job market as she finished her undergraduate degree she decided there was nothing that really interested her so she applied for a PGCE on a whim. The PGCE was full at her university but the PGCE tutors recommended a London College so she applied there and was accepted. She moved to London and had been there ever since.

It was a good experience for her. She said, 'I loved the course, I was one of those keenies that just absolutely loved the PGCE.' Both of her teaching placement schools had offered her a job: she chose a school in east London where there was a 'good sort of community'. However, during her first year 'everything became about OfSTED' so she left as she 'can't do things for OFSTED [as its] just absolutely pointless.' She wanted to do things because they were good for the children. One bright spot was that during the time she was at the school she had engaged with a mathematics curriculum development project in the Borough which was to prove useful to pursuing the type of teaching she believed in.

Eastchurch, the school she moved to, was in west London. By this time her ideas on teaching were becoming much clearer and more developed: she wanted to teach for conceptual understanding, not merely for procedural understanding. She had asked questions about this at the interview and had 'got the answers [she] wanted to hear'. She took the job only to find the school was 'not that place'. In fact, the school was really procedural in the classroom including in ways other than the teaching of mathematics. She had struggled with

> *having to do stuff I don't believe in' but was 'strong enough in [her] beliefs*
> *… [to know she wasn't] … a bad teacher.*

She had kept up her engagement with the curriculum development project in her previous Borough during this time and Pete, who was second in charge of mathematics at Brierley Grove Comprehensive, another school in the Borough had alerted her to a job at his school. She had applied, been offered the job and was now in her third year.

Mathematics teaching at Brierley Grove Comprehensive makes sense to her in contrast to the way in which most mathematics teachers are expected to teach which she says is 'mad', it doesn't 'seem to make any sense at all.' She thinks most mathematics teaching is not research

based but based on the 'best way' to get results – that is, procedurally. She thinks those teachers must have a different understanding to her as to what mathematics is, that they see mathematics only as procedures. Philippa believes that, provided the students are enabled to develop their conceptual understanding and then taught exam technique in the last few months, exams are not something teachers need to overly worry about.

> *If you teach mathematics well the exam should be trivial … [you shouldn't]*
> *… start with the exam and teach to that.*

That said the mathematics department still had to resist internal pressures from some of the senior leadership team and external pressures from the media and the government.

Philippa thinks that classes in several subjects at Brierley Grove Comprehensive are organised on a mixed attainment basis but she isn't certain which ones they were other than her own subject of mathematics (in years 7, 8 and 9) and perhaps English, humanities and perhaps science in the lowest two years. She thinks that mixed attainment teaching in mathematics had been introduced five or six years ago, before she had started at the school. Initially there had been 'massive' resistance to it but it had been introduced very gradually, a year at a time until it was throughout years 7 to 9. The previous year 11 group was the first year that had gone through years 7 to 9 in mixed attainment groups and the results had been the best they'd ever had: she wasn't sure if the mathematics results were either the best or the second best in the Borough. She said that had been 'helpful … people [were] getting used to it, starting to see the benefits'. However, despite this there was still 'resistance' in the department as only a minority of teachers, three out of eight, were prepared to trial mixed ability in year 10. The reason they gave for not wanting to extend mixed attainment into year 10 was that 'the ability range had got too wide by that point.' Philippa acknowledges these worries: 'people say … 'can I support the top end and can I support the weakest students in the class''. However, she problematised this by referring to a lesson she'd just taught where it wasn't the weakest students who'd been the problem in the lesson but *those who were least engaged.*

Philippa said that the department put a great deal of effort into getting the students to work effectively together in groups but at the same time there was a lot of resistance 'cos [some] people didn't see the point'. She doesn't know if this resistance is to do with mixed attainment but for her

> *it was just teaching in general … for mixed 'ability' to work, as in any*
> *teaching to work, you need kids to work in groups if you have that*
> *viewpoint on … pedagogy'.*

At the start of year 7 there is an induction period which used to be half a term but has now been reduced to about three weeks where

> *we don't teach them maths, we literally teach them to work together in*
> *groups because we know it's so important and if they can't do that then I'm*
> *not going to be able to teach them.*

Merely telling the year 7 students at the beginning of term to work in groups led to 'chaos' as they had no idea what that meant. Thus, during the induction period Philippa looks for opportunities to highlight to the students what good practice of working in groups might be. She describes an example:

> *We do things like: just stop, can everyone look what this group's done, it's*
> *really silly like someone has got up, they have moved their chair over there*

and now they're in a really good position to work. I haven't told them to do
that but they've naturally done that … it just highlights the skills we think
they naturally have, and I just don't think they do at all … you really have to
home in on what [working in a group] … means.

Recently they had thought of getting rid of the induction period. In its place, they had considered drop-in sessions throughout the year but the department as a whole had decided against this. There was a danger in this approach that instead of groupwork becoming the norm, groupwork would become a special lesson, just another educational fad. Philippa believes that the students

learn so much better when they're working in groups … [they are]
constantly talking about stuff … that is genuinely what I believe … think of
Vygotsky … it's very hard to do stuff in silence.

For lessons to be good teachers need to have high expectations of the students, expectations that could vary from student to student such that there would be differentiation by outcome: students need to be engaged, to have a need to discover things for themselves, to make conjectures and to be able to convince themselves in a very mathematical way (before the end of secondary school).

Having an interesting task which is a good question is also important; the questioning by the teacher and the dialogue between teacher and student is also important. Questions need to be 'genuinely mathematically interesting … [with] … the lesson making mathematical sense … [rather] … than something that's just being done for the sake of it'. Philippa thinks that asking questions about painting rooms has 'nothing to do with the maths' and she finds them 'really annoying'.   She has a pure mathematics degree but had done a physics A Level so was generally unimpressed by the lack of mathematical modelling in classrooms.

Philippa believes there are some people who like the certainty involved in some areas of mathematics. She gives expanding brackets as an example of this but characterises it as 'boring'; she thinks it is 'a confidence thing … people feel very good when they feel they can get 10 out of 10 and it makes them feel good'. On the other hand, many students don't enjoy mathematics which she puts down to the way they are taught whereas, in contrast, her students enjoy learning mathematics which she puts down to

everything they say is valued, it's not a black and white subject … there's
something for everyone to explore and everyone can answer.

However, Philippa says she personally feels

a pressure to try and just grade or level every single thing that that the kids
do and it's all about that and it's nothing to do with offering students an
enriching experience about mathematics.

Nevertheless, she maintains that the department does its best to put the students first. However, they do everything they need to do to tick all of the boxes required and then push them aside. The department had had to argue for mixed attainment as the head had questioned why the mathematics department was mixed attainment when every other school in the Borough was teaching in sets and indeed had told them they need 'to be teaching in sets'. Philippa said the shortage of mathematics teachers gave them a strong bargaining chip as the school would find it difficult to replace them if they left. Nonetheless she says it is

difficult work convincing people, when you're trying to do something that,
maybe, isn't the norm (which I don't understand why it isn't but it isn't).

Philippa took the job at Brierley Grove Comprehensive because she knew and trusted Pete through her involvement with the curriculum development project and believed she would be able to teach in the way she wanted to without being hassled. She knew what she was coming into and thought she 'would be mad not to take it'.

When she arrived, there was mixed attainment in years 7, 8 and 9. It had been introduced by Pete who had taken the second in charge position because Dave, the Head of Department, had agreed he could introduce mixed attainment. Dave had been supportive but as Head of Department he had many other responsibilities and needed someone to drive it forward.

A requirement of the school is for teachers to report grades at various points throughout the year. Philippa believes that the grades mean 'absolutely nothing but the data man at the school treated it like gold'. Although there was pressure to meet those goalposts 'the maths department [was] better at statistics than the data man [so they knew] how to play things'. She said it's 'all rubbish' and what with the new GCSEs and the new grades the levels would all be going, not that the maths department reports levels anyway as they don't believe in it. She says people can't 'cope if you don't label children', there needs to be something so she assumes that 'the kids will, I'm assuming, be labelled with a grade nationally now from 1-9 the moment they come into year 7. However, she says the maths department wouldn't be doing that as they didn't agree with it. Moreover, she says,

I just don't think it helps anyone. So, this kids a level 6 what does that tell
me. Absolutely nothing. They might be an algebra genius but they can't
visualise anything … we won't do that … that is a pressure but we [resist it].

In years 7, 8 and 9 the students are in form groups, but they are set in year 10 and Philippa says that that is when 'it all goes wrong in my opinion'. Teaching the top set is 'lovely' but 'if you teach the C/D borderline … it's a pain 'cos they think they're rubbish 'cos they're not used to it'. In Eastchurch, her previous school, the children had been set on entry at year 7 and she had heard 'I'm rubbish at maths' all the time in the lower sets. It wasn't as strong in year 10 but it was there, especially with the bottom foundation group. She didn't think it was healthy when students were separated out, she said

I think it's really good for you to talk and work on maths problems with
people who aren't good at maths, that gives you more skills sometimes.

She thinks the longer separating the students out is delayed the better it is but in the end because of the exams they did need to be separated to prepare for the exams. However, at this point she says she has almost stopped teaching them maths: the last few months in year 11 are about ensuring they know exam technique. They are young people and they need to be taught how to write an answer but

if they've got really good mathematical understanding that is easy to teach
… You just say it's going to be a bit boring for the next few weeks.

She feels that if you are honest with the students it works out fine but unfortunately many schools put the students into sets in year 7 and spend the next five years telling the students 'this is grade x, this is what the examiners are expecting you to do'. She wonders 'what has the examiner got to do with mathematics?' Despite this, she thinks the new GCSE might be better.

Next year she and Pete were jointly taking on the role of Head of Department as Dave, the current Head of Department, was leaving.

Appendix 7:   Akhila's story

Akhila is of Indian heritage. Her parents were hard working and wanted their children to get a good education, have good careers and be happy, not to have to struggle the way they had had to.

At the time I interviewed Akhila she was nearing the end of her second year of teaching at Brierley Grove Comprehensive, an inner-city school in East London. She had been placed in Brierley Grove at the last minute on her PGCE as the placement she had originally been assigned to, had fallen through. Recalling her first impression she says

> *When I first got here … I was probably surprised at how different the school*
> *is in terms of its mathematics teaching compared to other schools. I guess,*
> *it's quite typical for schools to be known as referring to textbooks,*
> *worksheets, procedural teaching.*

She had been in mathematics departments in other schools when she was doing her mathematics degree as she'd decided that she was going to do a PGCE as she wasn't interested in going into banking or finance. She had been a STEM ambassador, going into schools promoting STEM degrees, and as a result of this had got a placement in a school.

She had loved mathematics at school, in fact it was the only subject she had really enjoyed at A-level but she had applied to do something completely different at university. She had stuck at this for two years but decided that what she really wanted to do was mathematics so at the end of her second year she had transferred to the mathematics degree.

She had been a school student in North London: the school she had attended from years 7 – 11 had been in either *Requires Improvement* or *Special Measures*[65] while she had been a school student there and she had heard recently that it was closing. This contrasted with the girls sixth form she had attended which she described as probably one of the top schools in London, known 'for getting results and getting girls into Oxbridge'. Akhila thinks the schools had just done what they could with their available resources but said both schools had taught mathematics in a similar fashion. The teaching was very much textbook, and rule driven. Her sixth form was very traditional – the lessons weren't very exciting but 'they had a system in place'. You would

> *just go in for an hour, learn something, learn how to differentiate. Do, you*
> *know, fifty questions on it, then leave.*

Coming to Brierley Grove has made her 'challenge' her own mathematics knowledge: she said, 'you know things, but you don't really'. There is a lot of emphasis on discussion, getting the students to investigate, think about and discover things for themselves. When you have to teach it and talk about it and discuss it, 'it was much harder than just teaching the rule'. Unlike other schools where topics are crammed in, students at Brierley Grove spend a long time on a topic so they can get a deep understanding of it. That is a big difference she noticed but also, she'd never come across mixed-attainment teaching at KS3 before. As a PGCE student she wondered how she would cope with having different sorts of students in her classroom: it had caused her some stress, but she also definitely knew she wanted to keep in touch with the mathematics department. Her experience in her second placement as a student was more typical: she was encouraged to use textbooks and give the school students worksheets to deal

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[65] Requires Improvement and Special Measures are two categories which are judged to be not good enough by Ofsted, the government school inspectorate.

with behaviour issues. Her tutors at college had encouraged the students to teach in a similar way to Brierley Grove but she saw little of that style of teaching in her second placement. Her experience there confirmed in her the desire to get a job at Brierley Grove if that was possible.

Akhila said Brierley Grove was

not about data, it's not about grades and results and stuff, I think it's actually just about teaching students their subject … getting them to really love maths.

Her form talks about what they had learnt in school at the end of the day, not about tests. In common with the other teachers at the school, she knows her students really well. She says there is a lot of continuity in the mathematics department as teachers usually take the same classes through from one year to the next.   She has taken her year 7 class through to year 9 and hopes to take them through to year 10. This was a possibility because the department is running a pilot the following year, extending mixed attainment into year 10.

The students experience a lot of mathematics teaching. At KS3 they have nine fifty minute lessons a week and at KS4 they have eleven lessons a week. Akhila says that many of the lessons are doubles which are 'really good for getting [the students] to explore something whereas single lessons are useful for practice'.

Akhila thinks that a good lesson is one were the students are engaged with what they are learning. She thinks the learning should be interesting, there should be lots to do and it should be personal to the student but she also suggests that it is possible that some students might be engaged with thirty questions from a textbook although that wasn't something she does.

As an example she describes a lesson where the students created the data. The lesson had been on reaction times. There had been some nice conversations and there had been an element of cross curricular work involving science which had shown that there was a point to working with data, in this case to work out averages. Akhila knew from previous experience, having done similar lessons before, that the lesson was one the students would remember. She thinks this might also have to do with introducing some competition into the work, for example, having the girls versus the boys.

She also thinks that part of what makes a good lesson is when the students question the mathematics they are learning. She doesn't want the students to blindly accept everything they are told as she had done at school. She said

It wasn't until I got to university and started really struggling with maths , 'cos I think I was probably okay for GCSE and A-level, … I was just questioning why does this work, where does it come from, you know I questioned my own mathematical subject knowledge from my A-levels, I never though I explored it properly deep enough.

She thinks it is important to have the students having conversations, working in groups, asking questions not only of her but also of themselves and each other, getting them to think like mathematicians, thinking about the mathematics they are learning. However, she said it takes a long time, you really have to know your class, that it doesn't happen immediately, that 'it was a work in progress'. Her lessons are never silent; she thinks the students talk much more than they do in other lessons but it is useful talk.

When the students start in year 7 there is a focus on getting them to learn how to work in groups: learning how to communicate and collaborate properly with each other, getting to know how to talk, how to ask questions, how to reason and work through logic problems and generally to develop the skills to make a good mathematician. There is some resistance to this as some students asked what is the point of doing this was as it isn't maths. Maths to them was stuff like 'percentage increase/decrease of something'.

Akhila really enjoyed mathematics at school and her friends relied on her to explain things in a way that they could understand. Up to and including university she would spend time trying to really understand something. She had never considered teaching anything else though she had liked English Literature at school. She had liked the idea of working with school students which was why she had done it at university. It was also to make sure that teaching was what she wanted to do particularly as her friends were applying for graduate schemes which she didn't want to do. Her school experience whilst at university hadn't put her off teaching, indeed she had 'quite enjoyed it'. She had enjoyed good relationships with several teachers, including her mathematics teacher, while she was at school and had kept in touch with them after she left. She describes herself as one of those 'quiet, quiet girls who just got on with everything'. Her thoughts about becoming a teacher are a bit confused. At first, she says when she had been at secondary school she hadn't thought about being a teacher but when she was younger she had thought she might teach though not specifically mathematics. Later, she says, that by the time she was older she knew she loved mathematics and 'it was a subject where you could directly apply maths to a job' but there isn't a particular reason why she became a teacher.

Akhila had not originally gone to university to study mathematics but had transferred to mathematics at the end of the second year. The course she had originally been accepted for was a five year vocational degree but she had decided in the second year that it was not for her. As she had had a gap year between school and university it had been three years since she had done any mathematics plus she hadn't done Further mathematics. She struggled in the first year as she had to recap on A-level while trying to learn first year university mathematics. Her tutor had told her she would most probably fail but that motivated her, giving her one more reason to do well. She ended up with a first class honours degree. In the first year she had just learnt the mathematics in order to pass the exam. She hadn't liked it and said that was the last time she ever did that.

When asked what she thought the purpose of education was she said 'people say education is what you're left with once you forget everything else' but more to the point she thinks the purpose of education is 'the growing up you do while you're learning'. She feels that the purpose isn't to produce data or to get results although she feels that it had become so in recent years. It hadn't felt like that when she had been a school student. She'd loved her schooling: she hadn't felt any of the type of experience she thought the school students she is teaching feel. Her school had had inspectors in all the time, but she hadn't thought anything about it. Her students are more aware than she'd been when she was at school. The KS3 students ask questions about Ofsted, ask her 'Is the school going to close down?' She thinks it is a shame that young kids have to think about such things. It had only been ten years since she'd been at school, but she thinks ten years is a long time and education had changed in that time. She feels that education

should be giving students an opportunity to realise that they have the potential to do whatever they like … many students don't see that potential.

She thinks it is part of her job to get students to see their potential but

I have definitely disaffected students in my classes. I see it less in my KS3
classes but in my KS4 classes I definitely see a bit more.

It is more visible in setted classes. You can

see enthusiasm drop in and disaffection much more present when you're
kind of going along the sets.

She thinks it is typical of white British children in the school so there is a focus on getting them to realise that they can be ambitious and get good jobs and do well for themselves however they might define that. Her school had been worse than Brierley Grove but when she was at school she couldn't wait 'to get out and do things' and she wants the same thing for the children at Brierley Grove. She wants them to see that there is a life beyond the borough they live in. She thinks that the Bengali children want to do well but isn't sure if that is the case with the white British kids. She thinks it is the teacher's job because the children spend a large part of their day at school but on the other hand she is realistic about what effect a teacher can have on a student's life:

There's only so much you can do as a teacher but as long as that's what
you've got at the front of your mind when you're teaching then if it's
something that inspires them … they really like that, that gives them a bit of
hope in your subject you've done your job a little bit.

She thinks that once a student is put in a set teacher's expectations of the students go down without them even realising it. She said,

I know when I am teaching mixed ability … I'm teaching content which I
expect 95% of the class to at least try. There will be my weakest in the class
who need support but even then I'll try to get it through to them in a way
they can grasp just a little bit whereas, you know, if you're in a set class
you're just immediately thinking I'm not even going to bother to teach, you
know, reverse percentages or something whereas I taught that to every
single one of my children in year 9.

Akhila thinks it is important that all children are introduced to mathematical ideas 'regardless of how able [they are] to get it'. She also thinks that setting students in year 7 means they have two years less to develop their mathematical thinking compared to year 9: working with 'brighter' students means students are able to develop their mathematical thinking, 'middle' students had the opportunity of explaining to someone else who doesn't get it as quickly.

Akhila tries to get the students to work together as much as possible: she says that they are never really working by themselves; they are talking and arguing, teaching each other. As a teacher

You can help one group but you feel secure that they're helping each other
and you don't have to stress about what every kid is doing 'cos you can
relax and obviously its less of a worry when you know they're talking about
maths … it's quite obvious I think if they go off task … it just works really
well when you mix them in their groups so you have a brighter one working
with a, someone who's not so bright and they're helping each other through
that so it does work pretty well.

However, Akhila says these things need to be 'embedded in the culture in the maths classroom' from the moment they start year 7. The department is currently trying to get more

investigations into the year 9 curriculum so that students get to develop their reasoning skills by working together in groups of three. The idea is they would explore something open-ended, make their own questions and conjectures, deciding as a group how to convince others. She says the first time they tried it had been 'awful' but by the third or fourth attempt they knew what they were doing and didn't even think about it.

The mathematics department has also been developing *learning journals*. In the beginning they had just been a series of assessment tasks but currently there is space for learning notes and end of topic assessments which are differentiated so the students can try some or all of the assessments. Akhila has noticed that some students in the mixed ability groups weren't trying the most difficult assessments. The assessments are in the learning journals and can be seen beforehand; the students can discuss the questions with each other and they can use their notes. Akhila thinks that it is good that the students discuss the assessments as it shows they are trying to understand the problems. The assessments come at the end of a topic after a week and a half to two weeks. When the assessments are completed Akhila marks them and returns them to the students who respond by making corrections. She may also give them something to support them or extend their understanding. The space for notes at KS3 isn't enough for some students so they were going to be more like the KS4 ones starting in the following year. However, the learning journals are a work in progress.

Appendix 8:   Adara's story

Adara had known from an early age that she was going to end up in a 'career helping someone' and while at school she had 'narrowed it down to nursing or teaching or social work.'   She had loved school, she had loved being at school and in particular she had loved mathematics. She said,

> *I was okay at other subjects, I was fine but maths was just something I found easy, I found interesting and I just kind of flew with it really at school.*

She had partly become a mathematics teacher because she had 'really loved maths' and at school she could 'offload her inner geek'. However, she had not studied mathematics at university, as she was really interested in lots of different things choosing to study sociology and education instead. Although there had been quite a lot of statistics in her degree there was not enough that she could do a one year PGCE. Instead she had enrolled on a two year PGCE. In the first year of the PGCE the group had been taught mathematics at an equivalent level to that of the first year of an undergraduate degree. She described this as 'lovely' and as enough 'to top you up'.

One year of university mathematics was enough for her because she said

> *When it gets to a certain level where it gets too abstract I switch off. … [The first year] wasn't beyond me. It hadn't got to the point where it was so abstract …it wasn't anything overly complicated and so that, that for me was my limit … I just know that when it gets too abstract I do find it muddling … at this point I'm totally understanding it …*

She had done her PGCE around the millennium and had started teaching mathematics shortly after that in Xavier School, a quite challenging school, a school which was subsequently put into 'notice to improve[66] by Ofsted. Xavier School had been a

> *real baptism of fire in terms of classroom management, behaviour management. It [was] a tough school to work at and [she] changed the way [she] taught in order to maintain good classroom discipline.*

She stayed there four terms, leaving at the end of the autumn term in her second year as she had been asked to apply for a job in Fielding School (which had been one of the schools where she had done a teaching placement during the second year of her PGCE). Xavier School had offered her the job which she had accepted. When she had been on teaching practice at Fielding School they had also offered her a job but she had already accepted one at Xavier School. She had had no 'issues' with Xavier School but preferred the ethos of Fielding School, in particular the fact that mathematics classes were organised in mixed 'ability'[67] groups. Fielding School is a small city centre school but is not a typical inner city school. It is close to a prestigious research orientated university and many staff send their children there. In addition the number of students with a pupil premium[68] is below average.

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[66] Special measures' is the lowest category a school can be put into as a result of an inspection by Ofsted. It means the school has been judged to be failing.
[67]

Adara felt more in tune with the ethos of Fielding School. She preferred the grouping of children by mixed 'ability' and she felt that the school would

> *allow [her] to develop as a teacher in a slightly different way … cos the kids*
> *were better behaved there it meant that maybe I could try different things,*
> *that I wouldn't have been able to do at my previous school …*

There were only three other staff in the mathematics department when she started teaching there as the school was only four form entry. However, she described the staff or 'all experienced, good or outstanding teachers' and thought she could learn a lot there particularly as the 'standards there are incredibly high'. She had stayed there for eight years during which time she had married and had two children. She had returned when her children were young to do intervention work and hadn't properly left until 2011. She said it had been a lovely school to work at, that she had had some good times there.

Before she had started her teaching placement at Fielding School she hadn't known much about mixed 'ability' teaching and would have said that she wanted to teach in a school that practised setting

> *because logically its easier for the teacher. Cos if you've got a narrower*
> *range then you can pitch it at just the right level … but having been at*
> *Fielding School and having seen the benefits of mixed 'ability' and the fact*
> *that I could teach mixed 'ability' totally changed my [mind], not that my*
> *mind needed changing … this is how I align myself.*

Her experiences since she had become a parent had further convinced her about mixed 'ability' teaching. She has two daughters, both at primary school. She said the oldest one had come home and said to her 'I'm not on the top table' whereas her youngest daughter had come home and said in year 1, 'Mummy, I am on the top table.' Adara said that

> *Children know even when they are called squares or they name them after*
> *Mr Men … and then they identify themselves with that label so even more*
> *so as a parent I do believe mixed 'ability' is the way forward … [rather than]*
> *… me trying to say to my daughter it doesn't matter what table you are on.*

When the mathematics department at Duckworth Community School (DCS), her current school, had introduced mixed 'ability' into years 7 and 10 the department had expected some sort of 'backlash' from parents but it hadn't happened. On the contrary Adara said at an open evening for year 6 parents, several parents had said they thought it was 'lovely that you're mixed ability.'

Before coming to Duckworth Adara had taught part-time at Cobb College. She described it as an outstanding school. It was much bigger than DCS but the whole mathematics department was 100% behind mixed ability teaching which they had been doing for years. She had been able to 'slot right in' as by that time she had years of experience of teaching mixed 'ability'.

Adara had been recruited from Cobb College as a lead teacher[69] in the knowledge that DCS was going over to mixed 'ability' teaching in mathematics. The Head of Department had come to see her after she had accepted the job to let her know that that was the intention of the mathematics department. However, around the time she had been appointed a new headteacher, who was a mathematician, had also been appointed. He was keen to do some

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[69] A lead teacher is

teaching but preferred putting students into sets to mixed 'ability' groupings. She didn't really know why he preferred putting students into sets but she assumed, and she didn't 'know whether this was true or not, that maybe he just [thought] it was easier for the teacher'. Adara said that as far as she knew 'no other subject' in the school was mixed 'ability'. There might be some in year 7 but she said 'I do know as we head towards GCSE they are setted in subjects'.

When Adara joined DCS there were six full time mathematics teachers in the mathematics department including her. She said previous to her arrival the setting had been very rigid. However, because the students were taught in two parallel halves she described it as

not true setting because one half could be stronger than the other half and so when I've got my bottom sets year 9 they're not really bottom set 'cos we're only pulling them from half a year group.

She had arrived at the school after discussions had taken place in the department about what the department could do that would benefit the students. One of the ideas that had been put forward, and agreed to, was to introduce mixed 'ability' teaching. She said 'Everyone was willing to give it a try despite not having done it before'. Of the existing five full-time teachers three were keen to adopt mixed 'ability', and two had reservations but were willing to give it a go. The six teachers all taught very differently: half of the teachers had the desks arranged in their classes in groups while the other half had them arranged in rows. Each did whatever worked for them; there was no pressure to just do what other people were doing including arranging their classrooms so that the students could be in groups.

Adara made particular use of her interactive white board (IWB) in her teaching, using it to create resources, plan lessons in her head and generally take ownership of what she was going to do. However, she shared a year 7 class with her new headteacher who didn't like the IWB at all. In fact, he thought that instead of preparing your own lessons it was much better if someone else, e.g. the head of department, prepared all lessons thus freeing you up to 'focus on other things that are [as] important as being a teacher'. Adara said

I would hate that because I know what my class needs and I enjoy the process of creating things.

There was a central bank of resources on the computer network which people 'could dip into' which was important as the department didn't have enough textbooks. She never used textbooks herself although other teachers did. She took resources she had either made herself or found elsewhere or found on the system and amended them in order to create something for a particular class. She would then put it back on the system telling people that it was suitable for a particular class if they wanted to use it, or if they just use wanted to use bits of it that was fine.

Adara thought that the most important thing for the students in her classrooms was for them to be motivated. She said

She wanted them to focus, she wanted them to engage … to contribute and to feel comfortable enough to ask me for help … I want [them to] feel secure enough in the classroom to do that.

A sense of enjoyment wasn't important as 'maths could be … one of those subjects that's just not for you'.

Adara had a small classroom which she had had problems arranging to her satisfaction as some arrangements had made it difficult for her to access all of the students. She was in her fourth

re-arrangement. She could make her way around the room, the children could all see the board but were all in close enough proximity to be able to discuss things with people near them.

Adara was not overly keen on investigative work or at least the type of investigative work that had been produced for GCSE coursework describing it as 'the bane of our lives'. Nowadays she wouldn't spend an entire hour on an investigative work, she said she had ' steered away from that'. However, the new GCSE had a focus on problem solving so the department was trying to gear their teaching towards that. She thought that a good mathematics lesson was one in which the students made progress, that they left the lesson

> *having learnt something, they didn't know before or could understand something they didn't know before ... or acquired a new skill.*

However, she said she sometimes thought of her lessons as doubles so the point of the work would not become clear until the second lesson.

The department was currently looking into issues to do with the spiral curriculum and was considering a more mastery style curriculum where the kids were completely secure before moving on to another topic.

The department had introduced mixed 'ability' into year 7 and year 10 the previous September but had reverted to grouping by 'ability' in year 10 after Christmas. Adara said that introducing mixed 'ability' into year 7 and year 10 at the same time as there was a new GCSE spec meant that 'just too many things were changing'. The new GCSE spec was really hard for all teachers but to add mixed 'ability' on top was 'just too much' for the teachers to cope with.

> *The staff felt strongly about it in that it wasn't the right thing to do at that time.*

However, the experience with year 7 had been really positive,

> *People had been pleasantly surprised at how well it [had] gone … and so rolling it into year 8 seems fairly natural. There just wasn't the concern there was with year 7 … the staff are happy, the kids are happy. We test them every half term. The children are meeting the targets they have been set.*

None of the year 7 children had queried which group they were in whereas it had happened in a previous school Adara had taught in.

Change back from mixed 'ability' to setting in year 10

When the year 10s had been changed back from mixed 'ability' to sets Adara had noted a change in the attitude of some students. Mixed 'ability' had worked with her year 10 class. Perhaps this had been because of her previous experience. She had had students

> *who disliked maths, who were really weak at maths, working with more able students, seeing the groupwork, and the discussion and those children being exposed to other students who enjoyed maths, who were seeing more sophisticated ways of working out and behaviour just wasn't an issue 'cos these kids were focused and on task.*

With the change back to setting Adara took the bottom set. She kept the weakest kids from the group she had been teaching but there was a sea change in the behaviour of some

individuals. To illustrate what she meant she talked about one particular boy. In the mixed ability class he had worked really well alongside 'these great, able mathematicians'. He

was giving it his all, was seeing kids enjoy maths, was exposed to better maths and more sophisticated methods and wouldn't have dreamt of rearing his ugly head in terms of bad behaviour 'cos it wouldn't have been tolerated because these people liked mathematics.

But with the change back to setting he was put into the bottom set alongside 'like-minded individuals' who 'thought he was hilarious'. Adara was 'gutted' as, finding they were in his class, the bottom set labelled themselves as the bottom set.

All of a sudden … things that previously were not tolerated and would not be found funny were suddenly funny because they were with other people who thought that kind of thing was hilarious.

Adara said she found it harder working with her bottom set because

I'm having to impose behaviour management strategies that I never had to before because it's the bottom set I'm dealing with – we're crap at maths, bottom set maths.

Previously these students had been in the same class as a really good mathematician so

'it would never occur to them 'to go I'm in the bottom set'. It just wasn't an issue. And so, for me, I'm a really good believer in mixed ability teaching.

Her timetable had changed very recently and she was now teaching a year 10 set 2 class in the other half of the year group. They had been in a mixed 'ability' group for the first term of year 10 and had then, in common with the rest of year 10, been put into sets. They were disillusioned with their maths and she was 'trying to win them round'. She said

They've found maths tough … really challenging, some of them were switched off, some of them … disengaged … they are … not your 8s and 9s, they are 6s and 5s … a middle higher set.

Adara was trying to 'get them up to speed' as they were a bit behind in the Scheme of Work[70]. However she thought they were responding and she would be able to fill in any 'gaps in their knowledge and skills'.

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[70] Scheme of Work – the outline plan for the teaching during the year.

Appendix 9:   Final interview script

	Research sub-questions		Interview questions
	How do their personal histories influence the development of their perspectives? What are the philosophies and understandings of teachers who resist grouping by 'ability'? How are the teachers' philosophies and understandings shaped by the local context in which they work?		Can you describe xxx School and in particular can you tell me something about the mathematics department? (two part question) Can you describe a good mathematics lesson? Can you tell me some of the reasons why you became a mathematics teacher? Have you experienced any additional pressures, either internal or external in your teaching as a result of your teaching methods/ group organisation? What do the children think of the way they are grouped or do they even think about it? Do you have any questions?

Table 1 Interview Script

The above table shows the research questions and the table following shows the relationship between the two sets of questions.

Appendix 10: Research paper on Broadbent School

"No, it just didn't work": a teacher's reflections on all-attainment teaching
Colin Jackson[1] and Hilary Povey[2]

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Setting - the practice by which learners are allocated to different classes on the basis of perceived ability - is a social justice issue. Despite overwhelming evidence that, overall, setting is educationally harmful and in discriminatory ways, the practice is almost universal in English secondary mathematics classrooms. To gain insight into this apparent contradiction, we offer the story of a single teacher's ultimate rejection of all-attainment teaching.

Keywords: Ability grouping, equity, ability thinking.

Introduction
In this paper we begin by arguing that setting by "ability" is a social justice issue. Despite overwhelming evidence that, overall, setting is educationally harmful and in discriminatory ways, the practice is almost universal in English secondary mathematics classrooms. In order to understand this apparent contradiction, we offer the story of a single teacher who, early in his teaching career, embraced all-attainment teaching[71]; continued to think in fixed ability ways and therefore supposed that there should be differential teaching for different levels of "ability"; found himself overwhelmed by such a task; and finally abandoned all-attainment teaching because "it just didn't work". We conclude with a brief discussion.

Setting and "ability" thinking[72]
English education in terms of both policy and practice currently takes for granted hereditarian assumptions; and a discourse of ability is used very widely to place children in sets for mathematics in secondary schools (Wilkinson and Penney, 2014). The belief in fixed amounts of "ability" and the consequent grouping of children according to how much they are perceived to "have" is taken as natural and common sense (Francis et al., 2016). The idea that ability is a given and that only some students can be high achievers discourages many students (Boaler, 2005) and communicates and reinforces damaging fixed mindset beliefs (Boaler, 2013).

In almost all instances the methods used to allocate children to sets are claimed to be objective and based solely on their prior performance. However, in practice, in English secondary schools prior attainment is found to be a relatively poor predictor of set. A wide range of social factors come into play which privileges those with greater cultural power and systematically disadvantage others (Muijs & Dunne 2010; Bartholomew, 2003; Hallam & Parsons, 2013; Ireson, Clark & Hallam, 2002; Macqueen, 2013; Wilkinson & Penney, 2014).

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[71] We use the vocabulary of "all attainment" rather than the more common "mixed ability" to avoid endorsing so-called "ability thinking" (see, for example, Boylan and Povey, 2014).
[72] In this section, we draw substantially on Jackson, 2016. See Jackson, 2016 for a more extended discussion.

Teachers' expectations of children in lower sets tend to be low and these pupils are usually offered a restricted, narrow and instrumental curriculum which further inhibits performance. They are constructed as poorly motivated, badly behaved and incapable of independent working and independent thought and therefore in need of repetitive tasks which require lots of practice (De Geest and Watson, 2004). In contrast, those in the top set are constructed as well motivated, hardworking, well behaved and capable of independent working and independent thought and are given a more demanding curriculum and much richer opportunities to succeed (Bartholomew, 2003). Thus setting and ability thinking construct that to which they claim to be responding.

While "ability" grouping has been shown to have little consistent effect on attainment (Francis et al., 2016), it is known that it has detrimental effects in terms of personal and social outcomes (Nunes Bryant, Sylva & Barros,, 2009). The effect of setting continues into adulthood resulting in more limited horizons and stunting life opportunities (Boaler, 2005). Thus, as Slavin argues, "ability" grouping can be seen as an affront to basic ideas of democracy (1990). Involved here are issues of power and culture: "ability" grouping is not just a neutral organisational practice. Oakes and colleagues (1997) maintain that common sense conceptions of ability and intelligence are at the heart of schooling and, in regimes where neoliberalism holds sway, the ability discourse is part of an ideological battle defining children from lower social and economic status groups as expendable (Oakes, 2005). Further, the performativity regimes (Ball, 2003; Povey & Adams, 2016) imposed on schooling have created a climate whereby failing to conform to the common sense view of the world carries huge risks to schools and to individual teachers; and grouping children by "ability" as measured through some form of assessment, endorsed by policy makers, is seen as risk free.

A technicist approach to reform will therefore not work as it assumes resistance to changing "ability" grouping is simply a rational choice by relatively free agents. We offer here a story of a single teacher, Jim, and his changing relationship to setting. (Pseudonyms are used throughout and some details have been changed to protect participant anonymity.) Before doing so, we consider very briefly the role of storying in the construction of knowledge.

Telling stories
We are telling this story about Jim, much of it in his own words, because we believe that stories help us understand more about the world. There is an "unavoidable moral urgency" (Clough, 2002) in stories which fits our purpose in this paper. Jerome Bruner (1986) wrote about two different kinds of knowledge: *paradigmatic knowledge* and *narrative knowledge*. Whilst the former is expressed through logical propositions, the latter is expressed through stories. He argues that it is characteristically human to think in stories and that they provide us with a way to make sense of experience. Stories imply, and attempt to lay bare, intentional states, that is, to offer insights into why we do what we do.

In constructing this story, it is, of course, our categories, concepts, constructs and so on which frame and shape the work. However, we have tried to stay as faithful as we can to Jim's own constructions, accounts and perspectives as far as we have been able to elicit and hear them. We have also tried to offer sufficient detail to allow others to test out the trustworthiness or otherwise of the account and to judge, for example, whether the intentions suggested make sense.

Jim's story - or our story about Jim
Jim is a highly committed, very hard working teacher who has the interests of his students very much in the forefront of his thinking. On a personal level, he is open and his stance towards visitors to his school and department is always one of welcome. He has kept in touch with the

university where he completed his initial teacher education and continues to work frequently and supportively with its current students. He agreed to be interviewed (with a close colleague). The interviews were recorded and transcribed. Working with the transcripts in variety of ways, we began to be compelled by Jim's story as honest, contradictory and telling about teachers' relationships to the issues of setting; we tell a version of this story below.

Jim's final teaching practice at McVee High had not been a happy one. He had clear ideas about how mathematics should be taught and wanted to create his own lessons and his own resources. He wanted the scope to try out different and novel approaches and to avoid the routine use of an indifferent textbook.

> I don't know what I was expecting. I didn't really enjoy working at that school at all and I was really glad to leave. The head of department didn't like me. He didn't like my teaching … He'd get a face on if I wanted to move the tables around, even just move them anywhere. He just wanted them where they were and if I didn't want to use a textbook he would have a face on about that as well. Like "Why are you not using that page?" - "Because I've made this instead". He didn't like that. It was *Lock Maths* and all you did was you started on page one and the scheme of work was just … go through the book. And if you didn't go through the book, then you were an idiot apparently. But that was how it was and it was just a waste … I didn't practice being a teacher at all. You'd practise administering "Do page 12."

Part of the way through Jim's initial teacher education course, his tutor, Barry, left in order to take up the post of head of mathematics at Broadbent School. Broadbent serves a large, white working class, social housing estate in an ex-industrial town with overall attainment below the national average. The mathematics department had had a chequered past and when Barry was appointed there were vacancies in the department. Barry and Jim kept in touch and Barry approached Jim to ask him to come and have a look round the school with a view to starting his teaching career there. After the visit Jim was offered a post at Broadbent School as a newly qualified teacher and accepted the offer.

> I didn't want to work in a posh school. I didn't want to do that … Like Our Lady's where the kids are all little robots. I didn't want to work there. I wanted to work in a bit more challenging area and I already knew Barry as well … I'd always said that I would start my career in a more challenging school and probably end in an easier school because I just wouldn't have the energy…

Broadbent offered Jim six week's work in the second half of the summer term preceding his permanent appointment in September so he could get to know the school and the pupils a little. It is clear that Jim was already confident about his mathematics teaching and keen to begin practising.

> It was intended I think that we were supposed to come and like just have a look about and observe and stuff, but I couldn't do that in the end because I was spending most of my time with a woman called Marion, who'd got a full-time maths timetable but she had no real maths qualification at all. She was an art teacher and I was just watching her teach all these lessons and just thought "I can't really let her do it because she's doing it wrong." So I just ended up teaching for six weeks … I just said "I'll do them for you and you can go and do something else." … She couldn't teach them. She was just teaching them drawing. They were drawing things and she would let them sit there and do nothing while she would like paint portraits of them and I was like no, we can't be having that.

Jim had wanted to be a secondary mathematics teacher for longer than he could remember and he looked inward to his own thoughts and backwards to his own experiences as a school pupil to frame and understand his practice. For him, Broadbent offered the freedom to develop in his own way as a practitioner, a freedom he highly valued, and one which was "quite liberating actually".

> I didn't enjoy going to university at all. I didn't even want to do anything there. I just hated the whole experience. And I didn't like going to college, didn't like doing my [school exams]. I just wanted to be a maths teacher and I just wanted to get there, so it was quite nice to get there and have your own classroom and then actually start teaching. I'd wanted to be a maths teacher since I was [a child]. So everything just seemed like in the way of trying to get there …

Thus, Jim did not respond to and make use of the mathematics education approaches and understandings offered to him by his university tutors during his initial teacher education. At a slightly later date, when offered a professional development opportunity linked to a local university, he asserted with confidence that he had "never read a book". This seemed important to him in constructing his way of describing himself in the world.

He had a complex and contradictory relationship to his school experiences of mathematics.

> All my maths teachers had been rubbish. Every last one … I wasn't really taught maths because I always followed the … [resource based] scheme of work … never did a teacher really stand at the front and say "This is how you do this."

Despite this, Jim had kept all his mathematics books from school "because I knew I was going to be a teacher" and he remembered working together as a whole class on investigations, material which he was continuing to use at Broadbent. Not only that, at school he had "just really enjoyed maths and always have". In the context of this paper, two things stand out about Jim's account of his school experiences. First, he had been taught in all-attainment groups using an individualised scheme and, despite his assertion that all his teachers were "rubbish", he said that "everybody did well because you had appropriate tasks". This "completely differentiated" approach seemed fundamentally to inform his thinking about all-attainment teaching. Second, he spoke about himself as having a fixed level of mathematical ability and he linked his understanding of his own competence as a mathematician entirely to external markers.

> I've never been like really good at it, but I just really enjoy doing it. I mean I only got a level 5 in my primary school SATs and I got a level 7 in my secondary school SATs and I got a B at GCSE. I got an E at A Level … [73]

This was echoed in the way Jim talked about the Broadbent pupils. Throughout the interview, the pupils were referred to by Jim in a variety of ways all of which seemed predicated on fixed ability thinking: "lower foundation type students"; "the very brightest students"; "ten kids that should definitely do high maths"; "their [SES] data … regardless of social context that is the grade they should get based on [results from primary school] … regardless of whether their mum's on drugs or they're on free school meals".

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[73] These are all public examinations in the English school system. The curriculum and the associated SATs were structured into levels. Jim's results are mostly above average but not excellent. The final school leaving mathematics grade is lower than average for those who take the examination.

Coinciding with Jim's arrival at Broadbent, Barry introduced all-attainment teaching for the first year classes.

> We all knew what Barry was about … it's not like he kind of hides it under a bushel. He would say in meetings what was his kind of pedagogy and what he wanted to achieve.

But this claim seems to have related to using a more open and problem-solving approach rather than providing any sort of challenge to fixed ability thinking. Barry prepared packs of materials which were full of ideas that offered a more investigatory approach than the one with which the teachers were familiar organised around broad topics. When asked for an example, Jim said

> … the first half term … you would do a unit on triangles and you'd do a unit on cubes … and you could do them in whichever order you wanted to. [But] you didn't have to use any of it. You could use none of it, some of it, all of it, your own stuff … Some of the resources I didn't like so I didn't use them … [I used] a combination. We had textbooks, so sometimes I'd use those, sometimes I'd make my own and sometimes they'd do it off the board and sometimes … just find something on the internet and re-purpose something if you like.

Towards the end of the year, Barry asked his department if they would like to continue working in this way with the pupils during the following school year, thus extending his all-attainment project into the first two years of the school.

> Did we want to continue the kind of thematic approach? Did we want to continue the mixed ability approach? And we all said yes. We enjoyed it. We enjoyed doing it, so we said yeah.

However, for Jim, teaching all-attainment groups was synonymous with providing differentiated materials. On occasions he was able to make this work effectively for him and his class:

> If you really wanted to differentiate, particularly when we used to teach mixed ability and we were doing fractions … I just had the [levels of difficulty] on the board and they would just pick whichever one they wanted … most people just try and go for the one that's quite challenging. Some of them knew that there was no point in trying the level 8 one because they were a level 4 kid or something, but they didn't go for the easy option. They went for an appropriate level one and I think they quite enjoyed it. They liked it … and I think they liked having the choice as well.

But overall the task of trying to provide differentiated materials across the attainment range, rather than adopting a fundamental pedagogy for attainment for all, proved overwhelming and undoable.

> My experience of [the second year groups] was at that point the difference between the highest and the lowest had increased dramatically and it was becoming a strain … They'd all made progress, but the higher ones had made more progress and so I was having to differentiate more and then do the same for my new first years … it was becoming very fraught and time consuming and I wasn't doing it as good as I could have… No, I wasn't teaching as well as I should have been teaching because I was spending too much time doing too much differentiation … I just couldn't do it effectively … there was just so much planning and I was kind of making do I think.

Jim did not give up easily and shortly afterwards when Barry had moved on and Jim was given responsibility for the department, he even extended the all-attainment teaching to a third year. However, and unsurprisingly, this did not last.

> The kids bottomed out, teachers were over stressed, over worked. I don't understand why I did it in the first place … I mean I can look back now and think "You stupid idiot!" I obviously already knew that it was really difficult to differentiate across two different year groups and it was a lot of planning, so I don't understand why I did it.

It is interesting to follow how Jim justified and explained the policy reversal when looking back several years later. The initial cohort of students who had had two years of all-attainment teaching - and experienced all the initial commitment and enthusiasm - had done remarkably well in both the high stakes, external tests they took, one at the end of their third year and one at the end of their fifth. The following year group was a much more challenging cohort and were problematic throughout the school. But the difficulties Jim and the department experienced were not seen in this light. Rather, they became the basis for a rejection of an all-attainment approach. And we see again the role that all-attainment teaching as individual differentiation played in making life impossible.

> It just didn't work. The kids weren't getting the grades or the marks or the levels, whatever, and behaviour was awful. No, it just didn't work … you could physically see that there was more stress on teachers' faces because not only were you having to deal with challenging behaviour, but you were trying to deal with trying to get X to get a level 8 and Y to try and count up to 5 in the same class and it was too hard. It was too hard and it didn't work. It failed. Everybody was more than happy [to go back to setting] … The year after we taught just setted by ability and they got much higher results.

Jim is now firmly of the opinion that, at least in a school like Broadbent, there is no place for all-attainment teaching:

> I would just set them. I'm definitely now not a mixed ability fan in a challenging school. It's just too much.

Discussion

Our aims in this paper are modest. We do not expect stories like this to have any traction with policy makers and we very much welcome alternative approaches that may have the "requisite symbolic power" (Francis et al., 2016, p. 13) to do so. Here our purposes are rather different. Our intention has been to tell a story of a single teacher which illustrates how "powerful discursive productions of the 'obvious', 'real', and 'natural' " (Francis et al., 2016, p. 10) work in practice to shape this teacher's thinking about ability. Jim is striving to make sense within this discursive framework. He conceives the pupils as simply *being* such and such a level *person* in mathematics and so inherently needing a differentiated approach to learning: the pupil's essence determines within fairly narrow limits what she or he can do. With such a view, offering a more open curriculum in which the unpredictable is expected makes no sense and the task of all attainment teaching becomes simply unmanageable: Jim is led to validate practices with respect to pupil grouping that reinforce inequalities despite the honourable intentions to do otherwise.

If fixed hierarchies exist - of who can understand and achieve what in mathematics - and there is a predicted and predictable limit to what can be expected from any particular individual, as current policy technologies insist, then the possibility of creating a pedagogy where all can succeed, and where success is attributed to the learning community rather than to individuals, is precluded:

the production of hierarchies of ability via a discourse of 'natural order' acts as a technology of privilege, and renders alternative accounts (including research evidence) unintelligible. (Francis et al., 2016, p. 12)

Knowledge, discursive practices and both deep and espoused beliefs all interact in complex and layered ways in shaping how we think and what we do. A two-fold argument follows from Jim's story. First, changing practice alone is unlikely to engender ways of being in the world that challenge established 'natural' hierarchies. Second, there is a need for research-informed, counter-hegemonic knowledge and understandings to be foregrounded, alongside curriculum innovation and the re-imagining of pedagogy, if the dominant and unjust practices of grouping by "ability" are to be effectively countered in the countries in which they currently prevail.

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Appendix 11: Research papers from doctoral research

Jackson, C. (2017a). Social class and "ability" grouping in mathematics in English secondary schools: A review Paper presented at the *CERME 10: 10th Congress for European Research in Mathematics Education (CERME10, February 1- 5,2017),* Dublin, Ireland: DCU Institute of Education. 1489-1496.

Jackson, C. (2017b). 'Sets 4 and 5 were stuffed full of pupil premium kids': Two teachers experiences of 'ability' grouping. Paper presented at the *9th International Conference of Mathematics Education and Society-MES9,* Volos, Greece, 2, 554 -568.

Jackson, C. (2017c). "We can't be bothered … that's just the way it is here": Low expectations in a working class school. Paper presented at the *Proceedings of the 14th International Conference Challenges in Mathematics Education for the Next Decade Sep. 10– 15, 2017,* Hotel Annabella, Balatonfüred, Hungary. 164-169.

Jackson, C. (2019a). Teachers teaching all-attainment mathematics: What sustains them. Paper presented at the *Proceedings of the British Society for Research into Learning Mathematics 39 (1),* Milton Keynes.

Jackson, C. & Povey, P., 2019c) Learning Mathematics without Limits and All-attainment Grouping in Secondary Schools: Pete's story, *FORUM*, 61(1), 11-26.

Jackson, C. (2019b). Going against the grain: Critical thinking in and beyond mathematics. Paper presented at *The Mathematics Education for the Future Project Proceedings of the 15Th International Conference Theory and Practice: An Interface Or A Great Divide,* Maynooth University, Kildare, Ireland. 25-256.

Appendix 12: Ethics Documents

Consent Form

TITLE OF STUDY:
All-attainment mathematics teaching in England: how teachers resist ability grouping.

Please answer the following questions by circling your responses

Have you read and understood the information sheet about this study?	YES	NO
Have you been able to ask questions about this study?	YES	NO
Have you received enough information about this study?	YES	NO
Do you understand that you are free to withdraw from this study?		
Within the time frames specified (up to 14 days after the research interview)	YES	NO
Without giving a reason for your withdrawal?	YES	NO
Your responses will be anonymised before they are analysed.	YES	NO
Do you give permission for members of the research team to have access to your anonymised responses?	YES	NO
Do you agree to take part in this study?	YES	NO

Your signature will certify that you have voluntarily decided to take part in this research study having read and understood the information in the sheet for participants. It will also certify that you have had adequate opportunity to discuss the study with an investigator and that all questions have been answered to your satisfaction.

Signature of participant: .... Date: ....

Name (block letters): ....

Signature of investigator: .... Date: ....

Principal investigator

Colin Jackson City Campus, Sheffield Hallam University
Mob: 07851609512
email: colin.jackson@shu.ac.uk

Please keep your copy of the consent form and the information sheet together.

Participant information Sheet - Interviews

All-attainment mathematics teaching in England: how teachers resist ability grouping

1. Please will you take part in a study about mathematics teachers and all-attainment teaching?

2. You have been selected to participate because you indicated you would be willing to be interviewed as part of the research.

3. As part of the interview process you may be invited to talk about your beliefs on the nature of mathematics, on your beliefs about mathematics teaching and what your practices as a mathematics teacher are. The interviews will be audio recorded on a digital recorder.

4. Interviews may take place at your school and may also take place in less formal settings e.g. a local café.

5. Initial interviews will usually take approximately one hour. You may be asked to participate in a follow-up interview. This may be up to three hours.

6. You will have the opportunity to read a transcript of relevant parts of each interview, my reflections on the interview and to discuss the interviews and reflections. You will also have an opportunity to discuss your participation with the interviewer (myself) at the conclusion of the research project.

7. Colin Jackson will be responsible for all of the information when this study is over.

8. Colin Jackson, xxxx (supervisor), xxxx (second supervisor), other members of the research team and the external examiners will have access to all of the information when the research is completed.

9. On completion of this research the information will be used as the basis for a doctorate of education thesis. The raw data will be kept for up to 4 years.

10. The information will be used as the basis for conference presentations and papers and research papers.

11. Your responses will be anonymised before they are analysed.

12. The whole study is likely to last at least two years.

13. You will be emailed a summary of the results of the study.

14. I would be delighted if you are able to participate in this research. However participation in the interviews is totally voluntary and you may decline to participate.

15. You have the right to withdraw within the specified time during the study.
    (This specified time is up to 14 days after the date of the interview).

16. If you have any other questions or worries, please ask them.

Please contact xxxx or xxxx with any concerns after the study.

Letter to School

Xx xxxx 2017

Dear xxxx

I realise that mathematics departments are under great pressure, but this is just a brief note firstly to introduce myself and secondly to express an interest in carrying out some of the research for my doctorate in the mathematics department in your school.

First of all I would like to give you some background about myself and to give you the reasons why I am interested in researching the mathematics department in your school. I currently work in mathematics education at Sheffield Hallam University.

I started my teaching career as a mathematics teacher at Morpeth School in Bethnal Green in London in 1985 moving on to Gladesmore Community School in Haringay in 1987. I subsequently worked at Queens Park Community School in Brent for several years and finished my career as a mathematics teacher in schools as Head of Department at Fartown School in Huddersfield. Leaving Fartown in 2000 I commenced a masters degree in education at Sheffield Hallam University. Shortly after I started my degree, I also began teaching part-time at Sheffield Hallam gaining a permanent job as an academic several years later.

I commenced my Doctorate in Education in 2012 and am about to embark on gathering the data for my main study having finished the taught phase. My research interests are in social justice and mathematics education with a particular focus on grouping students by 'ability'. My doctoral research is in the area of 'ability' grouping. The mathematics department in your school sounds an exciting and interesting place which might provide an appropriate focus for my research.

I would be very grateful indeed if you were willing to consider my proposal about conducting my doctoral research in the mathematics department in your school and would appreciate an opportunity to talk to you about it at the earliest opportunity. I would anticipate carrying out my research in the summer term of this academic year.

I look forward to hearing from you.

Best wishes

Colin Jackson
(Doctoral student)

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