Developing Science Identity and Cultural Capital: A Hermeneutic Study of Teacher-Led Secondary Science Curriculum Development

Claire Frances Copeland

January 2025

A thesis submitted in partial fulfilment of the requirement of the University of Staffordshire for the degree of Doctor of Education.

Abstract

Science uptake in post-compulsory education is diminishing in the UK. Data collected by the Programme for International Student Assessment, suggests stagnation in secondary science performance, with fewer high achievers. Previous research linked reduced science participation, attainment, and aspirations to lower socioeconomic status, low social mobility, and reduced access to cultural capital. Cultural capital is a concept introduced by sociologist Bourdieu and refers to social and cultural assets that influence a person's educational outcomes.

In 2019, the UK's national school inspection body, the Office for Standards in Education, Children's Services and Skills, introduced new inspection criteria in its *Education Inspection Framework*. This framework placed the emphasis on inspections of the curriculum and identified the importance of this in providing opportunities to increase students' cultural capital.

This small-scale qualitative study (involving five participants) took place in a secondary school, located in an area of England with low levels of social mobility. The area ranked 298th out of 324 in England's 2017 Social Mobility Index, a government measure assessing individuals' opportunities to improve their socioeconomic position. The school implemented their 'Linear Curriculum' which aimed to provide opportunities for students to develop science identity (perceptions of themselves as scientists) and cultural capital. The curriculum also aimed to improve student confidence and academic performance, both arguably as prerequisites for the continuation of the study of science beyond the compulsory school age.

This research examines how the Linear Curriculum impacts science students through the hermeneutic analysis of teacher perceptions. Data were generated through diary entries, semi-structured interviews, and a focus group with five teachers involved in the development and implementation of the curriculum. Perceptions were analysed using a theoretical framework developed in this research, combining the philosophies of Bourdieu and Gadamer. Triangulation of the data sought to identify and clarify the perceptions of teachers regarding the effect of the Linear Curriculum on the students and its' impact on students' science identity and cultural capital.

Analysis of data revealed a ‘fusion of horizons’ where teachers agreed the Linear Curriculum was well structured and challenging for all students, despite the incorporation of the content from the Triple Science General Certificate of Secondary Education (GCSE), content included the individual GCSEs in Biology, Chemistry and Physics. There was an awareness of its limitations, and the curriculum was described as a work in progress. The participants had a shared vision of science identity, with their descriptions based on their personal qualities. However, cultural capital was less well understood and was perceived to be a tangible act or object that could be provided to the student, in terms of gained knowledge and experiences in the classroom.

Participants perceived the Linear Curriculum had the potential to increase science identity and cultural capital, whilst recognising the importance of their role in providing support for all, particularly those with less educationally dominant cultural capital. Additionally, the process of curriculum development fostered increased professionalism and identity in the participants.

Acknowledgements

A heartfelt thank you to my supervisors Professor Gill Forrester, Dr Jo Basford, and Dr Jan Hetherington, without their support and humour, this would not have been achieved. A special thank you to Professor Gill and Dr Jan, along with Julianne, Heather, and Dr Fouzia, whom I befriended at the AERA conference in San Diego in 2022 and will always hold dear to my heart.

I would like to offer a special thank you to Sir David Bean for awarding me the financial support, enabling me to travel to San Diego and to present, through the University's Dr Ruth Thompson Global Teaching Scholarship. This opportunity changed my life and has been one of my greatest achievements while completing this research.

I would like to express my deepest gratitude to Dr Dave Skingsley and Dr Veronica Poulter, who gave their time to read my work and shared my enthusiasm for my research. Although Dr Veronica is no longer with us, their wisdom and encouragement continue to inspire me.

I would like to thank my work colleagues for always being there and supporting me throughout this research and for putting up with me talking constantly about how many words I didn't write over the weekend! A special thank you to my participants Emma, Laura, Max, Jim, and Robert (pseudonyms) who willingly gave up their precious time to talk to me and allowed me to share their stories. To the Principal of the school for trusting the department to do the amazing job they have done on the curriculum and for allowing me to complete this research.

A special thank you to my friends in the WhatsApp 'EdD Study Group,' especially Helen, Niall, Lauren, Dan, Ty, and Ana. You have always been there when I needed support, no matter the time of day. Throughout the entire five and a half years of study and research, you have answered all my questions and guided me through every brick wall I have hit. Thank you for your kindness and friendship and I wish you all success, you deserve it!

Finally, a huge thank you to John, my husband, who has listened to every single idea that has come into my head over the last 5 years and always supported me with time and love. I couldn't have done this without you. To Patrick and Laura, who have at

times been amused that mum is ‘at uni’ but have always supported me and respected my desire to prove I am good enough to do this work. A thank you to my mum and dad who were always in the background, asking how I was getting on (and then wishing they hadn’t asked!). Last but not least, Tommy my lovely Border Collie, who has sat at my feet patiently for five years, waiting for his walks.

Authors Declaration

I, Claire Frances Copeland, declare that I am the sole author of this thesis. No part of this thesis has been previously submitted for any other degree at the University of Staffordshire or another institution.

Signed:

Claire Copeland

Table of Contents

Acknowledgements ..... **iv**

Table of Contents ..... **vii**

List of Tables and Figures ..... **xiii**

Abbreviations ..... **xiv**

Chapter 1 Introduction **1**

1.1 Introduction 1

1.2 Personal Interest in Science Education 2

1.3 Professional Interests 3

1.4 The Research Focus 4

1.5 The Importance of Conducting This Research 5

1.6 Research Design and Methodology 6

1.7 Research Aims and Objectives 6

1.8 Structure of the Thesis 7

Chapter 2 Literature Review **9**

2.1 Introduction 9

2.2 The Evolution of Curriculum Models 10

2.3 The *National Curriculum in England* 13

2.3.1 Education Pre-1988 13

2.3.2 Implementation of the Education Reform Act 1988 14

2.3.3 The Science National Curriculum in England 16

2.4 Accountability and Inspection in English Education: Impacts on Schools and Teachers 19

2.4.1 The Introduction of Ofsted 19

2.4.2 New Labour: Reform, Reward and Professionalism 19

2.4.3 The Coalition: Academisation, Autonomy and Inequality 21

2.4.4 The Education Inspection Framework 23

2.4.5 Emotional and Practical Impacts on Teachers 25

2.4.6 Teachers in Curriculum Reform 26
2.5 Social Theory 29
2.5.1 Bourdieu's Theories of Social and Cultural Reproduction 29
2.5.2 Cultural Capital in Education 31
2.5.3 Identity Theories in Education 35
2.5.4 Science Identity 38
2.6 The Teacher: Identity, Agency, and Professionalism 40
2.6.1 Teacher Identity 40
2.6.2 Teacher Agency 42
2.6.3 Teacher Professionalism 44
2.7 The Problems in Science 46
2.8 Summary 48
Chapter 3 Research Design and Methodology 49
3.1 Introduction 49
3.2 The Research Questions 49
3.3 Methodological Approach 50
3.4 Phenomenology 53
3.5 Researcher Positionality 54
3.6 Use of Gadamer's Hermeneutic Inquiry in This Research 55
3.7 Research Design 56
3.7.1 Setting 56
3.7.2 Participants 56
3.7.3 Data Generation 58
3.8 Data Management and Security of Research Documentation 62
3.9 Data Analysis and Interpretation 63
3.9.1 Choosing Appropriate Research Questions 63
3.9.2 Gaining Understanding Through Pre-understandings 64

3.9.3 Gaining Understanding Through Dialogue With the Participants 68
3.9.4 Gaining Understanding Through Dialogue With Text 68
3.9.5 Establishing Trustworthiness 71
3.10 Ethical Considerations 73
3.11 Summary 75
Chapter 4 Findings 76
4.1 Introduction 76
4.2 Participant Pen Portraits 76
4.2.1 Emma 76
4.2.2 Jim 77
4.2.3 Laura 77
4.2.4 Max 78
4.2.5 Robert 78
4.3 Teachers' Narratives Around the Linear Curriculum 78
4.3.1 Initial Development and Perceptions of the Linear Curriculum 79
4.3.2 Positives of the Linear Curriculum 83
4.3.3 Limitations and Further Development of the Linear Curriculum 87
4.4 Teachers' Narratives of Science Identity and Cultural Capital 91
4.4.1 How do Science Teachers Understand Science Identity in Themselves? 91
4.4.2 Teachers' Perceptions of How Science Identity Manifests in Secondary Students 92
4.4.3 The Extent to Which the Linear Curriculum Develops Science Identity 100
4.4.4 Definitions of Cultural Capital 103
4.4.5 How Cultural Capital Manifests in Society 106
4.4.6 Perceptions of How the Linear Curriculum Provides Cultural Capital for Students 107

4.4.7 The Extent to Which the Linear Curriculum Develops Cultural Capital in Students 111
4.5 Impact of Curriculum Development on Teachers 114
4.5.1 Teacher Identity 114
4.5.2 Teacher Agency 117
4.5.3 Teacher Professionalism 119
4.6 Summary 123
Chapter 5 Discussion 125
5.1 Introduction 125
5.2 Evaluation of the Linear Curriculum Model 126
5.3 Introducing a New Theoretical Framework 128
5.3.1 Creation of the Framework 129
5.3.2 Terms Used in the Framework 131
5.3.3 Purpose of the Framework in This Research 133
5.4 The Strengths and Limitations of the Linear Curriculum (RQ1) 134
5.5 The Relationship Between Teachers' *Habitus* and Prejudices and Curriculum Development (RQ2) 139
5.6 Teachers' Perceptions of How Science Identity and Cultural Capital Manifest in Their Students (RQ3) 142
5.6.1 How Science Identity Manifests in Students 142
5.6.2 How Cultural Capital Manifests in Students 147
5.7 The Impact of Designing and Implementing the Linear Curriculum on Teachers' Sense of Professionalism, Agency and Identity (RQ4) 150
5.7.1 Curriculum Development and Teacher Identity 151
5.7.2 Curriculum Development and Agency 154
5.7.3 Curriculum Development and Professionalism 156
5.8 Summary 158
Chapter 6 Conclusion 160

6.1 Introduction 160
6.2 Addressing the Research Questions 161
6.2.1 What are the Perceived Strengths and Limitations of the Linear Curriculum? (RQ1) 161
6.2.2 How do Teachers' Habitus and Prejudices Impact Curriculum Development? (RQ2) 164
6.2.3 How do Teachers Perceive Science Identity and Cultural Capital Manifest in Their Students? (RQ3) 165
6.2.4 How and to What Extent Does the Linear Curriculum Influence Teachers' Sense of Professionalism, Agency and Identity? (RQ4) 167
6.3 Contributions to Knowledge 168
6.4 Recommendations for Practice 171
6.5 Future Research 174
6.6 Research Limitations and Strengths 175
6.7 Researcher Positionality 177
6.8 Professional Learning That Has Taken Place 180
References 184
Appendices 216
Appendix 1: The Science Linear Curriculum 217
Appendix 2: Literature Search Strategy 218
Appendix 3: Summary of the Methodology Adopted in This Research 221
Appendix 4: A Conversation With Jim About a Diary Entry 222
Appendix 5: Pilot Study and Initial Questionnaire 223
Appendix 6: Participant Information Sheet 225
Appendix 7: Participant Consent Form 234
Appendix 8: Questionnaire 238
Appendix 9: Diary Entries 251
Appendix 10: Semi-Structured Individual Interview 253

Appendix 11: Follow-up Interview 254

Appendix 12: Ethical Approval 255

Appendix 13: Focus Group Interview 259

Appendix 14: Complete Pen Portraits 260

Appendix 15: Examples of Initial Open Coding, NVivo12 Nodes, Descriptions and Their Potential Relationship With the Research Questions 270

List of Tables and Figures

List of Tables

Table 3.1: Demographics of Participants (n=5) 58
Table 3.2: My Pre-understandings in Relation to the Research Questions 67
Table 3.3: Major Themes Determined From the Data 70
Table 4.1: How Can Science Teachers and the Linear Curriculum Develop Science Identity? 103

List of Figures

Figure 3.1: Bricolage of My Pre-understanding 65
Figure 3.2: Diagrammatic Representation of the Major Themes and Sub-themes 71
Figure 5.1: Theoretical Framework Combining the Philosophies of Bourdieu and Gadamer 131
Figure 5.2: Illustration to Show the Application of the Theoretical Framework 141
Figure 5.3: Summary of Science Identity Characteristics 143
Figure 5.4: Diagram Showing the Potential Student Outcomes in Science Education 146

Abbreviations

A-level	Advanced Level
CPD	Continued Professional Development
EEF	Education Endowment Foundation
EIF	*Education Inspection Framework*
ERA	Education Reform Act
FG	Focus group interview
GCSE	General Certificate of Secondary Education
KS	Key Stage
OECD	Organisation for Economic Co-operation and Development
Ofsted	Office for Standards in Education, Children's Services and Skills
PISA	Programme for International Student Assessment
QA	Questionnaire responses
RQ	Research Question
SATs	Standardised Assessment Tests
SES	Socioeconomic status
SSI	Semi-structured interview
STEM	Science, technology, engineering, and mathematics

Chapter 1 Introduction

1.1 Introduction

The importance of improving science education in the UK and internationally has been widely recognised by governments, teachers, and industry stakeholders (Moote *et al*., 2020, 2021). Across the field of Science, Technology, Engineering and Mathematics (STEM), global discourse highlights the role of science education in developing the scientists of the future, who in turn contribute to national and global economies (Francis *et al*., 2023; Moote *et al*., 2021). International research has explored different aspects of education, all aiming to improve outcomes and aspirations in science (Archer *et al*., 2013a, 2020; ASPIRES Research, 2022; Aschbacher *et al*., 2010). Braund and Reiss (2006), for example, explored science curricula and raised concerns about approaches that, while aiming to engage a broader student base, failed to adequately prepare those with the potential to continue their science education beyond the compulsory level. Similarly, Debarger *et al*. (2017) emphasised the importance of high-quality curriculum resources and teachers in effective curriculum reform. To ensure consistency and quality of the curriculum and effective educational provision, external inspections were introduced, by organisations in the form of Inspectorates of Education. Some, such as the Dutch Inspectorate of Education, have existed for over two hundred years, with their roles centred on external quality control and school evaluation (Altrichter and Kemethofer, 2015). In England, the equivalent body of the Office for Standards in Education, Children's Services and Skills (Ofsted), whose role in curriculum evaluation provides the national context for this study.

Engaging in this international discourse, this study focuses on a science curriculum designed by a group of teachers working in a secondary school in England. The driver for this curriculum development was a change in the school's external assessment by Ofsted, who reports to the British Government. Ofsted was created in 1992, under the *Education (Schools) Act* (see Chapter 2.4.1), with its role focused on inspecting and regulating services which provided education and skills for learners of all ages. Using a 'common inspection framework' Ofsted obtains evidence in education settings and publishes their findings in reports to schools, parents, and the Government. These inspections aim to improve the quality of education, focusing on four main areas:

Effectiveness of leadership and management, Quality of teaching, learning and assessment, Personal development, behaviour and welfare and Outcomes for learners. Their new inspection framework, the *Education Inspection Framework (EIF)* (Ofsted, 2019b), changed the emphasis of inspections away from one of reliance on examination results to one with a more holistic view of the 'Quality of education,' with a focus on curriculum, and an emphasis on the inclusion of 'cultural capital' as an additional aspect to consider.

This research contributes to the broader international dialogue on science curriculum design and reform, with the curriculum model in this study being situated within the English education system. This thesis explores a science curriculum model developed in response to the 2019 *Inspecting the Curriculum* policy (Ofsted, 2019a), issued alongside the *Education Inspection Framework* (Ofsted, 2019b), and provides insight into the lived experiences of five teachers, working in a secondary school in a low social mobility area in England. The study aimed to explore their experiences teaching from the curriculum, focusing on how they perceived it had the potential to build cultural capital and science identity in their students, and to what extent.

1.2 Personal Interest in Science Education

The natural sciences and science education are my passion. I come from a background of hardworking, working-class parents. No one within the immediate or extended family worked in any role connected to science. My parents are not what I would classify as 'sciencey' but shared their love of nature, watching nature programmes as a family and introducing me to bird watching, to keep me busy during the school summer holidays. At school, I was always a quiet student and enjoyed learning, particularly in my science lessons. At Primary school, I was blessed with an amazing and inspirational science teacher, who would regularly don his laboratory coat and treat us to a class investigation or practical (see Figure 3.1 and Chapter 3.9.2 for more details of my background).

My love for science led to a professional role within the National Health Service as a Biomedical Scientist, followed by a later career change into education as a secondary science teacher. Through my experience as a science teacher and then in the role of Head of Science, I have experienced first-hand, the 'joy' and the 'horror' of secondary

students when studying science. The perceived difficulty and the overwhelming volume of the science curriculum content (Archer *et al*., 2020) have arguably contributed to the decrease in the number of students progressing into post-compulsory (post-16) science study in my school, especially in Chemistry and particularly Physics, where courses have not run in the Sixth Form. Poor uptake of post-compulsory science, especially the physical sciences, is not unique to this school and has been reported in the literature (Homer, Ryder and Banner, 2014; Archer *et al*., 2017a; DeWitt, Archer and Moote, 2019). The potential reduction of scientists in the workforce has been raised as a concern for the country's economic status (McDool and Morris, 2022), as science, along with Technology, Engineering and Mathematics (STEM subjects), is seen as a pivotal driver for ensuring competitiveness in future scientific and technological advances (Moote *et al*., 2020).

1.3 Professional Interests

The *National Curriculum in England* was introduced in 1988 (DES, 1988), designating science as a core subject alongside English and mathematics. To ensure the programmes of study were implemented correctly Standardised Assessment Tests (SATs) were introduced in the core subjects, testing students at the end of each Key Stage (KS) of their education, aged 7, 11 and 14 years (Gathercole and Pickering, 2000). The calculated 'levels' achieved were then used as a measure of progress against targets, and the data were published in league tables, making schools accountable and placing them in a competitive market (Forrester and Garratt, 2016). As a consequence of this data publication, schools were described as 'teaching to the test,' which Ofsted highlighted in their *Success in Science* report (2008). Marshall (2008) and Winter (2017) explained 'teaching to the test' as a product of schools aiming to meet the narrow requirements of the assessment, to place the school favourably in the league tables. A report commissioned by the Wellcome Trust (Murphy *et al*., 2010) following the abolition of the KS2 Science SATs and subsequent removal of KS3 SATs, described the concerns of both parents and students and its potential impact on the lack of science teaching and preparation for secondary school, supported by Maddern (2011) who reported concerns of teachers.

In my current role as Head of Science, I have witnessed first-hand how students perceive other core subjects, English, and mathematics, to be of greater importance, arguably resulting in less interest in General Certificate of Secondary Education (GCSE, national examinations taken at age 16) science and reduced post-compulsory uptake. Furthermore, following the trend reported elsewhere, uptake in the physical sciences, in my school, has been male-orientated (Archer *et al*., 2012; Archer, Dewitt and Willis, 2014; Carlone *et al*., 2015; DeWitt, Archer and Moote, 2019) and in low numbers.

The apparent stagnation of secondary education was highlighted by Ofsted in their report *Key Stage 3: The Wasted Years?* (Ofsted, 2015a) which identified a slight increase in achievement at the end of primary school was not reflected at GCSE level and revealed an increasing gap between students from poorer and those from more affluent backgrounds. The lack of challenge and engagement, particularly in KS3, was linked to the previous notion of 'teaching to the test' leading to the formulation and launching of a new inspection policy *Inspecting the Curriculum* (Ofsted, 2019a) (see Chapter 2.4), with a renewed focus on what was being taught in the classroom rather than the final grades achieved. School leaders responded to this, arguably giving autonomy back to teachers, providing them the opportunity to review their curriculum offer, to ensure greater engagement and challenge for all students. This was certainly the case in my school and as a group of science teachers, we discussed in depth what we wanted our students to know and be able to do at each stage of their secondary education. This led to the development of a curriculum model which the department named the Linear Curriculum (Appendix 1), through which it aimed to address the issues already mentioned. Implementation of this curriculum began in September 2019; however, major disruptions ensued due to the extended lockdowns and school closures caused by the COVID-19 global pandemic. Subsequent work to 'close gaps' in student knowledge, missed whilst schools were closed, was addressed, meaning the curriculum model has yet to run through with a cohort from Year 7 (Y7) to Year 11 (Y11).

1.4 The Research Focus

Following the implementation of the policy *Inspecting the Curriculum* (Ofsted, 2019a), changes occurred in the school Science department in how and when topics were

taught. The overarching aims of the newly developed Linear Curriculum were to provide equality and improve engagement, outcomes, and retention to post-16 science courses, by providing suitable levels of challenge, through developing conceptual difficulty of topics across the secondary education years. This research aims to explore science teachers' perceptions of the in-house designed curriculum's potential to develop students' science identity, how well they see themselves as a scientist, and their cultural capital, a Bourdieusian concept encompassing the social and cultural assets that influence social positioning and opportunities. These concepts are discussed in detail in Chapter 2.5.

1.5 The Importance of Conducting This Research

Smith (2010) and Essex (2018) both examined the school science curricula, with Smith focused on concerns of recruitment of scientists, while Essex examined the suitability of the *National Curriculum in England* for all learners, including those with special educational needs. They both contended school science aimed to prepare the small number of students who would become the scientists of the future to maintain the UK's competitive edge, whilst at the same time aiming to provide scientific literacy to the wider population, including those with lower socioeconomic status (SES), to improve their social mobility. Science qualifications provide strategic value in the labour market and education and command wage premiums (Claussen and Osborne, 2013; Francis *et al*., 2023), indicating the relatively high exchange value of science qualifications in society, and spotlighting the importance of secondary science education.

Homer, Ryder and Donnelly (2013) described one of the aims of the 2006 Key Stage 4 science curriculum reform (QCA, 2005) as being to improve social mobility and inclusion. Whilst also finding links between Triple Science GCSEs in Biology, Chemistry and Physics (Chapter 2.3.3) and improved science participation, they also highlighted issues with prior attainment and student science identity. The resultant implications for curriculum development within STEM and specifically science is an understanding of how and whether science identity can be built in students.

Through the lens of the teacher and an exploration of how they perceive science identity in their students, this research enhances understanding of the critical role

teachers play in curriculum development and the promotion of science. It offers a new perspective on factors affecting the uptake of science subjects post-16 to add to the literature.

1.6 Research Design and Methodology

This research followed a Gadamerian philosophical hermeneutic phenomenological methodology, whereby the emic nature of the researcher provided an advantageous positionality in understanding the shared phenomenon (Pratt, 2020). Within a co-created and shared space, the Linear Curriculum was designed and implemented by a group of science teachers. As a member of this group, the researcher's pre-understandings, developed through reflexivity (Archer, 2007; Schön, 2016) (Chapters 3.5 and 3.9.2), were invaluable in interpreting and understanding the perceptions of the participants in the study. However, the emic positionality afforded to the researcher also demanded a continuous consideration of positionality through a reflexive stance. This positionality is explored methodologically in Chapter 3.5 and explored further in Chapter 6.7, where the considerations and limitations posed are reflected upon and strategies are offered to others undertaking similar insider research.

The research relied principally on the generation of qualitative data, with some initial demographics and preconceptions collected in a quantitative questionnaire. Following this, participants recorded their lived experiences in the classroom over the period of a term in the form of diary entries. Queries arising from these were used alongside standardised questions in two semi-structured interviews. Data generated in a focus group interview were used to triangulate the data.

1.7 Research Aims and Objectives

This research aimed to explore the lived experience of secondary science teachers implementing their Linear Curriculum, developed by all the teachers within the department, with a focus on cultural capital and science identity, and the extent to which these concepts can be developed in students.

The research objectives are:

- To investigate teachers' perceptions of the strengths and limitations of the Linear Curriculum
- To explore differences in perceptions of the Linear Curriculum, cultural capital, and science identity of teachers with a range of personal and professional backgrounds.
- To investigate how secondary science teachers perceive science identity and cultural capital manifest in students.
- To explore the experiences of classroom teachers whilst teaching science following the Linear Curriculum.

Subsequently, the research questions (RQ) are:

RQ1: What are the perceived strengths and limitations of the Linear Curriculum?

RQ2: How do teachers' *habitus* and prejudices impact curriculum development?

RQ3: How do teachers perceive science identity and cultural capital manifest in their students?

RQ4: How and to what extent does the Linear Curriculum influence teachers' sense of professionalism, agency and identity?

1.8 Structure of the Thesis

This thesis is presented traditionally and is intended to take the reader through the research journey from the eye of the researcher. Throughout this work, the choices and decisions made will be justified with the social theories of Gadamer and Bourdieu underpinning the data generation and analysis, whilst eliciting the contribution of this work in the field of science education.

Following this Introduction Chapter, the thesis is structured as follows:

Chapter 2: Literature review. This chapter reviews the literature (Appendix 2) on the *National Curriculum in England* and the role of Ofsted. It then explores the philosophical theories of Bourdieu and their interaction with curriculum policy. The review ends with an examination of the processes involved in curriculum development, and the impact these have on teacher professionalism and identity.

Chapter 3: Research Design and Methodology. This chapter explains and justifies the methodology and methods employed in this research. It includes an explanation of the research design, the process of data generation and analysis, and how these were guided by the philosophies of Gadamer (2013).

Chapter 4: Findings. This chapter presents the key findings, organised around the major themes and sub-themes identified during the analyses.

Chapter 5: Discussion. This chapter discusses the findings through the major themes and sub-themes, interpreted through the lens of Gadamer and Bourdieu using a new theoretical framework devised during the data analysis stage.

Chapter 6: Conclusion. The final chapter discusses the extent to which the data addresses the research questions and the contribution this research makes to the field of knowledge in secondary science education. It also includes recommendations for practice and further research, along with a discussion of the limitations of this research. It concludes with reflections of my doctoral journey.

Chapter 2 Literature Review

2.1 Introduction

Since the 1980s, many countries, for example Australia, New Zealand, Portugal, America, and England (Reid, 2005; Musofer and Lingard, 2021; Calado, Neves, and Morais, 2013; Debarger *et al*., 2017; Galton, 2002), have reformed and restructured their education systems, deregulating state education and creating institutional autonomy. Neo-liberal policies in schools globally moved them towards marketisation and competition as a means of distributing resources, solving societal issues, and creating greater efficiency (Apple, 2001). Conversely, neo-conservatist policies aimed to raise standards through accountability and a more managerial approach. Despite their apparent ideological differences, both neo-liberal and neo-conservatist-stances were embraced by the New Right to establish the educational conditions required to develop 'international competitiveness, profit and discipline' (*ibid*., p.410; Forrester and Garratt, 2016). To enhance quality and performance in the global marketplace, national governments have restructured their education system, in part through the implementation of a National Curriculum and their associated systems of assessment and inspection (Whitty and Whisby, 2016). While different approaches have been taken internationally, this chapter focuses on the *National Curriculum in England*, through development, implementation, and the implications of more recent reforms.

To understand how current policy has shaped classroom practice, this chapter begins with an overview of how curriculum models have evolved since the beginning of the twentieth century and then leads into the English National Curriculum, its development, and implementation, and discusses how the UK Government held schools to account in its implementation. The chapter then reviews the inclusion and use of the concept of cultural capital in curriculum development and inspection criteria, derived from a core concept within Bourdieu's social theories. An analysis of how this concept has impacted English secondary school science education follows. Interventions targeted to alleviate identified gaps in science achievement will be explored. The chapter concludes by examining the current issues in English science education and how curriculum development impacts teachers, in terms of their identity, agency and professionalism.

2.2 The Evolution of Curriculum Models

An early pivotal point in curriculum development in the UK, saw the publication of the *Education Act 1944* (Board of Education, 1944) requiring school authorities (local bodies overseeing education) to have curriculum policies for their schools, stemming from the recognition of schools with well-defined curriculum policies being higher performing (Graham and Tytler, 1993). Policy was defined by Ball (2015) as a combination of text and discourse, enacted by teachers within schools. Ball, Maguire and Braun (2012) described enactment as a process where interpretations of policy are re-interpreted and then translated into practices and pedagogies performed by the teacher in the classroom.

Ofsted's focus on curriculum in the *EIF* (Ofsted, 2019b) and *Inspecting the Curriculum* (Ofsted, 2019a) warrants a review of what curriculum is and its historical development. The term 'curriculum' has a range of conceptualisations from how content is structured and ordered, to the notion of curriculum simply being a process played out in the classroom, following an official course (Poulton and Mockler, 2024). Establishing a theoretical foundation for curriculum design is essential for evaluating how the Linear Curriculum differs from existing models and addresses the specific challenges of science education in low SES contexts. Understanding how curriculum has evolved and how different theorists have shaped its conceptual and practical development offers a critical insight into how curriculum policy is interpreted and enacted in practice. Immediately below, the key contributions of influential curriculum theorists, whose work continues to influence modern curriculum thinking, are outlined.

Bobbit played a leading role, in the early twentieth century, establishing curriculum as a concept within education. He considered the work of teachers to have 'imprecise purposes,' advocating the use of learning outcomes in lessons (Kelly, 2009, p.68). This scientific approach to curriculum development was later adopted by Tyler (1949), whose foundational work with his 'aims and objectives model' of curriculum, was deductive and linear, moving from general to more specific outcomes (Bhuttah *et al*., 2019), whilst also being 'society centred,' addressing both societal and learner needs. Tyler offered a rationale with which he provided clarity to curriculum developers; however, his curriculum model was also considered to be undemocratic, rigid, and prescriptive, with the potential to reduce teacher autonomy (Reid, 2005). The use of

'objectives' within teaching was supported by Hirst (Kelly, 2009) who argued that not starting lessons by listing its objectives, would be irrational and the lesson would lack direction. Additionally, Hodge (2024) noted the fragmentation of the curriculum development process, between different stakeholders, as a significant divergence from Tyler's original vision.

Building on Tyler's model, Taba introduced her 'grass-roots' approach where she emphasised the importance of the teacher in curriculum development (Taba, 1962). Unlike Tyler, who assumed policymakers would oversee the process holistically, Taba highlighted the importance of the teacher in determining the needs of the learner, before designing the curriculum. Her model differed from Tyler's and somewhat addressed its limitations, in that she determined the importance of sequencing of content, which she proposed should be selected based on student interest and maturity, focusing on engaging the student (Bhuttah *et al*., 2019). Despite empowering teachers, and offering them agency to determine their curriculum, this design was potentially restricted by teacher expertise and limited by standardised assessments and policy. This model was further developed by Wheeler (*ibid.*, 2019), who suggested that the evaluative stage should be incorporated throughout the curriculum development rather than being a separate stage at the end. His cyclical model aimed to create an adaptive curriculum, addressing the inflexibility of Tyler's approach. Although this approach aligns with modern pedagogical perspectives, its significant demand on time and resources posed challenges for practitioners and school leaders.

In contrast to the objectives-led models, Stenhouse argued that successful education did not always produce uniform results and could not be reduced to measurable outcomes, as it did not accommodate 'induction into knowledge' (Stenhouse, 1975, p.81). He proposed a 'process' model which was not simply about providing facts for students to learn and for them to then regurgitate, but was dynamic, with the student at the centre (Hizli Alkan and Priestley, 2019). Kilag *et al*. (2023) highlighted the potential for lack of consistency and fragmentation of education where a curriculum is led by student interest rather than the common educational goals seen in modern education. To provide this flexible curriculum, Stenhouse (1983) acknowledged the importance of teacher CPD and reflexivity and claimed there could be no curriculum development without teacher development (Hizli Alkan and Priestley, 2019). This was

supported by Godfrey (2017) who described the importance of educational research in schools as a means for self-improvement.

Bruner offered an alternative perspective with his 'spiral curriculum,' which focused on the cognitive development of the student rather than purely on content or process (Bates, 2018). Bruner posited it was the role of the teacher to develop 'curiosity,' a will to achieve 'competency' and 'reciprocity' in their students, and the job of subject specialists to design the curriculum from which teachers instructed (Walker, 2014). Bruner proposed that rather than simply repeating content (Harden and Stamper, 1999), topics should be revisited, each time developing understanding through the increased complexity of the subject matter (Guzel and Sahin, 2019). While this model aligns with cognitive theories of learning, it has been critiqued for its assumptions of teacher continuity. Gibbs (2014, p.43) argued he considered Bruner to be 'correct in concept but wrong in scope,' explaining its effectiveness was limited when applied across several academic years with a potential lack of coherence as students moved to different teachers. The practical demands of this and its dependence on teachers working in the same manner and with the same intent lacked feasibility in school settings.

Different countries have taken different approaches, using various curriculum models, to develop their own National Curriculum frameworks. For instance, Finland's phenomenon-based learning (Schaffar and Wolff, 2024) merges science with real-world problems, and the East Asian curriculum takes a 'mastery' approach (Jerrim and Vignoles, 2016). The *National Curriculum in England* has been viewed as a hybrid of the 'aims and objectives' model, with the prescribed content representing the 'aim,' and the attainment targets set out by the *National Curriculum* serving as the 'objectives' (Kelly, 2009). The range in the structure and rationale of the different *National Curriculum* models used internationally, helps to highlight the constraints and possibilities for science curriculum development in England. Kelly argued, however, that there was neither recognition in the written documents of the National Curriculum about the curriculum models adopted, in England, nor about their limitations in practice. While structured objectives provided clarity and direction, the pedagogical constraints also asserted within the National Curriculum warrant further exploration. As such, the Linear Curriculum was designed within the constraints

afforded by the National Curriculum; however, it aimed to reduce the perceived barriers, particularly with regard to social justice and equality. The design of the Linear Curriculum is discussed and evaluated in Chapter 5.2.

2.3 The *National Curriculum in England*

2.3.1 Education Pre-1988

In the United Kingdom, following the end of the Second World War, the *Education Act 1944* (Board of Education, 1944; Ball, 2017) was implemented in England and Wales by the *Conservatives* under Winston Churchill, then Prime Minister, during a post-war push for educational equality and free to all. However, a sense of social injustice ensued and was brought about partly by the tripartite schooling system, composed of grammar schools (academic), secondary modern schools (vocational), and technical schools each intended to accommodate different types of learners. Pupils/children were allocated based on an examination grade achieved at age 11 (Forrester and Garratt, 2016); a process implemented by the proceeding Labour Party in the *Education Act* 1947 (Ball, 2017). The uneven distribution of social classes between the schools, alongside the economic boom and increasing national prosperity seen under the Conservatives, led to the discontentment of the new middle-class parents. This, alongside rising unemployment in the 1960s and 1970s and industrialists' complaints of an education system unfit to provide the key skills required for manufacturing (Graham and Tytler, 1993), was blamed on perceived falling standards and poor education (Forrester and Garratt, 2016). This prompted action by the now Labour Government and James Callaghan's seminal speech sparked the 'Great Debate' in 1976 at Ruskin College, Oxford (Callaghan, 1976) on the state of the education system in England. Lawton (1994) argued this speech seemed to confuse rather than clarify educational issues, at a time when schools and teachers were being blamed for the many problems of the modern industrial society. To begin addressing these issues, Callaghan (1976) called for a core National Curriculum. At this time, educationalists were concerned the curriculum being used in schools served only the most able, preparing them for further and higher education, whereas the less able were receiving a 'watered down' version that held little relevance to them once they had left school (Graham and Tytler, 1993, p.3). Callaghan challenged the monopoly he said educationalists seemed to have over the 'methods and purposes of education' and

'the secret garden of the curriculum' (Ball, 2017, p.82). Furthermore, he raised concerns about the lack of girls studying science and the large numbers of vacancies in science and engineering places in higher education, compared to humanity courses. Science had already been recognised as an important subject when the Ministry of Education was merged with the Science and Technology section of the Department of Industry to form the Department of Education and Science, the aim being to maintain a focus on scientific research and development for the economic growth and development of the country (Callaghan, 1976). The Ruskin speech initiated discussions on the English education system and resulted in changes, including the requirement of schools to provide a written curriculum policy as laid out in the government directive from the Department of Education and Science Circular (6/81) (DES, 1981). This was seen as the beginning of change where there had previously been concerns around the lack of a nationally agreed curriculum and associated standards.

2.3.2 Implementation of the Education Reform Act 1988

Ball (2017, p.14) described the implementation of the *Education Reform Act* (*ERA*) in England and Wales, as the 'most fundamental piece of education legislation since 1944.' The ERA was a landmark UK law introducing *National Curriculum in England* standards and market-based reforms. He contended this was important, not only for what it stood for but also for the openings it provided for future reforms. Broadbent and Laughlin (1997) described how the New Right rhetoric claimed it wanted to control the waste and inefficiencies seen in the public sector through the introduction of private-sector approaches. Reynolds (1992, p.289) asserted the changes brought about by the *ERA* were because of the 'introduction of the principles of "market forces"' under the neoliberal and neoconservative views of the New Right Conservative party. Whitty and Wisby (2016, p.317) agreed with this and described how the 'New Right' ideology of the Conservative Prime Ministers Margaret Thatcher and John Major, combined economic liberalism with traditional social values, aimed to give the consumer/parent greater powers over the producers/schools because of the perceived 'dulling' and 'levelling down of standards' in the education system. Ball (2017) concurred with this point in terms of changes to the infrastructure of education through the introduction of competition between schools and choices for parents. Reynolds (1992) purported a link between competitiveness in the economy and

education, as education was seen as a means of developing the new type of worker required to enhance the British economy. Whitty and Wisby (2016) concurred that competitiveness in education was important to the New Right, which pushed schools to be more receptive to the wishes of the parents while maintaining control over school outcomes. Reform within schools was an uneasy mix of devolution and centralisation (Ball, 2017), with financial responsibility devolved from Local Education Authorities, who managed public education services in a particular area, directly to the schools and their governing bodies, making schools accountable for their spending as it was argued they 'knew their own priorities . . . [and could] make the most sensible spending decisions' (Broadbent and Laughlin, 1997, p.285). However, Ball (2017) argued despite giving schools financial autonomy they took away schools' autonomy, in terms of curriculum and assessment through the implementation of the *ERA*.

These changes provided the illusion of granting schools and teachers greater autonomy; however, overall strategic control was maintained externally through the publication of performance data from each school (Whitty and Wisby, 2016). Within the markets created, parents had a greater choice in school selection, and schools became accountable to parents, in a similar way to public sector companies being held to account by shareholders. Gewirtz (1996, p.217) noted a marked 'class-based' difference in how parents engaged with and were able to exploit this market. She contended parental social class, particularly those she described in the category of 'privileged/skilled' (professional middle class), played a part in determining how well they were able to exploit the market to the advantage of their child.

The *ERA* (DES, 1988; Gordon, 1988) saw the introduction of the compulsory *National Curriculum in England*, and despite early discussion of it consisting of only three subjects, English, mathematics, and science, as was favoured by the Conservative leader Margaret Thatcher (Graham and Tytler, 1993), a broader ten-subject curriculum was implemented by Kenneth Baker, the Secretary of State for Education. For each subject, the *National Curriculum* clearly defined what was to be taught, to provide a 'broad and balanced' curriculum to keep future career options open to all students (Millar, 2011, p.173), the pedagogy to be utilised by teachers, and when it was to be taught. It also introduced a set of standards against which students were assessed at various stages of their education (Broadbent and Laughlin, 1997). Education was split

into four Key Stages (KS), KS1 (5 to 7 years) and KS2 (7 to 11 years) were to be taught in primary school and KS3 (11 to 14 years) and KS4 (14 to 16 years) in secondary school. Throughout their education, all students were to be taught the three core subjects, English, mathematics, and science (Graham and Tytler, 1993), alongside other non-compulsory subjects.

Following the introduction of the *National Curriculum in England*, Woolley (2019, pp.217-218) described how a group of History teachers considered the early years post-1988 as a 'period of limitation,' with the 'government diktat' of a detailed and prescriptive curriculum impacting teacher autonomy. Ball (2017) also argued teacher autonomy was being reduced, and Winter (2017, p.57) supported this in her description of education reform and accountability as, 'fixing . . . input, process and output requirements.' The perceived tight control over pedagogy and curriculum, the introduction of attainment targets and expected levels of progress, and school league tables were all elements contributing to reduced autonomy in the classroom (Winter, 2017). Reiss (1990, p.1) supported this when describing teachers' early perceptions of the *National Curriculum in England* as being a 'straight-jacket' in terms of what went on in the classroom. Hacker and Rowe (1998, p.96) furthered this with their description of the curriculum model being characterised as having a 'fidelity perspective,' whereby the expectation was of the whole package being replicated in all schools exactly as the centralised developers determined. Analysis of the implementation process was determined by the outcome, which Hacker and Rowe (1998) described as a naïve perspective, as what went on inside the classroom was a greater determinant of the outcome. Additionally, Apple (2001) noted how the neoliberal approach to the curriculum, did not in itself translate to the realities seen in schools.

2.3.3 The Science National Curriculum in England

Before the launch of the *National Curriculum in England*, working parties were set up to determine the curriculum content. The science report highlighted concerns about the content volume, with Graham and Tytler (1993, p.38) describing the science curriculum as being 'all things to all men,' highlighting the extremes in the depth of knowledge required, with unclear attainment targets and programmes of study. Webster (1995, p.83) concurred and described it as a 'monster' that had been

developed to satisfy the Government with attainment targets that could be assessed and with the depth of knowledge required by scientific organisations with a vested interest, including the Association for Science Education. Levinson (2018) agreed with Essex (2018) when they described the science *National Curriculum* as having to appease two polarised groups of students, those who needed a level of education to enable them to become scientifically informed good citizens, whilst also providing the challenge and interest demanded by those students with a fascination in the sciences and a wish to study science further at university. Levinson (2018) highlighted this problem and explained how school science was disconnected from students' everyday lives. The number of students progressing to university to study science was and still is low, particularly in students with low SES, who were found to be two and a half times less likely to aspire to be scientists in the ASPIRES 2 research (Archer *et al*., 2020), which in part is why this research is important.

Furthering these concerns, Graham (1991) highlighted the results of a study performed just before the introduction of the *ERA,* which showed only 15 per cent of students were studying a balanced science course and almost none were studying all three sciences: Biology, Chemistry, and Physics. The study also highlighted a marked difference in the larger numbers of boys studying Physics and girls studying Biology. This imbalance between the sciences was concerning in the science community, which perceived a link between science and 'national security and economic prosperity' (Millar, 2011, p.173). A move towards a balanced science qualification, covering all three areas and worth two GCSEs, a dual award, was seen as the best way forward to maintain science's prominence in education (Graham and Tytler, 1993; Millar, 2011). However, constraints within the whole school curriculum were identified, in terms of time and breadth available beyond STEM subjects. A single GCSE science option was proposed, which would reduce the impact of science on the school curriculum time and would be particularly suitable for less able students. With this more flexible pathway, it was decided there was no requirement to study each of the three science subjects separately, with all students now learning aspects from all three areas.

Up to this point, the changes impacted mainly state schools, but when the subject of available GCSE courses was being discussed, the traditional boys' independent schools became vocal in their disagreement. John MacGregor succeeded Kenneth Baker as

Secretary of State for Education in 1989 and appeared to relish conversation with the independent schools, much to the disappointment of those in state education. According to Graham and Tytler (1993), MacGregor was criticised for listening too much to the fancies of the independent schools, creating a heated argument within education, but concluded if dual science was as good as the educationalists and the scientists were claiming, then market forces would prevail, and this would become the first choice over teaching and examining individual science subjects. He declared independent schools could continue teaching the individual subjects, with the proviso students were taught all three subjects. Despite how this conclusion evolved, all students, the less able to the capable scientists, were now able to study a rigorous science curriculum (Graham and Tytler, 1993).

Since the introduction of the *National Curriculum in England*, science GCSEs have undergone various changes in format and content. The GCSE offer has ranged through Double Award; Core and/or Additional and/or Further Additional; GCSEs in Biology, Chemistry, and Physics, which are often referred to as Triple Science and are still on offer, running alongside the Combined Science GCSE currently available. Additionally, vocational awards such as BTEC Firsts in Applied Science and GCSE Additional Applied Science (Archer *et al*., 2017b) have also been on offer, providing access to the Science curriculum for all students. In 2006, the profile of the 'Triple Science' GCSEs was raised when the Government announced there would be an entitlement for all high-achieving students, to study Triple Science (Vidal Rodeiro, 2007; Fairbrother and Dillon, 2009), raising its profile as being available only to a select group of students. Millar (2011) explained this change was brought about to increase the number of students moving into higher education to study science. The number of students entered for the Triple Science GCSEs has risen from 5.6% in 2006 to approximately 37.7% in 2023 (Ofqual, 2024). Additionally, to further raise the profile of Triple Science, the Government announced in 2023 that the number of entries for Triple Science would form part of the school headline figures reported following the summer GCSE examinations (DfE, 2024a).

2.4 Accountability and Inspection in English Education: Impacts on Schools and Teachers

2.4.1 The Introduction of Ofsted

The implementation of the *ERA* saw a shift from central management and micromanagement to information production and monitoring in schools, which relied on outcomes as a measure of performance and faithfulness to the system (Ball, 2003). This brought about *The Education Act 1992* (DfE), which saw the introduction of the independent department, Ofsted, whose role focused on ensuring the consistent implementation of the *ERA* through inspection and accountability to the Government. Before the launch of Ofsted, schools had been judged on their published outcomes at the end of each Key Stage. Ofsted aimed to inspect schools every four years, following a standardised procedure, to determine why schools performed well or poorly and identify the reasons, using the data as a starting point (Smith, 2000; Follows, 2001). This marked a fundamental shift in how schools were evaluated, moving from outcome-based assessments to process-orientated inspections. The establishment of Ofsted set the stage for subsequent reforms under New Labour and the Coalition, which further reshaped accountability mechanisms.

2.4.2 New Labour: Reform, Reward and Professionalism

In 1998 the 'rebranded' New Labour, who sought to modernise their approach and appeal to a wider electorate, combining traditional left-wing policies with market-orientated reforms, issued the Green Paper, *Teachers: Meeting the Challenge of Change* (DfEE, 1998), in which they described how they recognised good schools, good leaders, and good teachers were not being rewarded, and consequently, teaching was not attracting enough highly qualified candidates. This consultation paper outlined how New Labour proposed to improve and modernise the teaching profession to provide all students with the 'best possible start in life' (*ibid*., p.4). Arguably, as a result of this, school leaders began to embed the policy ideas into schools by describing what they considered to be the characteristics of a 'good student' and a 'good teacher' (Ball, Maguire and Braun, 2012, pp.126, 133).

The Green Paper's proposal represented a significant departure from previous approaches to teacher development. The Green Paper also revealed how New Labour

intended to improve the skills of all adults concerned in the provision of education, through investing money at the Teacher Training level through to improving the skills of classroom teachers and to improving the leadership skills of Headteachers. Additionally, the Government proposed new staffing structures, alongside new performance management arrangements, whereby staff achieving their targets were then able to access better salaries and career progression. These changes, while arguably designed to professionalise teaching, had complex consequences for practitioners. Forrester (2005) described how the culmination of these factors resulted in undoubtedly putting teachers under pressure to perform. Troman (1997, p.349) added to this in his depiction of Ofsted inspectors as the 'absent presence in the school,' causing a constant threat to the lives of teachers. Winter (2017, pp.65-66) and Kelly (2009, p.149) both suggested these pressures encouraged teachers to 'teach to the test.' Winter (2017) described how teachers felt that if their students did not achieve the highest grades, then their life chances and career prospects would be limited, and ultimately the teacher would be held to account for that, so assessment drove the curriculum. Nicholl and McLellan (2008) further supported this stance with evidence gained whilst investigating creativity in teachers of Design and Technology. Despite recognising the importance of creativity in their lessons, teachers perceived they had to reconcile this with the requirement of getting the best grades for their students, which was how they would be judged both from internal and external inspections. Consequently, teachers described the loss of their creativity and autonomy (Forrester and Garratt, 2016). Ball (2003, p.221) described the inner argument of the teacher, sacrificing 'commitment, judgment and authenticity' for 'impression and performance,' and sacrificing their professionalism to meet the criteria of looking good for Ofsted.

However, not all impacts were negative. Conversely, Schagen and Weston (1998) reported a close correlation between the standards seen during lesson observation and school effectiveness when compared to more conventional GCSE data. Matthews and Smith (1995) also described the benefits of Ofsted inspection in secondary schools in terms of providing feedback and accountability of the school to its stakeholders, including parents. A benefit to teachers was 'staff development' to ensure they met

Government policy expectations, although it was not clear what this looked like and arguably reaffirmed teachers were to blame for failing education.

The New Labour approach represented a distinctive philosophical shift in education policy. During the period of the New Labour Government, their policy discourses were conceptualised as the 'Third Way,' a mix of the previous Labour social democratic beliefs of centralised control and the Conservative neo-liberal beliefs of a consumer market. Following the ideologies of the 'Third Way,' New Labour aimed to develop policies based on 'what works' from the world of research (Trowler, 2003, p.151) and became more business-like, focusing on standards and targets and performance monitoring rather than content (Ball, 2017). The New Labour era's emphasis on performativity laid the foundations for the Coalition's later focus on autonomy and academisation.

2.4.3 The Coalition: Academisation, Autonomy and Inequality

In 2010, after New Labour's term, the Coalition Government formed by the Conservative and Liberal Democrat parties sought to reform education further with an emphasis on school autonomy and accountability, with David Cameron's 'Big Society' (Ball, 2017). They aimed to make schools even more accountable through the introduction of the *Academies Act* 2010 (DfE, 2010a), which purportedly aimed to return autonomy to teachers in terms of the curriculum offer and to parents, the consumers, in terms of more choice (Ball, Maguire and Braun, 2012).

Academies were schools funded by the Government but independent of local authority control. The academisation policy had significant, if sometimes unintended consequences; while the Government was aiming to improve the professional profile of teachers through increasing academic entry requirements to Initial Teacher Training, academies used their powers to employ unqualified staff (teachers without a formal post-graduate teaching qualification), raising concerns about the quality of teaching. Additionally, academies used their power to move away from the *National Curriculum in England*, which led to the issue of the White Paper, *The Importance of Teaching* (DfE, 2010b), which focused on the quality of teachers. The document began with the Prime Minister and Deputy Prime Minister comparing 'our stifled education' to arguably more successful 'international competitors' who were moving ahead (DfE,

2010b, p.3). It then explained failings in English schools due to the quality of the teachers and summarised some of the strategies the Government intended to use to raise the achievement of students. One such tactic was to provide teachers with more autonomy, but within high levels of accountability (Whitty and Wisby, 2016).

Part of the Coalition manifesto focused on closing the attainment gap and increasing social mobility in lower socioeconomic areas (Whitty and Wisby, 2016). Pupil Premium was seen as a way of doing this by providing schools with extra money for each disadvantaged student. Disadvantaged students were classed as those eligible for free school meals, looked after children (in the care of an English local authority) or children with a parent serving in the regular armed forces, identified in a school census at any point in the last six years (Roberts, 2022). However, its benefits were questioned, and it did not incentivise schools to use it as a marketing tool to increase their intake of students in terms of SES (Whitty and Wisby, 2016). This arguably contributed to a slower rate of improvement, alongside poorer curriculum offers and the employment of unqualified teachers in academy schools, particularly in secondary schools (Ofsted, 2014). Additionally contributing to slow improvements were the changes to qualifications, with a return to more academic qualifications for all students and the removal of some vocational courses (Whitty and Wisby, 2016). The introduction of the English Baccalaureate in 2010 as a performance measure (DfE, 2011) was also seen as a contributing factor in stagnating attainment in secondary education (Rogers and Spours, 2020). In their annual reports, Ofsted (2014, 2015b) concluded this stagnation was in part due to poor transition programmes into KS3 and poor curriculum plans, which lacked focus on pupils' progress during KS3. Schäfer (2018) supported this and purported that secondary schools did not focus on pupils' prior learning and suggested secondary teachers doubted the quality of the primary provision, so repeated content. This led to a review of early secondary education, with the results published in the report *Key Stage 3: The Wasted Years?* (Ofsted, 2015a). Unsurprisingly, their findings supported previous inspection data, showing the early secondary years were underutilised, with many schools viewing these years as low priority. The curriculum did not build on KS2, it lacked challenge, assessments did not accurately assess, and data were too often ignored. While the Coalition promoted

autonomy, Ofsted's evolving inspection framework continued to shape school priorities.

2.4.4 The Education Inspection Framework

Due to the findings of Ofsted's (2015a) review, the following year the Conservative Government published their improvement plan in the form of the White Paper *Educational Excellence Everywhere* (DfE, 2016). Chapter 6 focused on the requirement for 'high expectations and a world-leading curriculum for all' (*ibid*., pp.88-103), whereby all children were equipped with the 'knowledge and character necessary for success in modern Britain.' This aimed to remind schools that the *National Curriculum in England* was still a benchmark against which they would be monitored. Although the Paper acknowledged academies could choose their own more challenging but broad and balanced curriculum, the following chapter outlined how schools would still be held accountable for outcomes in external examinations using student progress across eight subjects as a benchmark. In his analysis of *Educational Excellence Everywhere* (DfE, 2016), Godfrey (2017) described the Government's use of 'evidence-based' as opposed to 'evidence-informed' research, whereby he explained the Government's top-down approach was in danger of reducing teacher autonomy and school improvement (Chapter 2.6). The Paper used the phrase 'evidence-based' twenty-five times and 'evidence-informed' only twice, even though the Paper was attempting to affirm the need for schools and teachers to exercise greater autonomy to improve education. In addition to improving the curriculum, Chapter 6 further discussed proposed changes in the grading of GCSE results from letters (A* to E) to numbers (9 to 1), partly in response to what was referred to as 'grade inflation,' observed when GCSE results were benchmarked against performances in international assessments. These changes both aimed to make the GCSE qualifications more rigorous and to maintain England's competitive edge and were introduced in 2014 (DfE, 2014) with implementation for Y10 students in 2016, in preparation for the 2017/2018 external examinations.

To support the Government in improving schools, Ofsted launched its Strategy 2017-2022 (2017). Within this, they too appeared to recognise the danger of compliance in schools, so to potentially alleviate the 'tick box' (*ibid*., p.3) exercise of improvement, Ofsted announced their development of a common inspection framework. In her

annual report to the Government (Ofsted, 2018, p.7), Amanda Spielman (Chief Inspector of Ofsted) drew attention to the 'substance' of education as being that of the curriculum, which she deemed should once again be the focus within schools. She also recognised the importance of the autonomy of professionals in the classroom in terms of school improvement. However, she identified the tension between this and how school performance was measured in school league tables. She highlighted how these high-stakes inspections inadvertently impacted the curriculum in 'substance has lost out to performance tables and data' (*ibid*., p.26).

In 2019, the *Education Inspection Framework* (*EIF*) (Ofsted, 2019b) was issued, the main change to the school inspection criteria being the addition of the 'Quality of Education' judgement, which brought the focus of the inspection back to the curriculum, as was previously hinted. To support this shift in focus, the policy document *Inspecting the Curriculum* (Ofsted, 2019a) was also issued. Interestingly, despite this policy referencing both 'curriculum' and 'inspection,' the word 'curriculum' only appeared twenty-seven times compared to 'inspection/s/ing' appearing sixty-four times. Throughout their inspection documentation, Ofsted referenced their research and the volume of pilot studies done to support their inspection strategy, arguably attempting to legitimise their role. Alongside the *EIF* (Ofsted, 2019b), Ofsted published their *School Inspection Handbook*, with subsequent updates (2022), detailing how judgements would be made following inspections. As expected, the new criterion of 'Quality of Education' was included, and the curriculum took centre stage. However, the first section of paragraph 26 (Ofsted, 2019b, p.9) caused 'ripples of discontentment' in the education community (Birkenshaw and Temple Clothier, 2021, p.1), with some considering it 'indicative of "white, middle-class paternalism."'

> *'Leaders take on or construct a curriculum that is ambitious and designed to give all learners, particularly the most disadvantaged and those with special educational needs and/or disabilities or high needs, the knowledge and cultural capital they need to succeed in life.'*

The introduction of the term 'cultural capital' was perhaps surprising since it is absent in the *National Curriculum in England* documentation (DfE, 2014) and appeared just seven times throughout the Ofsted *Education Inspection Framework*, twice in

examples of grading judgements in the updated 2022 version (Ofsted, 2022). The lack of a clear definition of what cultural capital meant in terms of provision from a school was not forthcoming (Nightingale, 2020). These policy shifts had profound emotional and practical repercussions for teachers.

2.4.5 Emotional and Practical Impacts on Teachers

Teaching is seen as an 'emotional business' and as a vocation rather than a job *per se* (Jeffrey and Woods, 1996, p.326). As such, judgements made by Ofsted inspectors during lesson observations were perceived as personal (Jeffrey and Woods, 1996; Case, Case and Catling, 2000) and began to change the way teachers behaved in the classroom. Hacker and Rowe (1998, p.97) described how teaching and learning strategies were 'tacitly embedded' within the curriculum materials, especially in the *Experimental and Investigative Science* section (now referred to as *Working Scientifically*) of the *National Curriculum in England*, which followed alongside the traditional Biology, Chemistry, and Physics programmes of study. For the duration of their investigation of the impact on classroom practices, the *National Curriculum* experienced two major overhauls. Their results showed the opposite, with teacher time focused on students learning facts rather than understanding processes and less time spent conducting practical lessons. Hacker and Rowe (1998) suggested these changes were due to a combination of factors, including too much curriculum content to cover and too much time spent preparing for frequent classroom inspections both internally and externally by Ofsted. Perryman (2007, p.173) supported these findings and described the 'loss of power and control' felt by teachers when under the scrutiny of inspections. The negative emotional stress experienced by teachers led to a performance 'dictated by the discourse of inspection' (*ibid*.), with teachers following rigid and prescribed policies and routines aimed at passing inspections rather than educating their students. This shift in focus from teaching students to passing inspections had emotional and practical repercussions for teachers in the classroom.

Ball (2003, p.216) described the tensions felt by teachers within the classroom as the 'terrors of performativity,' with the outcomes of inspections representing the 'worth' of the individual as a teacher. Teachers' autonomy and personalities were arguably being quashed, and some teachers felt their professionalism counted for nothing. Teaching was no longer about developing the children but about data and school

league tables. The countless inspections, including internal, external, and peer reviews, resulted in uncertainty and instability, with teachers and schools continually striving to improve but changing demands and expectations adding to this.

Perryman *et al*. (2018) confirmed Ofsted's influence was transferred into school policy decisions and hence everyday school life. They found an emphasis on attainment, particularly in 'high stakes' subjects like English, mathematics, and science, which led to a results-driven approach (*ibid*., pp.151-152). School development plans became focused on attempting to make themselves 'Ofsted-proof,' aiming to pre-empt Ofsted requirements and to move school data to a more competitive position in the school league tables. Apple (2018, p.689) supported this position when he expressed his concerns for the curriculum content, as he perceived it as being driven by 'neoliberal, neoconservative, authoritarian populist, and new managerial forces,' rather than by the needs of the student, school, and communities.

Arguably to prevent schools from becoming too complacent, revisions of the Ofsted inspection framework altered the inspection grade from 'satisfactory' to 'requires improvement' which was designed to reflect more rigorous standards in inspections and to promote school improvement (Perryman *et al*., 2018). Ball, Maguire and Braun (2012) debated their concerns about the Government using school league tables as a means of driving up educational standards through high-stakes testing and measured outputs. Kelly (2009, p.18) concurred with this notion of the Government using testing and inspection as part of their 'coercive strategy' in controlling schools. Despite these pressures, teachers remained key agents in enacting curriculum reform.

2.4.6 Teachers in Curriculum Reform

The *ERA 1988* saw the introduction of the *National Curriculum in England* (DES, 1988), prescribing the knowledge to be taught to all students and how and when it was to be assessed. Pring (2018) likened the knowledge outlined in the *National Curriculum*, specialised inter-related conceptual knowledge beyond our everyday knowledge, to the 'powerful knowledge' described by Young (2009, p.198). Young and Muller (2013) highlighted the fundamental link and rights of all students to the acquisition of specialist 'powerful knowledge' and a high-quality curriculum. However, the use of the term 'powerful knowledge' and what it constitutes in school curricula has been

disputed by White (2018), who questioned whether subjects beyond the sciences could be included. Young (2009) posited subjects needed to contain interrelated concepts, so White doubted whether 'powerful knowledge' could be applied to all *National Curriculum* subjects. Additionally, he questioned whether Young's assumption of 'powerful knowledge' being the focal point of schools was correct, since there was an assumption that everyday knowledge was limiting and not as 'powerful.' White (2018, p.330) explained this through his personal experiences of 'intellectual richness,' whereby his everyday knowledge may be viewed as 'exotic to another.'

The concept of 'powerful knowledge' became a central feature of curriculum reform, particularly in response to surface-level teaching in inspections. The development of knowledge-rich curricula, and despite considering there to be no link between academic knowledge and everyday knowledge, Young (2015) acknowledged the role of the teacher and their pedagogy in making knowledge relevant and engaging to students. However, Gericke *et al*. (2018, pp.428-9) disputed Young's stance that teaching can be easily separated into content, 'powerful knowledge,' and pedagogy, how it is taught. They discussed how didactic teaching used transformations, placing content into a format manageable for teachers and making learning accessible to all students by ensuring its relevance to their lives.

Wallace and Priestley (2017, p.324), when exploring the impact of curriculum development of the new Scottish curriculum, aligned with this, describing teachers as 'intelligent decision-makers.' They discussed how teachers' interpretation of the intended curriculum, arguably shaped by their elitist *habitus*, informed strategies to make content relevant to students' lives. Sheikh and Bagley (2018) noted teacher emotionality and rationality impacted the enactment of policies and noted the potential of teachers losing their identity and feeling de-professionalised. Trowler (1998) and Ware (2014) agreed and highlighted how enactment of education policies was down to individuals in schools and no matter what the policymaker's original intentions, in practice there may be unintended consequences. Bradfield and Exley (2020) furthered this by highlighting the additional influences of the school culture on what is delivered in the classroom, while also recognising the importance of active engagement with teachers in the classroom.

Curriculum reform provides opportunities for teachers to develop new and better pedagogical approaches to teaching, as Hughes and Lewis (2020) highlighted when Welsh teachers were expected to actively engage with curriculum design and delivery when the new Welsh curriculum was introduced. However, the empowerment provided to teachers brought challenges in terms of teacher knowledge of skills required for curriculum planning, and confidence. As such, a programme of Continued Professional Development (CPD) was deemed essential. Similarly, when Debarger *et al*. (2017) investigated the repurposing of educational resources as a means of curriculum reform, they too recognised teacher professional development should be integral to the process.

Hizli Alkan and Priestley (2019) examined curriculum development through the lens of reflexivity and determined that by providing teachers with reflexive opportunities, they became more engaged in the process, and it provided potential alternative ways of tailoring CPD. Archer (2007, p.4) defined reflexivity as 'the regular exercise of the mental ability, shared by normal people, to consider themselves in relation to their social context and vice versa,' and can be traced back to the seminal work of Dewey in 1933. Reflexivity is the internal conversation we have with ourselves where we reflect on the experiences that shape our *habitus*. Mouzelis (2007) explained when *habitus* is misaligned within a field, a point is reached where reflexivity enters. Reflexivity occurs at the point where a person will question their taken-for-granted assumptions, and they will re-evaluate their position within the field. For this reason, Hizli Alkan and Priestley (2019) asserted teacher reflexivity is important in curriculum development because it allows teachers to engage in decisions about what is included, when, and why; it shapes how social and cultural issues are encompassed; and it enables teachers to reflect on their own experiences and to understand their strengths, weaknesses, biases, and assumptions. This aligns with the work of both Whitty (2017) and Muller and Young (2019), who acknowledged that the concept of 'powerful knowledge' in a knowledge-rich curriculum had been separated from Young's (2009) other concept of 'knowledge of the powerful.' This concept reflected the ideologies of sociologists such as Bourdieu and illustrated how school curricula aligned with the dominant social groups and marginalised other forms of knowledge, excluding this without consideration of its impact or relevance for students.

Debarger *et al*. (2017) and Hughes and Lewis (2020) posited curriculum reform may be implemented in various ways, either through teachers re-modelling their resources with which to deliver the curriculum or even using published resources. At either end of the spectrum, they agreed the resources *per se* would not result in successful curriculum implementation; rather, the teacher standing in front of the class was the most important factor and should be considered throughout the process.

2.5 Social Theory

The inclusion of cultural capital within education policies (Ofsted, 2019b, 2022) compels a review of how the term has been utilised. Cultural capital will be considered in comparison to its origins when Bourdieu and Passeron (1977) described cultural capital within their theories of social reproduction and symbolic violence.

2.5.1 Bourdieu's Theories of Social and Cultural Reproduction

Bourdieu and Passeron (1977) developed their theory of social reproduction and symbolic violence to describe unequal relationships within society. They explained how this invisible violence was permeated through coercion or force, where the actions were seen as the norm and internalised as such by the subjugated group whilst enforcing the interests of the dominant through what Bourdieu described as the *cultural arbitrary* (Bourdieu and Passeron, 1977). Bourdieu went on to explain this through his field, *habitus*, and capital theories.

Bourdieu described the multidimensional social space where these moments of symbolic violence occurred, as fields. These fields are arenas of force and struggle and are delineated by their *doxa*, the unsaid and socially accepted rules, with some rules being explicit and others implied (Bourdieu, 1984). Within this field, inequalities and social reproduction were explained through the amount and type of capital a person held and their *habitus*. Bourdieu (1986) explained a person's *habitus* as being an integral part of the person, the 'capacity to produce classifiable practices' and the 'capacity to differentiate and appreciate these practices,' (Bourdieu, 1984, p.166) or, more simply, the skills and dispositions a person possessed (Claussen and Osborne, 2013). Bourdieu explained the *habitus* forms through the internalisation of capital. The capital held by an individual can be transformed into symbolic capital within the field

where relationships of ‘power’ are determined. The amount and type of capital a person possessed, determined their position within the field.

Bourdieu (1986, p.241) explained capital is gained over time, exists in either an ‘objectified’ or an ‘embodied’ form, and has the propensity to reproduce and expand itself. Capital can exist in three forms: economic capital, directly linked to monetary value; cultural capital, which may be converted to economic capital and is also linked to academic qualifications; and social capital, linked to upbringing and family and may also be converted to economic capital. The conversion of capital between its forms is dependent on the field within which it is situated, as is the value bestowed on the type of capital, which contributes to its exchange rate (Bourdieu, 1986).

Cultural capital can exist in three forms. The embodied state includes the ‘dispositions of the mind and body,’ the objectified state is determined by the ‘cultural goods’ possessed, or which are accessible, and the institutionalised state is a form of objectification and includes educational qualifications (Bourdieu, 1986, p.17). Bourdieu used his theory of cultural capital to explain differences in academic achievement in children from different social classes through an uneven distribution of capital. Diane Reay (2018, p.537) illustrated this in her study of working-class students’ transition to university, where despite achieving a place in higher education, students from working-class backgrounds were still marginalised as they struggled to ‘fit’ due to their social identities, linked to their arguable lack of the correct cultural capital. Godec, Archer and Dawson (2022) also used an uneven distribution of cultural capital to examine young people's participation in STEM activities, finding those youngsters from more advantaged backgrounds participated more, despite sometimes lacking any interest in the subject, whereas more disadvantaged students with an interest in STEM often did not attend STEM activities.

Bourdieu furthered his explanation of uneven capital when he purported academic success was somewhat dependent on the cultural capital already gained before school, from the family and the familial social capital, and it was through this that the school could build cultural capital in students from dominant backgrounds. Bourdieu argued the education system and indeed schools are fields within which social reproduction occurs and arguably a place of symbolic violence. Bourdieu and Passeron (1977)

explained symbolic violence as subtle and often unrecognised systems through which the values and practices of the dominant culture are made to appear legitimate, reinforcing anything other as being subordinate and not valued in that field. Bourdieu's views of cultural capital neither being 'produced, increased or reduced' by education are highlighted by Bates and Connolly (2022, p.3) who agreed schools were places of social reproduction. However, Bourdieu (1986) recognised that within schools, cultural capital may be converted to institutionalised capital in the form of academic qualifications.

Bourdieu and Passeron (1977) explained all pedagogic action, strategies used in classroom management to pass on subject knowledge, result in symbolic violence because a cultural arbitrary is imposed. They explained cultural arbitrary as cultural norms and values that are socially constructed and maintained by power structures, leading to the perpetuation of social hierarchies. They are 'arbitrary' in the sense that they are the product of historical and social circumstances rather than universal truths. Nash (2004) questioned the knowledge outlined by the curriculum and who decided what was right and what was taught, what was included and what was excluded. He described how the cultural arbitrariness of the knowledge to be shared using the curriculum caused social reproduction and arguably became a place of symbolic violence. Archer *et al*. (2018, p.121) supported this, describing schools as places where dominant power relations were reproduced and where students 'know their place.'

2.5.2 Cultural Capital in Education

Sullivan (2002) highlighted the lack of a clear definition of cultural capital when she investigated the usefulness of Bourdieusian concepts in education. When exploring the link between parental social class and GCSE attainment, Stopforth and Gayle (2022, p.682) noted this lack of a definition as a 'central challenge' to their research. Speaking to the National Day Nurseries Association (2019, pp.5-6), Amanda Spielman described cultural capital as 'the essential knowledge' all children should have and then described it as 'a golden thread, woven through everything you do to teach the children well.' Although Ofsted stated they would not judge how schools addressed cultural capital, they expected it to be central to the curriculum (Ofsted, 2019b, 2019c). Basford (2019) furthered this, describing how it was not a tick-box activity or a course to run, but rather a way of teaching and building on students' previous

knowledge and experiences. Subsequently, in her speech at the Royal Opera House, Amanda Spielman (2020, p.6) (re)defined cultural capital using the statement, 'the essential knowledge that pupils need to be educated citizens, introducing them to the best that has been thought and said,' taken from the *National Curriculum in England* documentation (DfE, 2014), and borrowed from Matthew Arnold (Arnold and Wilson, 1960). Bates and Connolly (2022) argued this loose definition of cultural capital was linked to neoliberalism in education.

Bates and Connolly (2022, p.2) debated the use of the term 'cultural capital' as a political driver, a kind of social reform through the classroom, making the teacher accountable for the social mobility of the child. They described how the Government had progressively used teachers and the curriculum as a process for 'addressing educational disadvantage.' However, they argued teachers felt constrained by the introduction of the term 'cultural capital' in educational policy and described how teachers redefined the term 'cultural capital' as they saw fit for their students. Young (2019) added to this and proposed there had been a lack of understanding of the term 'cultural capital' by policymakers since the curriculum itself cannot change the wider society. Birkenshaw and Temple Clothier (2021, p.3) furthered this point when they likened cultural capital to 'political currency' and as a positioning point for Ofsted to tentatively prescribe pedagogy through their inspection of cultural capital within the curriculum, under the guise of 'standard of education.' This stance was observed in Amanda Spielman's speech at the Royal Opera House (2020, p.7) when she stated Ofsted believed Bourdieu was 'pessimistic in thinking that education can't make a difference,' since she and Ofsted believed education can be 'transformative' and it can contribute to pupils' social mobility, arguably demonstrating her misunderstanding of the term 'cultural capital.' Interpretation and understanding of this concept appear to be widespread and will be followed up in Chapters 4.4.4 and 5.6.2.

Bates and Connolly (2022) contended that the introduction of the term cultural capital in education may inadvertently have narrowed the curriculum rather than broadened it, particularly for disadvantaged children. They explain this through teachers left floundering in a 'vacuum' (*ibid*., p.9) which they filled as they saw fit. The lack of a clear definition led Nightingale (2020, p.236) to describe the use of the term cultural capital as an alternative way of stating the 'skills in combining with the knowledge to "address

social disadvantage."' The inclusion of the term could arguably present unintended consequences in terms of potentially limiting the educational scope rather than enriching it for students. The ambiguity and subjective interpretation of the term 'cultural capital' have the potential to leave teachers in a state of uncertainty.

Birkenshaw and Temple Clothier (2021) described the reductionist way in which the incorporation of cultural capital developed an elitist perspective in the classroom, where the experiences of the working class would arguably be seen as subordinate capital. Thomson and Hall (2022, p.861) agree and narrated education's role in the '(re)production of capitals and dispositions vital to/in other fields' and likened this to symbolic violence. Hall *et al*. (2021, p.328) concurred with this when they discussed Ofsted's use of cultural capital as using 'middle-class values to the exclusion of all others.'

Claussen and Osborne (2013) likened formal education to an academic market where cultural capital could be distributed. However, they clarified this by positing only those with sufficient, appropriate dominant capital may increase their cultural capital, while those with the 'wrong' dominant capital may increase their cultural capital but not to the same extent. They extended this to the amount of additional capital gained in informal situations and highlighted the challenges faced in education, specifically science education, in increasing the dominant cultural capital in all students, regardless of their previously acquired capital. Stopforth and Gayle (2022) agreed and furthered this when they explained how students with advantaged social class backgrounds had a greater amount of cultural capital that passed through generations of the family and could be exchanged for more favourable educational outcomes, such as GCSEs.

Conversely, Jæger (2011, p.295) whilst agreeing a student's cultural capital had a 'statistically significant effect on academic achievement,' disagreed that cultural capital was a useful measure of student success *per se*. He posited that the aspect of capital a student gained or participated in was a more useful measure of success. For example, the reading habits of a child from a family with a high SES are a stronger predictor of success when compared to those of a child with a low SES. However, Jæger found more practical aspects of cultural capital, including extracurricular activities and hobbies, were better indicators of success for students from a lower socioeconomic

background. Archer, DeWitt and Willis (2014) furthered the discussion of what could be used as a predictor of student success when they proposed the term 'science capital' as a measure of aspects of cultural, social, and economic capital that specifically related to school science education. Nevertheless, they also recognised the value of science capital will depend on the person possessing it and the field in which they are using it. They acknowledged middle-class students, who enjoyed the economic resources associated with high familial *habitus* and cultural capital, would be more likely to take advantage of opportunities offered in extracurricular science activities, despite lacking specific science capital.

Jensen and Wright (2015) disagreed with the use of the term science capital, arguing there was no empirical difference between science capital and cultural capital. Archer *et al*. (2015a) responded and clarified their position, using science capital not as a new source of capital but as a lens through which they could investigate science education, and the unequal distribution of science-related capital gained during compulsory education. They also responded to the criticism of their non-traditional use of Bourdieu's cultural theories, to which they highlighted how Bourdieu himself believed his concepts were 'tools for putting into practice' (Archer *et al*., 2015a, p.1149).

Despite criticism of the term science capital, it has since been used throughout the thirteen-year ASPIRES programme of research (Archer *et al*., 2013a, 2020; ASPIRES Research, 2022), exploring the factors that shape students' aspirations and progress in science through and after compulsory education. The term was also used by the House of Commons Science and Technology Committee (2017, p.10) when they used science capital as a measure of 'science-related knowledge, attitudes, experiences, and resources acquired through life.' The report highlighted the importance of the ASPIRES research, further strengthening the use of the term science capital when examining science education. While Bourdieu's work emphasised social structures and the symbolic violence enacted through education, recent research has extended this framework to focus on identity formation. Identity becomes an important lens through which to understand both students' engagement with science and the role of teachers during curriculum reform.

2.5.3 Identity Theories in Education

Identity theory is multi-faceted and contested in the social sciences. In its broadest sense, identity refers to how a person or group, perceive themselves in relation to the social world usually within a specific context, with the process of self-categorisation forming an identity (Stets and Burke, 2000). In science education, identity shapes both the students' sense of belonging and the teachers' professional practices. This section examines three dominant theoretical perspectives, identity theory, social identity theory and post-structuralist approaches, and shows how these amalgamate to form different identities during curriculum reform.

Early conceptualisations of identity can be traced back to Mead (1967), who was known as the father of symbolic interactionism. He determined identity was formed through interaction and interpretation of signals, both verbal and non-verbal. Mead posited an important part of developing a clear sense of self was in being able to recognise both the 'I' who acts in the world and the 'me,' who is the 'I' seen by others (Reid, 2016, p.188). Goffman (1951) built on this and posited identity as performance and context-dependent, where individuals present themselves in ways that align with societal expectations. In his work '*Identity and the Life Cycle*' (1959), Erikson described how identities are formed across one's lifespan, changing as you age and move through different stages of your life. He posited identity was not something you had, but rather something you developed during your entire life, and when you struggle to reconcile yourself with societal expectations, you suffer an identity crisis. Building on this, Stryker (1980) posited one's identity aligns with the field, or social structure in which it is formed, such as that of a teacher in a school and a student in a science classroom. He explained identity is linked to the role and expectations associated with it and that one can possess many identities depending on the social field one is currently occupying. These multiple identities are then hierarchically organised according to 'salience' (Stryker and Burke, 2000, p.286), which he explained as the order of importance, within the current social space and the likelihood of that identity being invoked. In general, the concept of identity is not a fixed attribute, but rather a relational one.

For teachers, their professional identities are shaped by the expectations of their professional communities, including the school in which they teach (Beijaard *et al*.,

2004). However, during periods of curriculum reform, Beijaard *et al*. (2004, p.122), described how teachers may 'lose a sense of themselves.' While symbolic interactionism offers a foundational understanding of identity formation, it has been critiqued because of its lack of consideration of structure, in terms of social, cultural and institutionalised structures that shape self-definition (Bourdieu, 1990) and moves into the tendency of oversimplifying identity development into being a stable outcome of individual effort, rather than a contested process.

In contrast, social identity theory, proposed by Tajfel *et al*. (1979), conceptualises identity through the lens of group membership. They argue that the self-concept of identity is derived from being a member of a social group, with the rules of membership describing how identity is formed. For example, teacher identity will arise from being a member of the teaching staff with rules aligning with departmental or school-wide norms of professionalism and identity. Harwood (2020) describes how social identity theory explains the desire of individuals to distinguish themselves and their group, from an alternate group. Membership to a group is favoured, to not being in the group, and its members will make sacrifices to ensure their group is in a more favourable position than other groups. Identity is formed here, not simply through personal characteristics or roles, but through affiliation with social groups. Social groups, including gender, ethnicity, class or profession, carry symbolic and emotional meaning. Archer *et al.* (2015b, p.935) used the concept of science identity and whether students 'belonged' to the group of being a 'science person' when they designed a method of measuring science capital in students. However, social identity theory relies on binary group rules and does not accommodate intersectional identities such as one that crosses a number of groups, for example, race, gender and in the case described earlier, as a 'science person,' where science is often stereotyped as a male orientated subject (Archer *et al*., 2014).

This limitation highlights the need for theories that address power and discourse, which is where post-structuralist approaches evolved. Central to the theories of post-structuralism in identity, is the concept of a fluid identity which is constructed and reconstructed through reflexivity (Chapters 2.4.6 and 3.5). Butler (1988) proposed gender can be theorised as a 'performance.' She conceived it not as a product of biology, but rather as a product of discursive and bodily acts. She determined gender

was not what you are but is something that you do (perform) and continually re-do, which generates a powerful illusion. Archer *et al*. (2019) used Butler's concept of identity as performance to examine identity formation in science students, affirming identities are constantly being re-made and performed, and never finished.

Foucault (1980) also rejected the notion of a fixed identity and explained identity as a product of the relationship between power and the forces exercised over a body. This perspective can be used to explain the unstable identity of a teacher negotiating accountability and performativity (Ball, 2003) and curriculum or pedagogical reform (Sachs, 2005). Similarly, student science identity is shaped by the dominant discourse (Brickhouse and Potter, 2001). The impact of the dominant discourse on student science identity may be further exacerbated during curriculum reform where, albeit unintentionally, the inclusion of certain cultural material to the exclusion of others, can affect student identity (Garcia-Huidobro, 2018).

The examination of identity theory, social identity theory and post-structuralist approaches reveals a range of conditions and experiences that shape and impact both teacher and student identities. While being distinct theories, they are not mutually exclusive and offer complementary lenses through which understanding of identity formation can be explored. However, the tensions between these frameworks are worthy of close examination. The social structures, described by the identity and social identity theories, highlight tensions centred on how they contend identities are formed. Identities are formed through either roles and expectations, symbolic interactionism, or group affiliation and belonging, social identity theory. In educational settings, both perspectives help illuminate how students and teachers align themselves with certain identities. However, these approaches often assume identity is relatively stable and rooted in coherent social structures. This can overlook the complexity of intersectional identities, where individuals navigate multiple, sometimes contradictory groupings, such as gender, ethnicity, class and profession, and the evolving nature of identity in response to contextual change.

Post-structuralist theory challenges these limitations by rejecting notions of fixed identity. Instead, identity is viewed as a fluid, performative process constructed through discourse and shaped by relations of power (Butler, 1988; Foucault, 1980).

This is particularly relevant during curriculum reform, where dominant discourses privilege certain forms of knowledge, behaviour, and cultural capital, often marginalising others. Teachers and students are both subject to these discourses, which can create an identity crisis (Erikson, 1959) or reinforce symbolic violence. Teachers may find their professional selves in tension with the performative expectations of policy, while students may struggle to form science identities if their cultural backgrounds are not recognised within the curriculum. These tensions illustrate that identity in education cannot be fully understood through a single lens; rather, it requires a synthesis of structural, social, and discursive perspectives.

2.5.4 Science Identity

These theories reveal identity as performative and context-dependent, critical for understanding how students adopt or resist 'science person' roles. Science identity was described by Carlone and Johnson (2007, p.1191) as 'the extent to which a person sees themselves and is recognised by others as being a "science person."' Vincent-Ruz and Schunn (2019) linked the possession of a science identity to science aspirations and the continuation of the study of science in further and higher education. Aschbacher, Li and Roth (2010) explained science identity is formed by lived experiences and social interactions at school and home and in the outside world and can be changed and developed. When they investigated students from a range of schools with a mix of socioeconomic backgrounds and ethnic groups, they found associations between strong student science identities, aspirations to study post-compulsory science, and high familial cultural capital along with perceived strong science support from teachers within a school. Calabrese Barton and Tan (2010) extended this and posited science identity as being important, particularly in students from disadvantaged backgrounds. They found that examining children completing a project situated within a framework encompassing their cultural backgrounds afforded them a sense of belonging and agency, as they adopted the dominant role in that field.

The link between identity and *habitus* was highlighted in the work of Wright (2008), who found when the *habitus* of teacher and student were more aligned, identity was more pronounced. Wright (2008) also noted how power relationships created through control over the curriculum presented issues of reduced identity in some students, who perceived their learning was not as worthy as others whose *habitus* were more

aligned to that of the teacher. Godec *et al*. (2018) developed this point and focused their attention on the classroom, adding the effect of the field of the classroom affected *habitus* and identity, linking them to engagement and academic achievement. They found when teacher and student *habitus* were aligned with the field *doxa*, students felt they belonged and engagement increased, improving identity. Aschbacher, Li and Roth (2010) linked the degree of identity to grades achieved, with those losing confidence in their ability, due to falling grades, also losing identity.

Archer *et al*. (2018) highlighted how practices of setting students by ability reproduced the dominant cultures and values of teachers, resulting in symbolic violence. Reproduction of this practice highlights how those students with the dominant capital in the field of the classroom are protected and social classes maintained, reflecting the interests of the privileged. Francis *et al*. (2017) outlined how the degree of identity held by the student was aligned with their positioning in ability set groups; those placed in lower sets (lower achievers in science) had less science identity and misaligned *habitus*.

Moote *et al*. (2020) suggested that if the field was the place in which capital was exchanged, rather than using interventions focused on building capital in students, a focus on the field and a change of *doxa* may potentially provide an alternative means of engaging students. This would also offer the potential of engaging the other forms of capital that students possess and may be a means of potentially providing a sense of belonging and arguably providing an avenue through which science identity could be increased. Archer *et al*. (2021) also investigated how changes in the field had the potential for equitable outcomes in informal science learning. Their findings elucidated how possession of dominant capital, was not the only factor involved in providing equitable outcomes; rather, the programmes and programme providers themselves also influenced the outcomes. They suggested educational spaces as fields whereby students could be supported and challenged, rather than simply as fields for social reproduction.

2.6 The Teacher: Identity, Agency, and Professionalism

2.6.1 Teacher Identity

Teacher identity is a foundational concept in understanding teacher development and professionalism. It underpins how teachers experience their roles and engage with the demands of their role. Teacher identity is symbolised by how the teacher perceives themselves as an educator. It is influenced by personal values, educational philosophies, cultural background, teaching experiences, professional and social experiences with students and other teachers, emotions, and positionality (Avraamidou, 2019), referring to how teachers' identities are shaped by their social positioning, including factors such as race, gender and class. Avraamidou explained the role of emotion in the context of science teaching, highlighting how emotions influence goals set and relationships to ideas and beliefs. She also described teacher identity as a shifting and reforming process, which evolves as teachers gain more knowledge and experiences in the classroom. This aligns with the work of Rinke (2008) who described how teacher identity is not something that is simply possessed but is shaped and reshaped by the interactions they have, with other professionals and policies, over a prolonged period of time. Beijaard *et al*. (2004) describe teacher identity as being shaped and reshaped by the collective stories of their personal and professional lives, shaped by the traditions of the school in which they work and the context in which it is enacted.

The literature suggests that teacher identity is not fixed but rather it is 'socially constructed, dynamic and hybrid' and it is shaped by 'discourse, narrative, and emotions, and influenced by social and organisational contexts' (Rushton *et al*., 2023. p.3). The importance of developing a positive teacher identity has been noted for maintaining a healthy and sustainable teaching workforce (Rushton *et al*., 2023), and to also maintain a teacher's sense of commitment to the role. Day, Elliot and Kington (2005) explained how the level of teacher identity can be linked to their commitment to being a teacher, which may then be used as a predictor of their performance. While identity formation is linked to professional growth across a teacher's career (Beauchamp and Thomas, 2010), it is also fluid and contextually dependent, evolving with career stage, institutional demands, and personal circumstances (Beijaard *et al*., 2022). While there is significant research into identity formation in early-career

teachers, developing their self-image of what they believe a teacher is or does, there is limited research exploring the factors influencing the decline in teacher identity as teachers move into the later years of their careers, although it has been suggested that teachers at this stage are attempting to attend to their work-life balance more favourably, possibly as a response to shifting priorities related to personal and professional experiences.

Teacher identity can be elaborated using theoretical approaches to explain how it is formed and contested. From a symbolic interactionist perspective, identity is shaped through interaction and role performance (Mead, 1967; Goffman, 1951). Teachers, therefore, perform their roles in alignment with expected norms, from both the student, colleagues, school, and government perspectives. This means identity is not just self-defined but is negotiated within the power relationships and expectations of schools and policy frameworks. Their identity becomes context-dependent, enacted differently in the classroom, staffroom, and during inspection. The 'I' of the teacher (as an actor) is continually shaped by the 'me' (as seen by others), making professional identity a negotiated and dynamic process. Stryker's (1980) view of identity being tied to social roles and structured fields, such as that of a school, emphasises how teachers navigate multiple, sometimes competing identities, including, subject expert, disciplinarian, and carer, organised by salience.

While symbolic interactionism focuses on identity as socially enacted, post-structuralist perspectives offer insight into how identity is constructed through discourse and institutional power. Post-structuralist perspectives offer further insight, particularly in periods of curriculum or pedagogical reform. Foucault (1980) highlighted how identity is constructed through discourse and power, with teachers not acting merely as passive recipients of policy but are produced through the discursive practices and institutional expectations that surround them. As Ball (2003) described, teachers often operate within frameworks of accountability and performativity, where their autonomy may be constrained, and identity shaped through compliance or resistance. Sachs (2005) described this as identity work, where teachers must constantly negotiate who they are professionally amidst shifting policy agendas and expectations.

The introduction of *Teachers' Standards* (DfE, 2021) and *National Professional Qualifications (NPQ)* (DfE, 2024b) aimed to reinforce the professionalism and identity of teachers (Day, 2019). However, Day noted how these policy tools also perpetuated the myth that teacher quality can be linked directly to student outcomes, a relationship he argued is highly complex and difficult to measure. These developments align with an increasingly performative culture in teaching, where teachers must conform to dictated professional identities with externally imposed accountability frameworks, sometimes at the expense of their own values or pedagogical instincts. An important aspect of developing a teacher's identity is agency. Beijaard *et al*. (2004) suggest agency is important because through taking an active role in their own development, teacher identity increases. Understanding identity in isolation is insufficient without recognising the role of agency, which enables teachers to navigate and potentially reshape the contexts that shape them. The next section explores the interrelationship between teacher identity and agency.

2.6.2 Teacher Agency

Teacher agency is important in shaping teacher identity, as discussed immediately above. Giddens's (1984) theory of structuration links a person's agency and actions to the social systems and structures they live in. He explained agency as including, intentionality, acting with purpose; knowledgeability, understanding what and why actions are taken; and, reflexivity, being able to consider their actions and adjust them based on the situation. So, people's actions are not random, and competent people can explain their actions, provide reasons, and influence others' behaviour. Giddens also explains how despite being reflective, awareness of one's agency only surfaces when something goes wrong, and agency will then allow an adjustment to bring the situation back to where it needs to be. Giddens also described the limitations of agency as being when one can explain what and why they are doing something but are not always aware of the rationale or motives of their actions. These unconscious influences mean that agency is not always fully intentional or controlled. Bourdieu posits that agency is shaped by *habitus* and position within the field, alongside the type and amount of capital possessed. Both Bourdieu and Giddens agree that not all agents have equal power, with positions in the field dictating the scope of agency available. Giddens furthers his ideas of agency and explains how structuration can

somewhat limit a person's agency as the rules and resources embedded in structures, condition the choices available. His theories are often linked to those of Bourdieu (Chapter 2.5), and his limitations of agency can be explained through Bourdieu's concepts of *habitus*, capital, and field.

Similarly, Archer (2000) linked agency to social structures, however, she argued that to properly explore agency and structure, they needed to be separated to be able to consider them, even though in reality they are linked. She furthered this by explaining the two concepts were intertwined, but not convertible one to the other. She also added the concept of culture, referring to the ideologies and social norms of a structure, explaining the relation between them. She described how if the culture changed, then eventually the structure would change. This then brings about changes in identity and choices, whereby one can choose to reproduce or transform the system. Archer (2000) argued that these cultural and structural changes affect agency, through interactions over time, and over time the agency can bring about change. Biesta and Tedder (2007) agreed and explained agency as the ability to take and control actions within a particular context, and Davies (2010) added to this and described agency as the capacity to stand back from a context and to be able to visualise potential outcomes, from differing actions. In a teaching context, this could involve choosing to deviate from a scripted pedagogy or curriculum map in favour of a more appropriate way of teaching for a particular group of students within the context.

Lennert da Silva and Mølstad (2020) describe how they consider teacher agency as being limited by the resources available during the day-to-day workings of a classroom. These limitations are also guided by the teachers' personal values and beliefs, the ethos and rules of the school and the external inspection and accountability criteria. Building on theoretical models, researchers have examined how teacher agency manifests in everyday classroom and policy interactions. King and Nomikou (2018) describe how agency enables teachers to be autonomous decision-makers, exercising their professional judgement in the classroom around decisions about curriculum, pedagogy, and classroom management. Lennert da Silva and Mølstad (2020) further this and describe agency as the capacity to mediate policy, achieved through their capacity to make judgements and act in the form of responses, either compliance or

resistance, to reform policies (King and Nomikou, 2018). Consequently, Hizli Alkan and Priestley (2019) note agency as being central to curriculum implementation and teacher identity because it allows for a more active, reflexive engagement with discourses that shape practice. Teacher identity is not a fixed product, but a continually evolving process informed by interaction, social roles, and discursive power.

2.6.3 Teacher Professionalism

The nature of teacher professionalism has been examined widely in the literature and refers to the characteristics a teacher possesses in the fulfilment of their role. It is defined, in part, by the training and qualifications they bring to their classroom (Day, 2019). Bates, Lewis and Pickard (2011) explain that while professionalism is difficult to define, it typically refers to a teacher's level of competency and effectiveness. The implementation of the *ERA* saw a flurry of literature describing how reform had deprofessionalised the role, by making teachers' work more 'routinised' and 'deskilled' (Forrester, 2000), undermining their professional judgement. While some argue reform diminished autonomy, others identified opportunities for collaboration with colleagues in whole-school initiatives and increased professional growth (*ibid*., 2000). Tamah and Wirjawan (2022) highlight the link between the professionalism of teachers and their accountability, which Ehren, Paterson and Baxter (2020) link to trust, and determine when the two are linked, school improvement can occur. They contrast this with the acts of control and monitoring, *(ibid*., 2020, p.186) which they argue 'violates the underpinning principle of trust' and originates from a position of distrust. Baxter, Ehren and Paterson (2018, p.6) described distrust as a 'constraining element' in teacher professionalism, limiting autonomy and relational trust, leading to 'negative perceptions' and limited success. This distrust may arguably be seen in the control and monitoring imposed initially by the introduction of the *National Curriculum in England* (DES, 1988) and subsequently through the various demands brought in through legislation, including *Teachers: Meeting the Challenge of Change* (DfEE, 1998), which set out clear expectations for teacher performance, through to the more recent Ofsted inspection criteria found in the *EIF* (Ofsted, 2019b).

Bates, Lewis and Pickard (2011) posit that despite teachers being viewed as professionals, aspects of the roles, including the lack of autonomy in teaching,

arguably imposed by the *National Curriculum* (as above), denied them full professional status. This was supported by McCulloch, Helsby and Knight (2000), who also described the de-professionalisation of teachers post-*ERA*; however, they contend the role of the teacher in interpreting and enacting these policies provided them with opportunities to become decision-makers, enhancing their professionalism. Hughes and Lewis (2020) furthered this when they described the professional decisions teachers engaged in during the Welsh curriculum reform. While they acknowledged the importance of teacher autonomy as an aspect of their professionalism, the findings highlighted how reduced autonomy did not necessarily reflect reduced professionalism. Pantic (2015) also recognised autonomy as being relative, with occasions when teachers are subordinate to others, from teacher to Subject Leader to senior leader, but she recognised all teachers have a degree of autonomy in their classrooms, in their pedagogy and behaviour management. Lennert da Silva and Mølstad (2020) identify teacher autonomy as a key aspect of a teacher role, providing perceived job satisfaction, self-efficacy, motivation, and commitment, with the amount of autonomy afforded to teachers having the potential to empower or de-professionalise the teacher role.

Teacher professional development is encompassed as an aspect of professionalism, with teachers having the autonomy to determine how to improve their role. Gadamer (2013, p.10) described professional development as *Bildung*, the 'human way of developing one's natural talents and capacities.' Bourdieu (1986, p.18) also used the term *Bildung* to describe an accumulation of capital, which he explained as 'a labor of inculcation and assimilation . . . which must be invested personally by the investor.' This conceptualisation of *Bildung* aligns with a view of professionalism as not just a set of competencies, but an ongoing process of personal and intellectual investment in teaching practice. Kim (2013, p.20) furthered this and related *Bildung* to teachers' growth through professional development, focusing on 'the teacher's philosophical, ontological, and professional journey of becoming,' aligning with the work of Day (2019).

2.7 The Problems in Science

Reflecting on their *Inspecting the Curriculum* (Ofsted, 2019a) and the *EIF* (Ofsted, 2019b) policies, Ofsted published the document *Research Series: Science* (2021). They noted how despite there being an increase in students wanting to study science post-16, there was a worrying number of students leaving school with low levels of science knowledge. They observed interest in science diminished as students moved through their secondary education and also noted the differences in the offering of Triple Science between schools as a contributory factor. Data from national and international student surveys were also highlighted and will be discussed further here.

The Programme for International Student Assessment (PISA) assess 15-year-old students on their reading, mathematical and scientific skills. In the most recent assessment (Ingram *et al*., 2023), UK students scored above average in all three sections. However, the science score for England was not significantly different from that achieved in 2018 (PISA, 2018). In the ten years between 2012 and 2022, science scores across the Organisation for Economic Co-operation and Development (OECD) countries declined, with England's average score dropping significantly. The gap between the highest and lowest-scoring students widened, and even though the scores at the 90th percentile remained constant, those in the 10th percentile were significantly lower than in 2012 and 2015, meaning England has more students scoring lower marks. Students with less disadvantaged backgrounds performed significantly better than those with lower SES from more disadvantaged backgrounds, across England and other OECD countries.

The Education Endowment Foundation (EEF) published a report (Nunes *et al*., 2017) focused on the impact of SES and was supported by data collected by the OECD (Ingram *et al*., 2023) in the PISA 2022 study, determining a consistent link between higher SES and participation and attainment in science compared to less advantaged students. This attainment gap continued throughout all stages of education and into post-16 science study. Berger and Archer (2018) examined the effect of low SES across the curriculum and found students with lower SES had lower aspirations and lower academic goals, supporting the EEF report. Xie and Ma (2019, p.852) furthered their findings after exploring the 2009 PISA assessment data. While their data agreed with the effect of low SES on student attainment, they also found Bourdieu's cultural capital

theory can be used to explain these differences, and they posited families with lower SES could partially mediate the differences by adjusting their habits and attitudes and through choosing 'more cultural productions' for the family.

In 2019, the Trends in International Mathematics and Science Study: National Report for England was released (Richardson *et al*., 2020). In this international survey, students are assessed at ages 9-10 years old (UK Year 5) and at 13-14 years old (UK Year 9). The study revealed science performance in Y9, despite still being above the average scale point score of 500, had decreased significantly since the previous assessment cycle in 2015, from a scale score of 537 to 517. Examination of the data revealed associations between lower SES (disadvantaged students in receipt of free school meals and pupil premium) and performance, following previous surveys, with students achieving around 100 scale points less compared to advantaged students.

A report, *Young People's Views on Science Education* (Hamlyn *et al*., 2020), published by the Wellcome Trust, provided a summary of the 2019 Science Education Tracker survey and an insight into the attitudes of young people in England to science education. They reported interest in science dramatically reduced as students moved through secondary education, partially due to a perceived lack of relevance to their lives. Students also considered science, relative to other subjects, to be more likely to require hard work to succeed. Archer *et al*. (2010, p.628) supported this when they elicited how students found science to be a 'hard (difficult) subject that required and demands application.' They found this ultimately led to poor aspirations for a STEM career and poor uptake post-16. Some practices in secondary schools also made science a more elitist subject, with only the very 'best' students being invited to study the Triple Suite of science subjects (Chapter 2.2.3). Archer *et al*. (2017b, p.311; 2017c, p.751) examined these practices in schools; the Triple Science route was perceived to be the course taken by only high-achieving and 'brainy' students, providing them with confidence and identity, whereas those who went through the conventional Double Award route possessed less identity and lower aspirations. The decision on which route the students took had been made by the teachers, resulting in students having already decided science was not for them. A lack of relevance to their own lives was also a factor in poor engagement with science (Hamlyn *et al*., 2020).

2.8 Summary

This chapter has shown how the changing landscape of education has impacted the role of curriculum makers and curriculum implementers, the teachers. The introduction of the Science *National Curriculum* saw science taught to all students. The science curriculum was perceived to have polar objectives; on the one hand, it aimed to provide sufficient scientific literacy to the nation, while on the other, it aimed to educate and prepare the scientists of the future, whose role in the country's scientific and economic competitiveness is essential. Consequently, science is perceived as a difficult subject, and national and international data have revealed how England's science scores are stagnating and beginning to trend downwards, ultimately potentially impacting post-16 uptake.

The introduction of Ofsted and their inspection of schools arguably led to teaching to the test and student enjoyment in science reduced as they moved through secondary school. The introduction of the policy *Inspecting the Curriculum* put the teaching focus back on the curriculum. The changes seen in schools led to this research, investigating the lived experiences of a group of teachers during their implementation of their Linear Curriculum model. This curriculum model aimed to provide students with increased science identity and cultural capital, to ultimately improve GCSE science grades and potentially increase aspirations to study science post-16. The subsequent chapter presents the methodological approach adopted in data generation for this research study.

Chapter 3 Research Design and Methodology

3.1 Introduction

This chapter outlines the research process used in this small-scale study based in an English secondary school in a low SES area. Schools are found globally, and also situated in low SES contexts, so this methodology may resonate in other similar contexts. The research was grounded in an interpretivist paradigm and aimed to explore and interpret teachers' perceptions through qualitative investigation (Blaike and Priest, 2019). Basit (2010, p.6) defines ontology as 'the nature of being,' and Savin-Baden and Howel Major (2013, p.57) describe it as 'the nature of reality, what the real world is and what exists in it.' This research demanded a relativist approach to ontology since the experiences of the participants were diverse and shaped their perceptions and realities (Blaike and Priest, 2019). Interpretation of these realities aligns with a subjective epistemological positionality, with epistemology being described as how we know what we know (Punch, 2014). The subjective nature of interpretation is embraced within Gadamer's philosophies of understanding and is described in Chapters 3.4 and 3.6. The subjectivity of this research brought reflexivity to the forefront as a key consideration. The approach taken in this research to challenge my reflexive positionality throughout the thesis is outlined in Chapter 3.5. This enables the role of reflexivity to be clarified and considerations to be included in the subsequent evaluation of methods and approaches (Chapters 6.6 and 6.7). Guided by these foundations, a philosophical hermeneutic phenomenological methodology was adopted, and the rationale is discussed. The research design, including the setting, participants and data generation follows, along with an explanation of how data security was managed, and justification of these decisions. Data analysis, guided by Gadamer's philosophies is explained and an overview of the major themes is identified. Ethical considerations conclude the chapter.

3.2 The Research Questions

This research aimed to explore the lived experiences of secondary science teachers, working in an English school, following the *National Curriculum in England* and implementing their Linear Curriculum. The Linear Curriculum was developed by all the teachers within the department and had a focus on cultural capital and science

identity. This research aims to determine the extent to which these concepts could be developed in students.

The research objectives were:

To investigate teachers' perceptions of the strengths and limitations of the Linear Curriculum

To explore differences in perceptions of the Linear Curriculum, cultural capital, and science identity of teachers with a range of personal and professional backgrounds.

To investigate how secondary science teachers perceive science identity and cultural capital manifest in students.

To explore the experiences of classroom teachers whilst teaching science following the Linear Curriculum.

Subsequently, the research questions were:

RQ1: What are the perceived strengths and limitations of the Linear Curriculum?

RQ2: How do teachers' *habitus* and prejudices impact curriculum development?

RQ3: How do teachers perceive science identity and cultural capital manifest in their students?

RQ4: How and to what extent does the Linear Curriculum influence teachers' sense of professionalism, agency and identity?

3.3 Methodological Approach

The nature of the research questions required the adoption of a predominantly qualitative methodology, which aligns with the hermeneutic and philosophical phenomenological approach taken. Any potential impact on students of the Linear Curriculum was sought from a group of teachers with differing personal and professional backgrounds. To establish participant demographics and ascertain a baseline of participant perceptions, a small amount of quantitative data were collected in the form of a questionnaire. It was important to determine the initial pre-understandings of the participants, with reference to the terms used in this research,

namely cultural capital, and science identity, to provide a baseline with which interpretation could occur. The collection of this type of data to supplement qualitative research is in line with the writings of Basit (2010) and Kara (2017).

Basit (2010, p.16) explained the need for a qualitative methodology when investigating the social world in which 'reality is subjective' and where there is 'no objective existence independent of individuals' views, perceptions and behaviour.' Cohen, Manion and Morrison (2018, p.287) concur and describe how there is not a 'single blueprint' for qualitative research because there are multiple views of the world. Similarly, Blaike and Priest (2019) acknowledged the similarities and differences in perceptions and experiences cannot be generalised. This research focused on the classroom experiences of a group of secondary science teachers who had developed a curriculum model they named the 'Linear Curriculum,' which they then implemented, intending to invoke science identity and cultural capital in their students, to promote aspirations in science, improve GCSE grades, and increase science uptake post-16. The realities of participants working within the Science department were co-created whilst also being individual, which led to the generation of subjective data that required interpretation. In such a situation where different members of a group share a space, but all have their unique assumptions, Alharahsheh and Pius (2020, p.41) explain how interpretivism allows consideration of differences in 'cultures . . . as well as times leading to the development of different social realities.' Interpretation of these differing viewpoints aligns with a phenomenological methodology (Reiners, 2012), whereby the experiences of participants in terms of their context can be interpreted and how these perceptions came to be, can be understood. The concept of hermeneutic phenomenology, underpinned by the philosophies of Hans-Georg Gadamer (2013), was utilised. Gadamer viewed interpretation through a 'fusion of horizons' with an understanding derived through conversation where there is a common language (2013, p.415). In his work, Gadamer (2013, pp.312-313) delved into the intricacies of the 'hermeneutic situation,' wherein he emphasised the perpetual incompleteness of self-knowledge. Within a given situation, individuals find themselves and their circumstances, preclude any possibility of achieving absolute objectivity. Consequently, participants are deeply engaged in shaping their understanding, rendering their perspectives inherently subjective. Gadamer further

posits that shedding light on these situations is an ongoing endeavour, never reaching a definitive conclusion. Gadamer's philosophical hermeneutic phenomenology accommodates any lack of researcher objectivity, and he explained that to fully understand something, a person must have 'a bond to the subject matter' (Gadamer, 2013, p.306). With an emic positionality, the decision to use Gadamer's philosophies was congruent with this research, where, as a researcher-practitioner, I was immersed in the phenomenon. Gadamer (2013, p.316) believed the pre-understandings held by the researcher are important and described how 'a hermeneutic situation is determined by the prejudices that we bring with us.' In the context of Gadamer, prejudices are not a negative emotion but rather the sum of one's background knowledge, assumptions, and traditions, which shape our understanding before the interpretation of a new situation. He furthered this notion of pre-understandings and explained the 'horizon of a particular present' was continually being developed and formed, and understanding was furthered through the historical horizons acquired (Gadamer, 2013, pp.316-317). Intersubjectivity provides the emic researcher with a 'common understanding' (Wallace and Priestley, 2017, p.333) of 'shared experiences' (Archer *et al*., 2010), which have been found to help determine a truer reflection of participants' perceptions. Wallace and Priestley (2017) successfully used the principle of intersubjectivity when they investigated the experiences of secondary science teachers involved in curriculum development following reform. They explained how being a researcher with a similar background to the participants helped to determine a truer understanding of their participants' perceptions, presenting support for this method in examining the lived experiences of teachers in this research. Additionally, Strong *et al*. (2008) described the use of hermeneutic phenomenology in counselling and supported how meaning can be constructed using the perceptions and experiences of participants and researchers in co-constructing meaning. They also highlighted the importance of written and verbal data in constructing the meaning of the lived experiences of participants within the phenomenon. Critics of phenomenology, for example, Cohen, Manion and Morrison (2018) and Denscombe (2014) argue it has an emphasis on description and interpretation rather than objective measurement and analysis found in the physical sciences. However, Neubauer, Witkop and Varpio (2019) explained how a thorough understanding of the

philosophies theorising human existence can counter these issues, given not all phenomenological approaches are alike.

3.4 Phenomenology

Phenomenology can be traced to the philosophies of Husserl, who described the lived experiences of participants within the research context (Husserl, 1999). Despite his philosophies purporting that a conscious awareness of a phenomenon would better develop a description of reality (Laverty, 2003), he believed the researcher should bracket their presuppositions to remove bias and enable the researcher to see the phenomenon more clearly. Heidegger (Heidegger, 1962) disagreed with Husserl and furthered his work by describing how researcher bias should be acknowledged within the research (Neubauer, Witkop and Varpio, 2019). He explained this should be done by reflecting on the themes of the participants' experience while at the same time reflecting on one's 'own experience' (*ibid*., p.92). Heidegger believed a researcher's bias was based on their historicality, their personal history, their background and culture, and their 'situatedness in the world' (Laverty, 2003, p.24) which influenced their interpretation and understanding of every encounter. To reduce the impact of these interpretative influences, Heidegger described a hermeneutic circle that moved between individual parts of an experience to the whole and back again.

The work of Gadamer is based on Heidegger's theory that hermeneutical interpretation is not focused on proving a circle is there, but rather on showing the circle possesses 'ontological positive significance' (Gadamer, 2013, p.279). When interpretation has ontological positive significance, the understanding it provides shapes and contributes to our being in the world. Gadamer furthered the work of both Husserl and Heidegger by extending hermeneutic phenomenology into a practical application. He proposed interpretation starts from a point where the researcher has some understanding of the phenomenon. Supporting this, Leiviskä (2013, p.518) described how 'an already existent historical-linguistic pre-understanding' is required in philosophical hermeneutic phenomenology. Hickey (2012, p.146) described the importance of 'opening up one's understandings of the phenomenon in order to create the space for considering the lived experiences of others,' supporting the need for the researcher to be within the research. During this research, reflecting on my

knowledge and understanding of the Linear Curriculum and my understanding of cultural capital and science identity was a crucial aspect of the phenomenological journey, whereby a space was created to acknowledge the lived experiences of teachers and colleagues and to understand these co-created realities. Borda (2007) noted that by acknowledging our preconceptions or pre-understandings and allowing an openness to a situation, there is an opportunity to understand our situation and offers the prospect of adopting an alternative.

Gadamer did not provide a methodology or method on how to use his philosophies, but he did determine a systematic approach was required, and the method described by Alsaigh and Coyne (2021), a hybrid of that described by Fleming, Gaidys and Robb (2003) and Ajjawi and Higgs (2007) was adopted in this research (Appendix 3). This framework provided a more detailed and structured methodology than the one used by Pratt (2016, 2020) who followed the structure outlined by Fleming, Gaidys and Robb (2003) when she researched nursing colleagues. The methodology used in these studies provided a framework for examination of written and verbal dialogue through a cycle of reading and re-reading to allow a fusion of horizons and new understanding.

3.5 Researcher Positionality

In hermeneutic phenomenological research, the positionality of the researcher is not a limitation to be bracketed, as suggested by Husserl (1999) (Chapters 3.4 and 3.6), but a vital part of the interpretative process. As an emic researcher, simultaneously a colleague, science lead in the school and researcher, the insider perspectives brought to the study, were shaped by shared experiences, a common language, and established relationships with the participants. Additionally, my insider positionality provided valuable insight into the data analysis, however, acknowledgement of potential biases and power dynamics was required through reflexive practices.

My positionality was shaped by both my personal experiences, a working-class upbringing, and professional experiences provided through my journey from the NHS to teaching and subject leadership. These factors form part of my pre-understandings and are carefully examined in Chapter 3.9.2. Consideration of these pre-understanding is important as following Gadamer's hermeneutic principles, understanding arises through a fusion of horizons, between the historically situated perspective of the

researcher and the participants. This fusion requires an 'openness' (Gadamer, 2013, p.281), whereby the researcher maintains a critical awareness of their own perspectives and how these may shape their interpretation of the participants' lived experiences. Reflexivity was maintained through a number of ways, including the use of a reflective journal, dialogue with supervisory teams and peers, participant validation of pen portraits and data interpretation and a transparent audit trail of decisions and reflections. Ethical considerations were also essential and are discussed in detail in Chapter 3.10. The subjective nature of this qualitative research aligns with the hermeneutic approach taken whilst noting that understanding is co-constructed following a period of openness. My positionality enabled a richness and depth of meaning-making within the research context, despite being a potential source of bias. Reflexivity and pre-understandings are pivotal in hermeneutics and are incorporated throughout this methodology. Chapter 6.7 extends this reflection critically through researcher positionality, interrogating not only how insider knowledge shaped interpretation but also considers the limitations of this. Implications for future researchers are also considered.

3.6 Use of Gadamer's Hermeneutic Inquiry in This Research

Before the commencement of any analytical activity, it was important to identify the researcher's pre-understandings, both personal and professional, in terms of and with reference to the research questions. These provided a basis on which to reflect and fuse horizons. Fleming, Gaidys and Robb (2003, p.117) described how a 'conversation with a colleague' would make pre-understandings visible, and these should be 'described and analysed in the research report.' During the analysis of this data, discussions took place with the supervisory team at the university, and informal conversations took place in the science staff room; points noted were recorded in a reflective journal, and changes or new assumptions were noted.

Gadamer postulated understanding may only be derived through dialogue, and so an interpretation of the text (written or verbal) is a prerequisite (Gadamer, 2013). My emic positionality placed me within the research context, enhancing my understanding of the texts and shaping my pre-understandings. My prejudices and pre-understandings were gained through working alongside the participants in the

development of the Linear Curriculum, and through co-habiting in the shared research environment. Working alongside the participants established a 'common language' making the exchange of ideas possible (Egelandsdal and Riese, 2020, p.98).

Dialogue includes both the written text and conversation. When these are interpreted alongside pre-understandings within a particular context, interpretation can occur (Laverty, 2003). However, as described by Fleming, Gaidys and Robb (2003), Gadamer determined understanding depended on the historical situation, so it was essential to seek the perceptions of the participants on more than one occasion. In this research, participants were asked to keep a diary (Chapter 3.7.3) where they noted key experiences in their working lives. These texts were then followed up with interviews (Chapter 3.7.3), which aimed to mimic conversations to help with interpretation and understanding (see Appendix 4 for an example).

3.7 Research Design

3.7.1 Setting

This research was conducted in an English secondary school found in the lower quartile for social mobility in school rankings (DfE, 2017a, 2017b). The UK Social Mobility Commission (2022, p.13) redefined social mobility as 'intergenerational social mobility – the difference between your life outcomes and those of your parents,' and is used as a government measure to assess the availability of opportunities for individuals to improve their socioeconomic position. Within their report, there are two case studies where teachers described their role, in addition to the parental role, in the development of cultural capital in their students (*ibid*., pp.43,58). In both cases, the development of cultural capital was linked to raising aspirations and improving social mobility (Chapter 2.5). This supports the focus of this research within a school setting as being both appropriate and a potential source of new and useful information.

3.7.2 Participants

This research was focused on the Science teachers in a secondary school, and the sample was purposively selected as described by Kara (2012), who defined it as when the participants most suited to the research were selected. Furthering this, Laverty (2003, p.29) described how participants selected should be 'diverse enough from each other to enhance possibilities of rich and unique stories.' Groenewald (2004) identified

phenomenological research as requiring between two and ten participants and longer interviews with up to ten participants, supporting the number of participants used in this research. However, a larger sample would arguably be required when the size of the school is greater than the one used in this research, with approximately 1100 students in total. Table 3.1 summarises the participant demographics and the range of personal and professional backgrounds, which further supports the provision of a range of realities. Kulo, Odundo and Kibui (2021, p.260) used purposive sampling to study Kenyan English teachers' perceptions of the curriculum they planned because they considered these participants to be the 'best sources of information,' demonstrating its cross-cultural validity and further supporting the choice of purposive sampling in this research. Of the teaching staff available to participate in this research, two had been involved in the pilot study (Appendix 5) so were excluded from the final research, the eight other staff were approached to take part in the research, and all completed the questionnaires, and five chose to continue by completing diary entries and the subsequent interviews.

The participant cohort size, including the researcher/practitioner, was arguably representative of Teachers of Science in an English secondary school, which is reported to have, on average, 8.81 teachers per 1000 students (Moor *et al*., 2006) in low social mobility areas. Nationally, the age range of teachers is between 22 and 65 years, which aligns with the teachers in the cohort (Table 3.1). However, in an average department, data suggests (Moor *et al*., 2006) three-fifths of teachers have more than five years of teaching experience, whereas, in this small-scale study, the number of years of teaching experience is slightly higher with four-fifths teaching for greater than five years. However, only three-fifths of the participants had more than ten years of teaching experience, which aligns with national statistics. In an average Science department, two-fifths of the teachers had work experience before teaching, which also aligns with the experiences of the participants. Therefore, the data generated in this research is broadly representative of science teachers in English secondary schools, located in low socioeconomic areas.

Table 3.1: Demographics of Participants (n=5)

Characteristic	Specific Characteristic	Number
Gender	Male	3
	Female	2
Age range:	21 – 30	1
	31 – 40	1
	41 – 50	2
	51 - 60	1
Years teaching experience	0 – 5	1
	6 – 10	1
	11+	3
Level of education	Bachelor's degree	3
	Master's degree	2
Professional qualification	Yes	4
	No	1
Role	Classroom-based only	2
	Teaching and Learning Responsibility or leadership role	3

Having read the research information sheet (Appendix 6) and agreeing and completing the consent form (Appendix 7), all participants were asked to provide a pseudonym of their choosing to ensure anonymity. The pseudonyms chosen were Emma, Jim, Laura, Max, and Robert. Personal details and all data collected were stored electronically and backed up on a device that was password-protected and not shared with any other user. All hard copies of data were stored in a locked drawer, accessible only to the researcher.

3.7.3 Data Generation

A questionnaire (Appendix 8) was used to facilitate the collection of demographical data to support answering the research questions and to ensure participants were 'diverse enough' to provide 'unique stories' (Laverty, 2003, p.49). Following the pilot study (Appendix 5) questions were reorganised to remove repetition and reduce the number asked, to limit intrusion into participants' lives, which can be a factor of non-participation (Cohen, Manion and Morrison, 2017). The questionnaire was deemed

useful in the pilot study in helping participants understand the concepts and context of the research. The questions included were adapted from those used in the ASPIRES projects (DeWitt, Archer and Mau, 2016; Archer *et al*., 2015b). This was required because the ASPIRES project questions were targeted at students, who were asked to consider how they viewed themselves in the context of science. Conversely, this research focused on teachers and their perceptions of how they viewed their students. Following analyses of the pilot study (Appendix 5) and the reduction in the number of questions, the questionnaire used in the research aimed to provide an overview of the meaning of the terms being explored to the participants, without providing a detailed description of science identity and cultural capital.

Diary entries (Appendix 9) and semi-structured interviews (Appendix 10 and Appendix 11) were used to capture the everyday experiences and observations of participants. Harrison *et al*. (2019) recommended the use of reflective diaries as a means of generating detailed and time-sensitive data. Similarly, Savin-Baden and Howel Major (2013) suggested semi-structured interviews provided the structure required to ensure research questions were answered whilst providing flexibility to discuss points arising during the conversation. Both data generation strategies were designed to reflect the research questions. Diary entries were collected over the autumn term from September to December 2022. Participants were asked to complete five entries over this period, with some choosing to complete the entries over a half term and others completing them throughout the period. Participants were provided with guidance on points to consider and include, as they recorded any incidents over the week, that they perceived were linked to the prompts provided (Appendix 9). The diary was of an open-ended nature to allow participants to record either occurrences and perceptions of one lesson or several lessons across the data generation period. They were given the flexibility of either handwriting these or typing them, and they were returned to the researcher as they were completed. On receipt of each diary entry, they were transcribed verbatim to provide an electronic copy, and each participant's data were collated. They were read, and thoughts and questions were noted, both in the reflective journal of the researcher and added to the semi-structured interview for further clarification and conversation. Although the diary entry instructions asked participants to record a diary entry once per week, with the school working to a two-

week timetable, some participants chose to record their data fortnightly, which also provided the participants with a degree of flexibility to record their experiences at a time that suited them best (Harrison *et al*., 2019) and fitted into their busy working lives, reducing any intrusion on their time. The fifth and final diary entry aimed to encourage each participant to reflect on any changes in their perceptions throughout the diary data generation period. By recording their experiences and observations as they taught the Linear Curriculum, recall bias was reduced (Bartlett and Milligan, 2015). The choice in how diaries were completed and the control participants held, in when they recorded in the diaries and what they chose to be included, may be regarded as a strength in reducing power relations potentially held by the researcher. Diary entries are also seen as a way of empowering the participants, providing them with the time to reflect on their thoughts before being asked to record them, when compared to an interview (*ibid*., 2015). Vinjamuri, Warde and Kolb (2017, p.934) concurred with this and explained the use of reflective diaries can provide a 'safe forum' for colleagues in less senior roles within the department. Lu (2019, p.55) agreed and described how participants were given a 'voice,' where in a face-to-face situation or a group interview, they may not wish to discuss or bring up potentially contentious thoughts or ideas.

Semi-structured interviews (Appendix 10) were conducted between January 2023 and April 2023. Thomas (2013, p.198) ascertained that semi-structured interviews provide 'the best of both worlds' whereby the structured questions ensure research objectives are met whilst also providing the flexibility of follow-up questions to enhance in-depth data generation, which was also noted by Pajari and Harmoinen (2020). The interviews were conducted in person and were audio recorded, each lasting between 45 and 50 minutes.

Participants were provided with copies of their completed questionnaire and diary entries for their referral during the interview. Before asking the structured questions, all participants were reminded of the research objectives and were asked questions about their work experience before teaching and what they enjoyed and found challenging about teaching. This aimed to put participants at ease and to begin the 'conversation' that was central to understanding (Gadamer, 2013). Throughout the interview, at pertinent points, participants were invited to 'tell the story of their

experience,' as described by Ebneyamini and Moghadam (2018, p.6), arguably giving the participants more ownership of their data.

Following the transcription of the initial interview and alongside the diary entry transcriptions, a pen portrait was authored for each participant to provide insight into their personal and professional backgrounds. Sheard and Marsh (2019) described how pen portraits offer a structured approach to qualitative data analysis, providing a technique through which data collected from multiple methods can be consistently analysed. The pen portraits reflected the interpretations of the researcher and highlighted how the participants perceived themselves as teachers and identified what they thought they were looking for in their students in terms of science identity and cultural capital. These pen portraits formed the initial stages of interpretation and were shared with the corresponding participants. Participants were given time to read and digest what had been written. It was determined at this point that a second semi-structured interview would be required to verify the accuracy of the pen portrait and to provide the participant with the opportunity to modify or enhance it. An extension to the original ethics application (Appendix 12) was made, and permission was granted. The second interview (Appendix 11) was seen as an important opportunity in terms of ethics, ensuring the researcher's interpretation of the data generated was in line with what each participant had shared to date. It was also seen as a means of improving the integrity of the data by providing the opportunity for the researcher to ask questions that had arisen during the construction of the pen portrait, whilst also providing the participant with the opportunity to provide feedback. Each interview was audio recorded and lasted between 1 and 7 minutes.

A focus group interview (Appendix 13) was also added to the extension of the ethics application. Gadamer (2013, p.307) asserted all understanding has a degree of *temporal distance* linked to time and the process of understanding. He determined understanding depended on a particular historical situation, so by speaking to the participants on separate occasions spread throughout the data-generation period, the participants were afforded the time to interpret and re-interpret their understanding of the situation of the Linear Curriculum. Gadamer (2013, p.375) described the conditions for a conversation to be where 'one really considers the weight of the other's opinion.' The focus group interview provided the opportunity to open a

dialogue between the participants, where they could share their horizons and understandings of the research topics. Gadamer posited that dialogue was not there for others to agree on a particular opinion but rather to explore others' horizons and prejudices and to co-create understanding. This offers further support for the data generation programme of this research, returning to the participants throughout the data generation period to enhance the interpretation process and gain a deeper understanding of their perceptions.

Through interpretation of the data generated, this research offers an understanding and 'better knowledge' of how the Science Linear Curriculum model may potentially provide students with science identity and cultural capital, aligning with the philosophies of Gadamer (2013, pp.361-2). Gadamer described how an experience is itself negative because, by one deciding it to be 'new,' it is translated to an experience which until that point has not been seen and so is not interpreted or understood. However, when the new experience is seen in a different light, its negativity becomes something useful through gained knowledge. Gadamer (2013, p.362) referred to these experiences as 'dialectical,' where something perceived as being negative can translate into a positive experience of understanding. Laverty (2003) suggested a reflective journal, written by the researcher, would assist in the reflection, interpretation, and understanding of the data collected, hence a reflective journal was kept. The journal recorded details of my experiences in the classroom, teaching from the Linear Curriculum, and my reflections on conversations in the staffroom about the Linear Curriculum itself and the pedagogies used. Reflections were also kept about my thoughts and interpretation of the participants' perceptions as they developed during the data analysis process (see Chapter 3.9.2), to maintain reflexivity.

3.8 Data Management and Security of Research Documentation

All written data, including signed consent forms, questionnaires, and diary entries, were scanned, transcribed, and stored on a password-protected personal computer. Hard copies were stored in a locked desk drawer, accessible only to the researcher. All interviews were audio-recorded on two separate devices to reduce the effect of equipment failure, as described by Groenewald (2004) and stored under the participant's pseudonym and date of the interview. All interviews were transcribed

verbatim and stored on a Word document on a password-protected personal computer.

3.9 Data Analysis and Interpretation

The data analysis and interpretation of findings were guided by Alsaigh and Coyne (2021), who combined the work of Fleming, Gaidys and Robb (2003) and Ajjawi and Higgs (2007) after finding the well-used framework of Fleming, Gaidys and Robb (2003) to be too vague. This combined framework took account of pre-understandings, fusion of horizons, and the hermeneutic circle as described by Gadamer (2013). Gadamer described the hermeneutic circle as the vehicle through which we can understand our world, where the pre-understandings and prejudices we possess affect our interpretation of the findings, which also influence our understanding, which then further shapes our pre-understandings (Borda, 2007). Whilst hermeneutics does not provide a set methodology, a fusion of horizons (Gadamer, 2013) between the researcher's pre-understandings, the participants, and the context in which the research is situated, is used to provide a new understanding of a phenomenon (Laverty, 2003). Gadamer (2013) described how meaning occurred through a circle of readings, reflective writing, and interpretations, requiring ongoing researcher reflexivity, and questioning about how the interpretations came about (Chapter 3.7.3). Fleming, Gaidys and Robb (2003) described how each stage in the hermeneutic circle may be completed simultaneously and not necessarily in sequence. Eger (1997, p.357) explained how, through continuously revisiting each stage, the 'circle' shrank, and greater understanding was achieved. The stages used are described below and summarised in Appendix 3.

3.9.1 Choosing Appropriate Research Questions

Gadamer (2013, p.306) stated that to conduct hermeneutic research, the researcher must seek understanding with something with which they have a bond. This aligns with this research, which is focused on interpreting and understanding the perceptions of colleagues (the participants) immersed in the phenomenon of delivering their Science Linear Curriculum designed by the department, to provide students opportunities to develop and increase science identity and cultural capital. The choice and appropriateness of the research questions must support the researcher's

methodological assumptions and beliefs (Fleming, Gaidys and Robb, 2003). To develop an understanding of the participants' perceptions, the research questions need to enable conversation and keep both the researcher and participant focused on the context of the research. The questions posed for this research (Chapters 1.7 and 3.2) aimed to understand how the co-created Linear Curriculum could potentially develop science identity and cultural capital in students. The understanding emerges through data generated from dialogue in conversation and text, using a range of data generation tools, maximising the potential of alignment with the research questions. Ajjawi and Higgs (2007, p.624) explained the importance of the research questions in the development of first-order constructs or codes used to analyse the data, using ideas expressed by the 'participants' in their own words or phrases,' capturing their desired meaning.

3.9.2 Gaining Understanding Through Pre-understandings

A reflective journal, as described in Chapter 3.6, was kept from the inception of this research through the development of the project, during the data generation and the analysis period. Gadamer described how we bring our pre-understandings (our preliminary knowledge of a subject) and our prejudices, our assumptions developed through time, to a situation, which we utilise to clarify and understand. He asserted it was important to be 'aware of one's own bias,' so there can be an understanding of a text, and it will then 'assert its own truth' (Gadamer, 2013, p.282). In her thesis, when investigating the role of professional practice instructors in evaluating undergraduate nurses' performance, Pratt (2016) summarised the bricolage of her pre-understandings in the format of a collage, which resonated with me during my journey of recognising my pre-understandings and prejudices. Figure 3.1 below displays some of the pivotal points in my life that have shaped my prejudices in the context of this research.

Figure 3.1: Bricolage of My Pre-understanding

This bricolage aims to explore my 'feelings and experiences' (Fleming, Gaidys and Robb, 2003, p.117), including my knowledge gained through this research and the accompanying literature review. Microsoft Copilot (2024) was used to produce these images copy-right free. The background is of a colliery and represents my working-class upbringing. My parents worked hard to give our family a comfortable life, and I have continued this ethos throughout my personal and professional life. Examining each picture in turn anticlockwise, the first (top left) represents my early academic career. Despite having academic success at school, I lost my way during post-16 education and left to begin my science career in the NHS. During this time, I picked up the academic reigns and returned to part-time education, successfully achieving a Master of Science degree. A later career change saw me move into secondary science education, and I was quickly promoted to Head of Science.

Education policy changes provoked a fresh look at the curriculum, and this was where my research journey began. Through this research, I have recognised the struggles of some groups of students, arguably through their lack of appropriate cultural capital. The school in which I work is situated in a low social mobility area. Student aspirations, GCSE achievement, and progression into science post-16 concerned me. The prospect of the department doing what it considered to be the best way forward in improving the life chances of the students was too good an opportunity to miss, and a curriculum

with the student at its heart was designed and implemented. The bottom right picture depicts a pathway of books, representing knowledge gained through education, moving upwards, representing the gain in social mobility.

The mask represents the feelings of not belonging, of imposter syndrome, experienced by many, including myself, when the cultural capital possessed does not fit the field. The top right picture represents how I thought this research journey would go and how it went, with things getting messy before the clarity emerged. In the centre is a picture of a family. This picture represents the family I was brought up in, the family I have created and live within, and the families of the children this research is for. Whilst the points above have shaped my horizon, personally and professionally, it is also important to consider my pre-understandings with respect to the research questions, as displayed in Table 3.2.

Table 3.2: My Pre-understandings in Relation to the Research Questions

What do I understand by the term science identity? *With my science background, I feel I have a science identity. I enjoy science, and I like to read scientific articles. I also like to discuss these with like-minded friends and colleagues. I have always enjoyed success both academically and professionally in science and see my qualifications as being an important aspect of my science identity. I feel my personality is composed of characteristics I perceive as being important in a scientist. These include my 'black and white' view of the world and my logical approach to problems.*
What do I understand by the term cultural capital? *I have two different definitions of this concept, my researcher one and my teacher one. As a researcher, I understand the concept of cultural capital as being something that can be used to explain differences in groups of students, such as those with greater cultural capital may perform better in GCSEs. Cultural capital is used to inform the habitus of a person and may be gained through experiences from the family home, including having access to reading books, going to restaurants, and visiting museums.* *However, as a teacher, I perhaps morph this definition to suit my own needs. Having been 'told' to develop a science curriculum that will help students develop cultural capital, I perhaps see it as being able to provide the students with knowledge beyond the curriculum and having experiences not available at home.*
Do I think the Linear Curriculum can build science identity and cultural capital in my students? *By teaching all students Triple Science content and teaching in mixed ability groups, some of the barriers that students face (e.g., Combined Science and bottom set) are removed. This, I believe, potentially places the students in a more positive relationship with school science. With the Working Scientifically skills embedded in the Linear Curriculum, I think it has the potential to develop science identity in students.* *As for cultural capital, from a teacher's perspective, the Linear Curriculum has 'sneaked' in the Triple Science content and arguably some of the more interesting science topics, such as the brain and space, so through giving students access to these, I think as a school we are providing them with knowledge beyond their every day and potentially offering the opportunity for students to improve their cultural capital.*
How did the development of the Linear Curriculum impact my professional practices? *I'm not sure that I correctly interpreted the school expectations for a 'curriculum to build cultural capital.' However, the trust endowed on me, and every member of staff was welcome. We were finally being allowed to do what we do best. Although relevant CPD wasn't forthcoming, the number of professional conversations that occurred was amazing, with all staff contributing. The trust went even further and is embedded in the department to a point where we are not afraid to say something doesn't work and are confident enough to exercise our autonomy to change as we see fit to benefit the students.*

3.9.3 Gaining Understanding Through Dialogue With the Participants

Fleming, Gaidys and Robb (2003, p.117) describe the 'collection of data' as a method of 'gaining understanding.' The process can be described as a sharing of language, which may be in the format of a conversation or as a dialogue between the written word and the reader. Emersion in the conversation or dialogue is considered the 'constitutive moment,' the point at which interpretation takes place and there is a deeper understanding and a fusion of horizons (Teevan, 2000, p.68).

The use of reflective diaries as a method of capturing written text provided a window through which the experiences of the participants could be examined and interpreted. The aim was not to understand from the participants' perspective but to reach a shared understanding. Understanding cannot be determined from the perspective of the participant due to 'historically effected consciousness,' in which Gadamer (2013, p.350) explained that the very act of understanding is shaped by our history and our interpretation is continually being changed as new interpretation provides different understanding. The participants agreed to three interviews, two individual interviews, the second being much shorter and aimed at checking the accuracy of the pen portraits, enhancing the validity of the data (Groenewald, 2004), and the third being a focus group interview. The participants' perceptions were gathered across the academic year, which Gadamer described as providing 'temporality' which is required to enable the capture of newer understandings due to updated pre-understandings and prejudices of both the researcher and participant. During the interviews, changes in expression, tone, and pace were recorded, alongside questions invoked or new thoughts and interpretations arising from the conversation.

3.9.4 Gaining Understanding Through Dialogue With Text

Alsaigh and Coyne (2021, pp.5-6) found this section of Fleming, Gaidys and Robb's (2003) analysis framework particularly difficult to use and subsequently broke it down into four stages, referring to them as 'immersion', 'understanding', 'abstraction', and 'synthesis and theme development.' This more detailed schema was determined to provide a greater scaffold in the interpretation process and was used in this research as it was also identified as potentially providing more opportunities to develop a deeper understanding.

a) Identification of First-Order Constructs (Immersion): Following verbatim transcription of the diary entries and interviews, they were re-read whilst listening to the audio recording to gain a preliminary interpretation and understanding of the whole text. This understanding was then summarised in a pen portrait (Appendix 14), which provided an outline of the participants' horizons as interpreted and understood by the researcher. The pen portrait was returned to the participant to check at a later stage. Questions raised whilst developing the pen portraits were recorded in the reflective journal, to return to during the next stage of data generation in the second individual interview. For example, Jim discussed providing 'challenge' for his students; Max described the importance of 'engagement' in his classroom; Laura described how her students were 'proud' of the work they had completed; Emma talked about 'lightbulb' moments in her classroom; and Robert talked about 'inspiring' his students. Each of these terms, 'challenge,' 'engagement,' 'proud,' 'lightbulb,' and 'inspiring,' were terms deemed to require clarity on how each participant understood the term with respect to their teaching role and the Linear Curriculum.

b) Identification of First-Order Constructs (Understanding): Following an initial understanding of the whole text, line-by-line analysis was completed by recording salient points in the margin. Relevant sentences and terms were coded using the participants' words, which is supported by Spencer, Ritchie and O'Connor (2003, p.203) who contested that through using in vivo coding, the researcher can remain 'true' to the data. NVivo12 software (Jackson and Bazeley, 2019) was used to organise the codes (Appendix 15) due to the large number and variety of them. The codes represented the participants' horizons, and the use of their language helped to develop a view of the data from the participants' perspectives rather than from the researcher's perspective (Alsaigh and Coyne, 2021).

c) Identification of Second-Order Constructs (Researcher's Horizon) (Abstraction): As all the texts and codes were further reviewed, codes with a similar meaning were identified and linked using common terminology across all data from all the participants (Appendix 15). Emerging codes were consolidated and refined through successive engagement with the texts. When all collected dialogues had been coded, refinement continued, driven by, and linked to the philosophies of Bourdieu as described in the Literature Review (Chapter 2.5). Codes were reorganised with similar

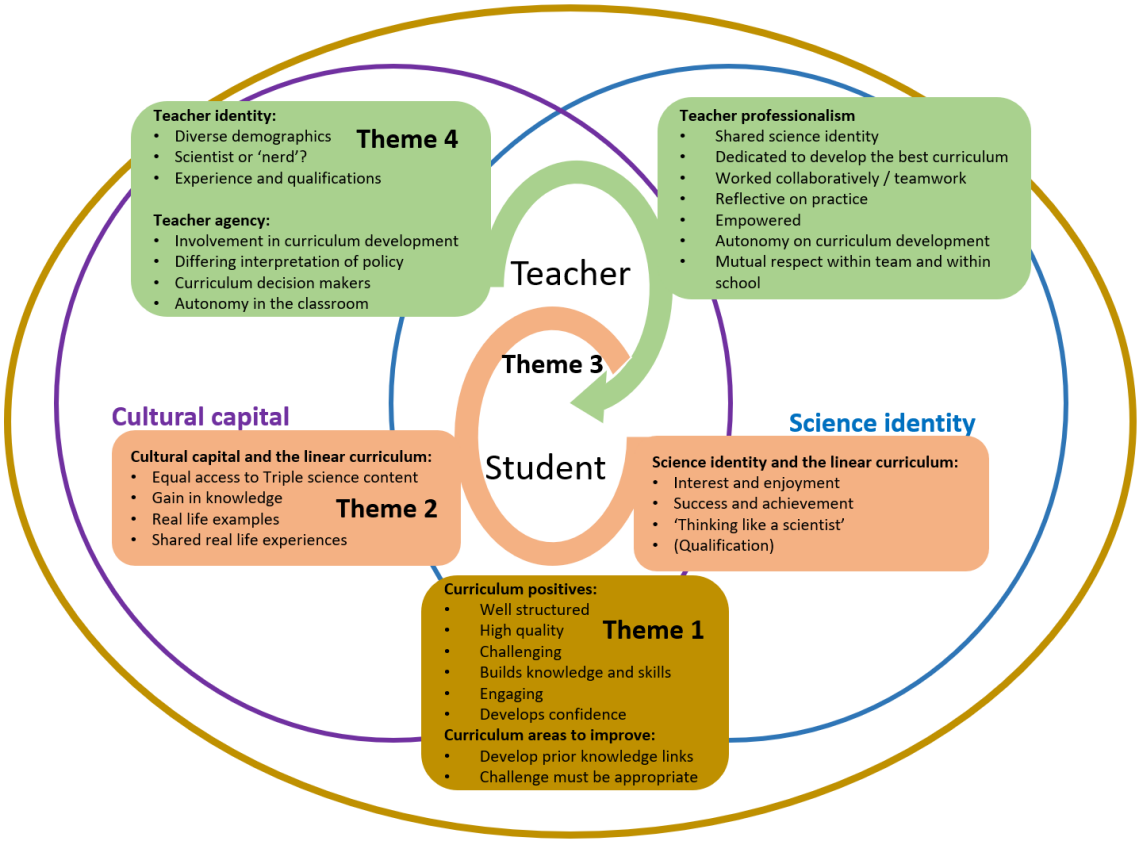
codes grouped into Nodes. As the Nodes were developed in NVivo12, the written dialogues of participants and researcher were revisited to ensure consistency of coding. The Nodes identified (Appendix 15) were a representation of the researcher's interpretation and understanding while acknowledging pre-understandings, at that point in time.

d) Synthesis and Theme Development (Meshing the Horizons): As the texts were reviewed, similar meanings were identified and labelled, using consistent terminology, across all texts and all participants. Emerging codes were consolidated and refined through successive engagement with the texts. Appendix 15 illustrates how the theme of the definition of cultural capital emerged. As themes were developed, they were challenged in terms of the research questions and in consultation with the written text and its wholistic meaning to ensure they remained true to the data. The development of the themes demanded a consistent and continuous approach and reflection of the researcher's pre-understandings to develop a truer interpretation and understanding of the data. The movement from reading and reflecting on parts of the data to reading and reflecting on the whole text was central to being in the hermeneutic circle and developing understanding. Table 3.3 and Figure 3.2 illustrate the themes and sub-themes developed.

Table 3.3: Major Themes Determined From the Data

	Theme	Description
1	Participants' perceptions of the Linear Curriculum	Initial perceptions: how the Linear Curriculum was developed, its benefits, limitations, and its further development.
2	Teachers' impact on the development of the Linear Curriculum	How teachers perceive themselves in relation to teaching, to the students, science identity and cultural capital
3	Relationships between the Linear Curriculum, the teacher, and the student	Teachers' perceptions of how science identity and cultural capital manifest in their students and the extent to which the Linear Curriculum develops these.
4	Impact of curriculum development on the teacher	How teachers see themselves, relationships between teachers and in the classroom, external pressures, and inner quarrels

Figure 3.2: Diagrammatic Representation of the Major Themes and Sub-themes



The final stages described by Alsaigh and Coyne (2021, p.5-6) are explained below.

e) Illumination and Illustration of the Phenomena: The researcher's initial interpretations and understanding of the data were summarised as a pen portrait for each participant (Chapter 3.7.3 and Appendix 14). These, along with all the data, were used to link the themes and sub-themes with the literature. These are discussed in detail in Chapter 5 Discussion.

f) Integration and Critique: This is the final stage of the hermeneutic circle where interpretations and understandings, at that specific point in time, are critiqued. At this stage, there is a fusion of horizons between the participants and the researcher. This stage is shared in Chapter 5 Discussion and Chapter 6 Conclusion.

3.9.5 Establishing Trustworthiness

When justifying interpretations of data, the employment of trustworthiness is seen as a means of confirming the validity and reliability of qualitative data. Lincoln and Guba

(1986) described trustworthiness as a combination of criteria including credibility, transferability, dependability, and confirmability.

a) Credibility: In alignment with the work of Laverty (2003), all the participants were immersed in the experience of further developing, implementing, and teaching the Science Linear Curriculum. Participants were prompted in their diary entries to reflect on their use of the curriculum model and asked to describe their experiences and the extent to which they thought the curriculum was suitable for their students. The semi-structured interviews focused on the questions devised from the research objectives, and then further questions relating to the diary entries were addressed to the relevant participants to gain a richness of data on the phenomenon. The use of the participants' own words in the initial coding assisted in keeping the data 'true' (Spencer, Ritchie and O'Connor, 2003, p.203) and supported the credibility of the findings. The use of the interview to follow up and develop a better understanding of data generated from the diary entries also helped to develop a more robust interpretation of the data, supported by Groenewald (2004), who noted the importance of triangulation of data as a form of validation. This research was designed to enable triangulation from all the data sources from the five participants. Data collected from the questionnaires and the diary entries were cross-referenced with the individual and focus group interviews, where further explanations were sought to clarify perceptions.

b) Transferability: Although researchers such as Denscombe (2014) highlight issues of lack of generalisability and transferability in phenomenological research, others such as Pitard (2016, p.2) counter this, describing how phenomenological studies are a means of understanding the 'nature and meaning of everyday experience.' Despite his concerns, Denscombe (2014, p.102) described how 'unfolding the events and laying bare the feelings experienced by people', can make the research findings more accessible to more readers. Demographical data collected from the participants (Table 3.1), along with the descriptions of the experiences and perceptions of the participants within the context, would arguably provide transferability to the reflexive reader (Boncori and Smith, 2020), although the readers' interpretation, determined by their 'historically effected consciousness' (Gadamer, 2013, p.350), may influence their understanding.

c) Dependability and confirmability: Ellis, Adams and Bochner (2011) described how work needs to be plausible and lifelike and reveal the continuity of the relationship between the participant and the researcher. The use of participants' voices within this research is seen as a means of making the research more credible, and when done well, it will be seen as a statement of the truth of the experience itself (Laverty, 2003). To confirm the accuracy of the data, participants were asked to check the transcription of their audio-recorded interviews, and they were also offered the opportunity to check interpretations of their data, in the pen portrait, checking it as being a true reflection of their experiences, providing a 'validity check' as suggested by Groenewald (2004, p.51). The reflective journal, which documented all selections and rationale, also provided data to support the dependability of the research (Fleming, Gaidys and Robb, 2003).

3.10 Ethical Considerations

Ethical approval (Appendix 12) was gained from the University following approval from the school Principal to allow the research to be conducted within the school. Before data collection and throughout the research and thesis writing process, the Ethical Guidelines for Educational Research from the British Educational Research Association (BERA, 2018) and Staffordshire University Research Ethical Review Policy (Staffordshire University, 2019) were complied with.

As an emic researcher, the insider privilege caused great concern. Brown, Spiro and Quinton (2020, p.753) highlighted 'issues of confidentiality, impartiality, and distancing from the research setting' when conducting insider research. Brooks, Maguire and te Riele (2014, p.115) discussed ethical issues when the research is focused on and with colleagues. They described issues of more senior colleagues requesting the researcher 'to reveal "who said what" or to remove findings that might be critical of the institution.' They further discussed the difficulty of anonymising participants, who could be easily identifiable within a specific department of a school without changing the attributes of their identities, which can then impact the research findings. Furthermore, they discussed the difficulties participants may experience when asked to comment on a topic the researcher is responsible for and additionally posited this may impact the researcher's reflexivity. During their research, Dhillon and Thomas

(2019) examined interpretations of data from an 'insider' and 'outsider' perspective through the lens of ethics. They described how the 'insider' analyses improved understanding because of the shared knowledge and experiences but also highlighted the importance of triangulation of data to reduce researcher bias (Chapter 3.9.5). Using the philosophies of Gadamer, the determination of positionality, comprising preconceptions and prejudices of the researcher was essential in the interpretation and understanding of the perceptions and experiences of the participants, and required sensitivity when describing participants' experiences. As the subject lead for the science department and researcher, potential power relations which might deter participants from sharing honest perceptions, as noted by Cohen, Manion and Morrison (2018), were considered. Measures to address these ethical issues are outlined below.

From the start of the data collection process, participants were assured of anonymity, and all online activity was addressed to my university email rather than a work email address, to provide a deliberate separation of the 'insider-outsider' positionality. Participants were informed in the Participant Information Sheet (Appendix 6) of their right to withdraw at any point without needing to provide a reason (Savin-Baden and Howel Major, 2013). To provide anonymity, participants were asked for a pseudonym of their choice, with which they wanted to be referred, and this was used throughout the research. Pseudonyms were known only to the relevant participant and the researcher. At the start of each interview, participants were reassured their responses and thoughts were important to the research and that they should be true to themselves rather than trying to provide the answers they thought would be needed to answer the research questions.

Since the research was conducted within a working practice where relationships existed between the researcher and the participants, it was important to ensure harm was not done and participants' words were not misrepresented. To reduce this harm, participants were offered the opportunity to check all texts where their experiences were described or their words interpreted (Ellis, 2007). Following the initial data processing, in the form of a pen portrait (Appendix 14), it was determined a second interview was required to provide the participants with the opportunity to check the text for its correctness and omissions, in accordance with Edwards (2021). Since this

was beyond the scope of the initial ethics application (Appendix 12), a further application was made to include a second interview to check and discuss the accuracy of the pen portrait. At this point, a further focus group interview was determined to be useful in investigating and understanding how the participants' prejudices worked together within the environment of the school (Laverty, 2003) and was added to the new ethical application. This additional interview provided temporal distance, enabling reflection on pre-understandings and prejudices and modification of participant interpretations and understandings (Gadamer, 2013).

3.11 Summary

This research utilised the work of Gadamer (2013), in hermeneutic phenomenology, to explore the perceptions of five purposively sampled Science teachers, working in a low social mobility area. Data were generated over an academic year (September 2022 to July 2023), using a questionnaire, reflective diaries, semi-structured interviews, and a focus group interview, providing both qualitative insights and triangulation.

Pen portraits were constructed and validated with participants, addressing ethical considerations. Analysis employed Gadamer's philosophies and was guided by the framework suggested by Alsaigh and Coyne (2021), incorporating researcher reflexivity, and organised into themes using NVivo12 (Jackson and Bazeley, 2019). Themes were developed, using participants' words (Appendix 15), and linked to the research questions and Bourdieu's concepts (Bourdieu and Passeron, 1977; Bourdieu, 1984, 1986).

Chapter 4 Findings

4.1 Introduction

This chapter opens with an overview of the participants' backgrounds (complete pen portraits can be found in Appendix 14). It then continues by presenting the findings of the study organised in three sections, covering the four main themes. The first section encompasses the first theme, focusing on the participants' perceptions of the Linear Curriculum, capturing the teachers' initial perceptions, how it was developed, its benefits, limitations, and further development, and addresses RQ1. The second section covers the second two themes, the teachers' impact on the development of the Linear Curriculum and the relationships between the teacher, the Linear Curriculum, and the student. This section captures teachers' perceptions of science identity and cultural capital, how they perceive these are displayed in themselves and their students, and the extent to which the Linear Curriculum develops these and addresses RQ2 and RQ3. The final section incorporates the last theme, of the impact of curriculum development on the teacher, capturing how teachers see themselves, relationships between teachers and in the classroom, external pressures, and inner quarrels and considers aspects of RQ2 and RQ4.

4.2 Participant Pen Portraits

This hermeneutic study used a multi-methods approach comprising a questionnaire, diary entries, semi-structured interviews, and a focus group interview (Chapter 3.7.3) with five participants: Emma, Jim, Laura, Max, and Robert. The names are pseudonyms chosen by the participants to protect their identity. Table 3.1 provides a summary of the demographic characteristics of the five participants. Using data generated through each stage of data generation, an overview in the format of a pen portrait was composed for each of the participants (Appendix 14). Sheard and Marsh (2019) described the use of pen portraits as a useful framework enabling analysis from multiple sources. A summary of each of the pen portraits follows.

4.2.1 Emma

Emma has taught secondary science for her whole working and teaching life. She is an experienced, energetic, and passionate teacher. Throughout her long career, Emma

has participated in CPD and achieved qualifications, both academic and vocational, to improve her understanding of teaching and learning and her leadership skills. As a professional, she sees CPD as an essential feature of her teaching career, keeping abreast of the latest research. As such, Emma reads educational texts in her own time and attends the school Book Club to share ideas from chosen educational texts. She sees herself as a reflective and adaptive teacher and has the confidence to trial systems she has read about to help improve her teaching skills. Having not achieved the 11-plus examination, Emma completed her education at her local comprehensive school rather than the grammar school she had been expected to attend by her parents. This in part acted as a driver in her teaching role, and she endeavours to provide her students with the best outcomes.

4.2.2 Jim

Jim worked in industry before entering the teaching profession. He is an experienced and reflective teacher, and having achieved a vocational qualification in middle leadership, he moved into a middle leader role some years ago. He is considered in all his responses and enjoys the challenges involved in teaching. He is proactive in adapting his lessons and continually works to improve his teaching and the learning opportunities for his students. Throughout this research and data generation, Jim described how he researched topics to assist his understanding of the terms used and then examined how he approached his teaching. Jim perceived that when in secondary school he was more successful in science. This success led to his enjoyment of the subject. Jim considered his parents and family to be 'sciencey,' but he considered only himself and one sibling as a scientist.

4.2.3 Laura

Laura has taught for between five and ten years, so may be considered experienced, but has not experienced teaching during curriculum reform. She entered the teaching profession straight from university after graduating with a science degree. She has completed a vocational qualification and currently works as a middle leader in the school. Despite considering herself a 'nerd,' a term she uses interchangeably and meaning possessing a science identity, she does not consider herself a scientist because she perceives a scientist practises science rather than just teaching it. In her classroom, she believes it is important to develop relationships to help engagement,

which she considers is required to improve science identity and gain knowledge. Laura is very passionate about developing confidence in students, which stems from her regret of not following her dream of studying Physics, which she thought she would fail. Laura became interested in science from an early age when her parents bought her encyclopaedias to read when she showed no interest in reading storybooks.

4.2.4 Max

Max came straight into teaching after graduating with a Master's degree and following the successful completion of a postgraduate teacher training course. During the interviews, Max pauses and thinks before he presents his answers, and although his relatively short teaching experience is sometimes evident, he appears conversant with teaching and learning strategies. Max is very passionate about teaching and passing on his love of learning to his students. Max recalls always enjoying science at school but cannot identify a single point at which he decided he wanted to continue down that route. Max does not associate his interest in science with a particular event but recalls enjoying science lessons at school and being successful. Although neither of his parents were in a science job or were particularly science-minded, they supported Max in his interests by buying him science-based books.

4.2.5 Robert

Robert worked for a few years as an unskilled labourer, followed by a year as an accountant before entering the teaching profession. He is an experienced and confident teacher and enjoys his time in lessons, building relationships with his students and helping them to make progress whilst enjoying science. He achieved a vocational qualification during his time working in middle leadership and reflected on how he enjoyed his earlier middle leader role and is now more focused on what happens inside his classroom. Robert recalls enjoying science in his young years in the family home, where he recalls watching nature programmes and subscribing to 'New Scientist' magazine. While having a natural enjoyment of science, Robert recalls considering moving into science because of potential future career prospects.

4.3 Teachers' Narratives Around the Linear Curriculum

This section provides a backdrop for this research on how the Linear Curriculum was developed. It then tracks how teachers used the curriculum, their perceptions of it,

and its continued development. Responses in the questionnaire (identified as QA) and the diary entries (identified as DE) were clarified in the initial semi-structured interview (identified as SSI) and in the focus group interview (identified as FG) (Chapter 3.7.3, Appendix 8, 10, 13).

4.3.1 Initial Development and Perceptions of the Linear Curriculum

Following the Ofsted consultation of the new inspection framework, *EIF* (2019b), schools were prompted to look at their curriculum offer. Before examining the participants' perceptions of the Linear Curriculum, it is important to consider their perceptions of what a curriculum is. Emma explains how the participants considered the curriculum to be a plan of what was taught and when across all three science subjects and across the five years of secondary education:

> It tells us what we teach, and it develops from Y7 right the way through to Y11, and it covers every topic that it can possibly cover in science, from Biology to Chemistry to Physics. (SSI: Emma)

The incorporation of content from all three science subjects in the curriculum plan in itself ensured the curriculum remained 'broad and balanced' (Chapter 2.3.2). However, alongside issues of retention to further education in the sciences, there was the additional requirement that the curriculum needed to provide students with the 'cultural capital they need to succeed in life' (2019b, p.9). This provided the starting point for the department to look at its curriculum offer and led to the development of its Linear Curriculum. While bearing in mind the constraints of the specifications available to teach, one of the first decisions the department had to make was to consider incorporating content from either the Combined Science or the Triple Award route. There were no constraints set on the department by the school Principal, and through professional conversations, a decision was made to develop a curriculum encompassing all the content any student would need to provide them with the opportunity to take the Triple GCSE examinations in Y11. The incorporation of the Triple Science content for all students was determined by the participants to be essential in providing equal opportunities for all and as a means of, to some extent, providing a socially just curriculum, as explained by Jim:

> Teaching them all Triple, so they all have the same experiences regardless of their context . . . we're trying to give them the best experiences we can give them regardless of their context. (SSI: Jim)

Emma furthered the need for a curriculum that was not only for every child but also stood out against the curricula offered by other schools, mentioning particularly 'private' schools, where there was an assumption that Triple Science is taught as the norm:

> We teach Triple right the way through to Y11 . . . every student has access to the same as what you would if you were in a private school, the school down the road, the school next door, or the school down South. You have all got the same entitlement and the same access. (SSI: Emma)

This was the beginning of the immersion of the driver through which the curriculum was borne, with equity and social justice at its heart. Once the decision was made on what to teach, the task of designing a curriculum that all staff could work with began. Robert described how the department worked together in the early stages as they developed a structure for the curriculum and highlighted the importance of conversation and dialogue between colleagues:

> I would say it was very much a team effort. It brought lots of different ideas together from different places . . . it was very much a cooperative project. I remember a huge poster where we jumbled up the scheme of work and things [*National Curriculum*] and put them out. (SSI: Robert)

Emma concurred and extended the description of how topics were mapped across the curriculum with an example:

> We sat down and discussed it at length. We all had different viewpoints at the time I remember. I remember getting the KS3 and KS4 *National Curriculum* and snipping it all up, and it was a very visual way we did it, where we laid it all out and made it fit . . . and where we looked at themes going through. So, we said "Right, cells" and put all the cell stuff together but then we said "Right, we'll do it into Years 7, 8, 9, 10," and we have the themes running through. And we sat around with this huge piece of paper and pieced it all together, and then where

> things didn't fit, we could then make them fit or see the overall pattern of where we thought they fitted better.' (SSI: Emma)

Emma explained here how concepts were grouped in what the participants referred to as 'themes' and how these were mapped across the age range, matching their conceptual difficulty with the year group to be taught. Emma highlighted 'we discussed at length' and 'we all had different viewpoints' which could arguably suggest there were potential disagreements of where each topic fitted best within the visual project used to organise topics. They also elicit how the curriculum was not considered complete with Robert's comment, 'when there's been a problem,' and teachers have reflected on the topics and where they fit best in the plan. Max was not involved in the original organisation and development of the Linear Curriculum and succinctly described his perceptions of the rationale used in its development, highlighting how it builds on concepts taught in previous years, gradually developing the complexity:

> I understand the idea that it develops through the five years: we build on what was covered in Y7. So, we start off carrying on from the primary school stuff that they would have seen, then building on their prior knowledge. And it is building and building up as you go through the school. (SSI: Max)

This highlights how the participants carefully considered the order topics were to be taught, ensuring each concept developed gradually and students had the prerequisite knowledge for the concept being taught. Furthermore, in the questionnaire, all the teachers agreed they thought the Linear Curriculum was different from any other curriculum model from which they had taught. However, while recognising the Linear Curriculum was different, Laura questioned the rationale behind its development and was unclear about the need for change, stating:

> I ticked 'neither agree nor disagree' because that's just me not 'asking' the right questions, 'just doing' if that makes sense. So, no, I wouldn't know why we would do it this way rather than just teaching in 'blocks' as we used to. (SSI: Laura)

This highlights Laura's feelings of detachment from the curriculum design process and hints at a wider issue around professional agency. She also makes an important point

about change for change's sake. Her statement suggests she perceives a lack of autonomy, agency and professionalism in decision-making regarding the curriculum, with her comments about her 'not asking the right questions' implying she was not actively involved in the decision-making process. However, despite her reservations, she agreed with all the other participants in the questionnaire, that the Linear Curriculum had more positive attributes than negatives (Chapters 4.3.2 and 4.3.3). Similarly, Jim indicated he did not recognise any advantage in developing the Linear Curriculum as opposed to previous curriculum models based on each Key Stage (KS3 and KS4) built around each of the *National Curriculum* requirements and taught in the order dictated by examination board specifications and how by moving topics out of order potentially gave rise to different problems:

> . . . because there are some topics, and we've discussed this; there are some topics that are too challenging or difficult to teach in KS3 to the level needed at GCSE . . . I'm fully onboard and understand how it is much better because we've had to filter things down. (SSI: Jim)

These concerns around the challenge offered by certain topics were exemplified by Jim using an example of how he thought teaching topics in the order set out in the *National Curriculum per se* was a better model for teaching more complex concepts. Jim used the example of teaching an atoms topic to Y7 students, which in itself had been determined to work well. However, when the topic was extended into more challenging explanations of how atomic structures were determined experimentally, Jim recognised the teaching required knowledge beyond the age of the recipients:

> What sprung to mind is the atoms model we teach in Y7, and some of the experiments we do are quite difficult, even at GCSE. Some things were done better in the previous model because we could teach at a higher level. (SSI: Jim)

Jim's observation reveals the tension between curriculum sequencing and age-appropriate conceptual difficulty, highlighting an area for possible realignment. He acknowledged these concepts as being difficult, even at the GCSE level, highlighting their misplacement in a Y7 curriculum. Robert had similar reservations and touched on this in the initial interview. His focus linked the conceptual difficulty of some topics and

their associated equally difficult assessment criteria. He identified how this mismatch presented particular difficulty in producing age-sensitive assessment material:

> I'm not quite happy with how we are assessing because, although I think the delivery of the content to Y7 is OK, I don't think we have brought the level of the assessment down to something they can cope with. The language is too hard in our assessments. A couple of them wrote in the Y8 assessment this week, 'I don't understand the question.' (SSI: Robert)

These early concerns about the quality of assessments were furthered in the focus group interview when Robert also shared his concerns about not developing students' knowledge to the depth required in the external examinations and potentially not providing them with the socially just curriculum that was intended:

> I was also a bit concerned about the fact that some of the stuff that would have been in Y10 might have ended up in Y7 and Y8 now. Not only is it done early and never returned to in some cases, but because it's being done by children who are perhaps two or three years younger than would previously have been our audience for that topic that it's, I hesitate using the word 'dumbed-down,' so should I say simplified, we don't go as deep, we don't stretch them as much as we would have done with the same topic if they were older. (FG: Robert)

Robert made important points here about the over-simplification of difficult concepts, perhaps highlighting the difficulties encountered when teaching topics to different and sometimes younger groups of students. However, despite these initial reservations, all the participants viewed the Linear Curriculum in a positive light and acknowledged it was a working document that required further developments, as explained in the following sections.

4.3.2 Positives of the Linear Curriculum

Max (SSI) described the Linear Curriculum as being "really well structured" and "definitely a lot better than previous [curriculum plans]" from which he had taught. Jim (SSI) described it as "a challenging, high-quality curriculum." When asked what she liked about the curriculum, Laura explained it in terms of how content was organised to gradually build in conceptual difficulty:

> I love how it kind of builds . . . key stuff and then it builds into more difficult tasks . . . I like that building up of skills . . . really helpful in terms of building that knowledge. (SSI: Laura)

While Laura explains how the structure of the Linear Curriculum was developed, Emma (SSI) further explained "It flows," and Max (SSI) added, "It's almost like a story." These quotes provide a very positive impression of how the participants viewed their curriculum model, with the word 'story' reinforcing the perception of coherences and continuity, highlighting how participants view sequencing as key to student engagement. The next part of this section will examine these points in more detail.

The Linear Curriculum was developed to gradually increase the complexity of concepts. Here Laura explains how skills are developed throughout the curriculum and uses as an example, the forces topic to describe how it is developed through the Linear Curriculum:

> I like that building up of skills. I think it works well for some topics . . . so for electricity, we start off with basics and then it gets harder, and it gets more difficult. And forces, so you start off with a really simple "What is a force?" "What's a resultant force?" and then you end with your scale diagrams . . . it gets difficult at the end. (SSI: Laura)

Laura's description reflects her appreciation for the curriculum's structured progression, particularly in how it scaffolds complexity in challenging topics. Her comment highlights how skills are also developed through the curriculum. Max further explained how topics were organised and exhibited the positive attributes this has in the classroom:

> I think if they are getting the foundations early and then they can see each year how they're progressing . . . and I've been in classrooms sometimes when they've been starting a new topic, for example, 'Using equations' in Y8, and we get to a point in that topic and they are like, "Yeah, we've seen this 'PEN,' we remember proton, electron, neutron, we've seen this in Y7," and then we build on it and they can progress from there. (SSI: Max)

This demonstrates how teachers used this sequencing to ensure progress within lessons. This gradual building of difficulty was planned from the outset, and through reflection and conversation, the department agreed and chose what they considered the best route through the concepts. Robert (SSI) reinforced this when he explained how he tells his students, “Every single one of you needs to learn this,” when he comes to a concept, he knows future work will depend upon it. This quote demonstrates Robert’s awareness of curriculum sequencing and how essential knowledge scaffolds future learning, underscoring the curriculum’s design rationale. As the topics develop across and through the years, it is essential to keep the challenge at the correct level to ensure continued engagement. This will be examined further in Chapter 5.4. In the questionnaire, all participants agreed the curriculum was both challenging and engaging. During the semi-structured interviews, participants were asked to explain how they perceived challenge was injected into the curriculum. Emma explained how the group considered where they perceived the challenge was best placed and were not led by other curriculum plans, where any difficult topics were left until later in the curriculum:

> I think we do an amazing curriculum here where we throw in challenges across all the topics, where it fits, from Y7 right the way through to Y11; we don't say “Oh, that's hard; we’ll leave it until Y11.” (SSI: Emma)

Nevertheless, whilst acknowledging the importance of adding challenge across the curriculum, Jim also explained the importance of ensuring the level of challenge matched the ability of the students:

> The challenge has to be not too challenging. It's hard to get the level right because obviously making it too challenging and they don't like something they perceive as being too difficult. (SSI: Jim)

Since one of the aims of the Linear Curriculum was to improve engagement, the level of challenge, as identified by Jim, was also an important consideration. Max (SSI) commented on how “people get put off” when the challenge is too high or content is inaccessible, which all the participants agreed was a challenge of teaching itself. Students asking, “Why do I have to learn this?” (SSI: Laura) is often followed by low motivation and results in students “who don’t do anything after they’ve left the

classroom" (SSI: Robert). Emma (SSI) described instances when students "don't want to be there" and then disrupt the learning of others with poor behaviour. All the participants mentioned engagement as being important within their classrooms and in their teaching. In terms of the Linear Curriculum model, Emma described how she believed the previous KS3 and KS4 curriculum models actively disengaged students through the repetition of content as opposed to the Linear Curriculum model, where the difficulty gradually increased and new knowledge was built on prior knowledge without repetition. Robert also mentioned disengagement when concepts and topics become "harder," however, he does not see this as a reflection on any "particular curriculum model" and linked it to the resilience of the students and their differing abilities and interests in science.

As part of the curriculum development, the department made booklet resources, which they used to deliver the curriculum in lessons. Despite the curriculum being the plan of what was to be taught when, and booklets being a resource produced for the pupils to use in lessons, throughout the data participants used the terms 'curriculum' and 'booklets' interchangeably, so it is worth looking at their perceptions of their booklet resources. Emma described how the department developed booklet resources to use alongside their Linear Curriculum to support students through the content, with the addition of 'knowledge organisers' to support students who found science challenging, providing them with a summary of new content and key terms. Laura agreed the booklets followed the curriculum, highlighting required prior knowledge and developing conceptual difficulty, which she thought helped to develop confidence in students as they had a resource to hand that they could refer to when they needed support. However, she also commented on the difficulty of using resources and booklets developed by other teachers. She described how she perceived them as being "restrictive," and she found they hindered her teaching style. Emma concurred with the importance of quality resources and depicted how "a brilliant five-year curriculum but with awful resources . . . wouldn't be delivered to build a better scientist." The quality of the resources themselves falls outside the scope of this research and will only be considered in relation to how participants use the term as a substitute for curriculum.

4.3.3 Limitations and Further Development of the Linear Curriculum

Despite the curriculum being designed to build in difficulty, there were sections within the curriculum plan that were considered to not do this. Laura described how some of the physics topics appeared to be stand-a-lone and, as such, did not develop conceptual difficulty and were not built on prior knowledge:

> Topics such as radiation I feel are more blocked, so you've got a topic on light, and then you've got a topic on nuclear radiation, which can't be broken down the same way. So, it's taught as a block. So, I think it's a mix; some topics work well, and some topics are a bit more 'blocky.' (SSI: Laura)

Laura highlighted topics in the curriculum that had not been developed to the same extent as other topics. This lack of development appeared to hinder the teaching of these concepts. However, she concluded this was an issue of the subject matter rather than the model on which the Linear Curriculum was built. However, Jim identified that despite the development of the Linear Curriculum being based on the principle of building on prior knowledge, there were still sections of the curriculum where this did not occur. This raised the question of whether some sections of the curriculum had not been reviewed and developed as much as others, potentially due to differences in teacher experiences of curriculum development.

Jim returned to the topic of 'prior knowledge' on several occasions. Whilst he recognised this was an important aspect of the curriculum, he was also aware this was lacking in some areas and described how the department was currently "back-tracking," adding the required content to lessons, making them more accessible to the students. Later in the data generation process, Jim returned to this topic when asked about the curriculum being linear in nature, and topics moved from KS4 to KS3. He now seemed more satisfied with the plan and saw the prior knowledge as a means of ensuring topics were revisited throughout the curriculum without the need to repeat them as mentioned by Emma previously. This also seemed to satisfy Laura and Max, who both expressed concerns about students 'forgetting' content if it was not revisited. Emma and Jim agreed it was an important next step to make the required prior knowledge more explicit in the curriculum when reflecting on their teaching throughout the year.

Interestingly, in the focus group interview, Laura raised concerns about certain aspects of the curriculum where she perceived prior knowledge could not be added, which also meant topics were not revisited at any point. However, discussion of this led to the identification of topics that participants considered were not being taught at the correct point in the curriculum and were being taught too early, before students had the prerequisite knowledge to understand the concept. The conversation that ensued discussed making the 'linking' of topics more explicit in the curriculum to help students develop their learning. However, when students were exposed to content above their years, participants perceived the implications moved beyond not understanding that one lesson, and Emma explained how during her teaching she realised aspects of the curriculum plan had failed in this. She noted a specific example she had taught, stem cells, and explained that if students did not have the required foundational knowledge, they would fail to understand and then they would be unable to answer higher-level questions later in their educational journey:

> We've done stem cells, and I don't think that their understanding is there yet in Y7 to fully understand it. Not enough for a Grade 9 in Y11, so it's a topic that I'd like to revise and come back to in Y11. (SSI: Emma)

Sequencing issues, such as this highlighted by Emma, appeared at points throughout the data. In the initial questionnaire, Max identified he could neither agree nor disagree whether the curriculum would have issues with content in the wrong place because he had "not taught the full curriculum yet" (SSI: Max), and so he found he "couldn't comment really" when the point of curriculum improvement was addressed in the semi-structured interview. However, in the focus group interview, Max modified his observation, explaining how "moving stuff, the little bit's where the challenge might be a little bit too much for the year that it is currently in," as a way of improving the curriculum model. Jim also acknowledged the curriculum rigour, there were "some quite challenging topics that we had moved down and . . . moved them up again." Despite the concerns of topics not being in the correct teaching order, Emma recognised mistakes had been made and identified how the department was "not afraid to re-juggle and move slightly and make tweaks and amends if we think it could be taught slightly differently or in a different order."

Different concerns were raised when the participants were asked whether the Linear Curriculum was suitable for all students. Jim expressed his concern for a particular group of students within the school who were taught separately from the main population. He described these students in his diary entries as having issues regarding poor attendance and some having specific learning needs. However, despite his reservations, he described how, as a teacher, he overcame these barriers by using concrete examples, making the topics relevant to the students. Emma also worried about the suitability of the curriculum for all, and raised concerns about teaching Triple content to Y11 students after the point in the year when they had been entered for their external GCSE examinations:

> Particularly in Y11 at the minute, where some students are maybe a grade 3 or 4, and you want them to be 4 or 5 for college. And we're teaching them some Triple stuff. And I'm thinking they're probably going to be [Combined Science] foundation students. (SSI: Emma)

This concern of not providing students with the best curriculum is partly linked to professionalism, highlighting the tensions between inclusion and exam-focused performativity, and is examined further in Chapter 4.5.2, and partly linked back to the problems already identified in content sequencing. Additionally, concerns were raised about the order of teaching the Linear Curriculum compared to published resources, particularly in terms of revision guides that students used to prepare for their GCSE examinations. In the Focus Group interview, the participants discussed these issues, with Emma sharing what she initially perceived as a potential problem of the Linear Curriculum sequencing:

> Possibly a daft one I came across, more this year, was revision material because revision material in terms of the revision guide has a specific order. Whereas we say, "We did that in Y7," "Is that Paper 1 or is it Paper 2?" So, our stuff didn't match the revision guides, but it wasn't a 'problem,' you just had to be aware of that. (FG: Emma)

The identification of how the Linear Curriculum was different from all other curriculum plans in terms of sequencing highlighted a major difference in its structure when compared to curricula models based on sequencing directly from the *National*

Curriculum. This initiated a conversation in the focus group interview, which was interesting because it reflected the journey the teachers had experienced during the development and implementation of the Linear Curriculum. They were working together to identify and resolve issues. Jim noted the problems faced by students as they moved into the traditional KS4 years, in knowing which topics were examined in the two papers at the GCSE level:

> I think from the pupils' point of view as well, at the start of Y10, Y11, and they don't know what they need to know for the exams, because obviously, we teach KS4 material throughout the 5-year curriculum. It makes it harder. (FG: Jim)

Whilst the participants had previously agreed about the positive attributes offered in teaching from the Linear Curriculum, here Jim noted how its organisation was potentially detrimental for the students, particularly when preparing for their external examinations. Similarly, Emma identified issues when new students joined the school and Jim acknowledged this seemed to be an increasing problem. However, Laura noted that the inclusion of prior knowledge was of even greater importance here and offered support to students, particularly for those who may have not been taught the same foundational knowledge.

Despite these concerns, the participants did not indicate any thoughts about changing the order of the content taught, to simply satisfy a published revision guide. Continuing the theme of making the curriculum accessible to all, it was also developed to build student confidence in science, which no participant thought it would not. However, when they were asked whether they thought the curriculum allowed mastery for all students, in the questionnaire, Robert disagreed and explained how his uncertainty of the definition of 'mastery,' presented him with alternative definitions. In the context of the curriculum, which was the focus of the interview, Robert posited that mastery should be about each student achieving their potential:

> I don't think it does, no. But mastery, the definition of mastery . . . I'm not convinced we are trying to get all the students to have mastery, so can it do for each student what they need? For that, I would say "Yes." Is mastery being the best you can be? But if it's being the best anybody could be, then obviously

> most children won't do that even with the best curriculum in the world . . . I don't think that's possible. (SSI: Robert)

Robert touched on the differences between students, noting that schools were not places where all students left with the same qualifications and, as such, this was not what the Linear Curriculum was aiming to achieve. This also raised the issue and importance of differing interpretations of departmental policy as mentioned previously in Chapter 2.4.6, and the importance of shared visions within the department during curriculum development. These initial differences and concerns amongst the participants are in themselves interesting and elicit the importance of working relationships, teacher professionalism, and teamwork when developing, negotiating, and implementing a curriculum. These will be explored further in Chapter 5.7.

4.4 Teachers' Narratives of Science Identity and Cultural Capital

Participants were not provided with definitions for the concepts of science identity and cultural capital before the commencement of data generation. However, the questionnaire (Appendix 8) provided them with characteristics they could consider in relation to the terms. Some of the participants discussed how they had done their own research on the terms, particularly of cultural capital. This section explores how the participants perceived science identity and cultural capital manifest in themselves, in society, and in their students. The extent to which the Linear Curriculum provides opportunities to build science identity and cultural capital in students is also explored.

4.4.1 How do Science Teachers Understand Science Identity in Themselves?

During Emma's interview, she described herself as a 'scientist' and explained the characteristics she considered she possessed for this role. All the other participants were asked the same question to determine whether there was a consensus amongst the group. Jim also considered himself a scientist and assumed all his colleagues would also consider themselves scientists. He associated his identity with how he dealt with day-to-day problems and tasks. When reflecting, he linked his identity with success in science at secondary school, followed by his enjoyment of the subject. Similarly, Robert also perceived himself as a scientist due to the behaviours he recognised himself exhibiting, for which he coined the phrase 'methodology' and aligned with a science identity. He recalled choosing the science route in school for its perceived

rewards in the form of better career progression, but as he learnt more science content, his enjoyment of the subject also increased.

As previously mentioned, Emma considered herself a scientist due to the training she had undergone and her achievements in this area. She linked her science interests and identity to her achievement of a science-based degree, following her success and enjoyment of science while at school. Max also described himself as a scientist, justifying his science identity through his qualifications and experience of time spent in laboratories conducting his research as part of his degree studies. He explained his academic choices through his enjoyment and achievement in the sciences in secondary school.

Unlike all the other participants, Laura was adamant she was not a scientist. She believed scientists practised science, whereas she only taught it. However, she referred to herself as a "nerd" and commented on enjoying teaching "nerdy stuff." She used the word "nerd" interchangeably to be synonymous with science identity and described its characteristics as including "a love of and an interest in science and enjoyment of the subject." The following section examines the characteristics of science identity as described by the participants.

4.4.2 Teachers' Perceptions of How Science Identity Manifests in Secondary Students

Once participants had a basic understanding of what science identity was from looking within themselves, the participants were asked to describe what they saw or looked for in their students. No definitions were provided to the participants throughout the data generation period of this research since their perceptions were being sought; however, the questionnaire provided five aspects of science identity, and participants were asked to consider whether each of them was required for someone to have a high science identity. They were then asked to decide which, if any, of the points were more important than the others (Appendix 8).

All the participants agreed an interest in science was an indicator of high science identity, and four out of the five participants considered talking and reading about science were also good indicators. Whilst Jim and Laura both thought all items were of equal importance (having an interest in science, talking, and reading about science, visiting science-centred organisations, and possession of a science qualification). The

other three participants considered the most important aspect was having an interest in science, whereas the least important aspect was possession of a science qualification. These differing values will be explored further in Chapter 5.6.1.

During the initial semi-structured interview (Appendix 10), participants were asked to reflect on their diary entries (Appendix 9) and were asked to illuminate further any incidences where they considered their students gained or increased their science identity. These attributes were characterised based initially on the participants' descriptions of their own science identity. In one of his diary entries, Max identified a student he perceived to have a high science identity when during a practical session about parallel circuits, the student linked without guidance, the practical they were doing in class and household wiring. This type of behaviour was also noted by Robert, who described a similar scenario when students asked the 'right' questions and on occasion asked questions about the thing he was about to share with the class. He described how he considered this behaviour demonstrated science identity when the student linked school science to the real world:

> So, if they were asking questions that showed they were forming links . . . I think, "Yeah, you've got this; you are thinking about this in the right way, and you are starting to make the connections that I am encouraging everyone in the class to make." (SSI: Robert)

This highlights how Robert associated science identity with the cognitive processes of making links and applying knowledge, a key marker of deeper understanding. Linking school science to real-world science was also noted by Max (SSI) who described how students with a "wanting to learn about the world, being curious about how everything works" was also a characteristic he would see in students with a high science identity.

Robert (SSI) aligned science identity with 'methodology,' which he explained was "a right order in which to do things" and "if you do it the right way, it is easier." He furthered this by describing how someone with a science identity would also be able to recognise patterns and make links, as noted above. Similarly, Jim described how he perceived science identity would manifest in a certain type of behaviour when topics in which they would apply a systematic approach:

> How they approach a problem scientifically, the scientific method . . . how they gather and evaluate the evidence, and that could be researching . . . their work would be very logical, systematic. You know these are all traits . . . the qualities that scientists need. (SSI: Jim)

Jim described the logical sequencing involved when investigating and researching. Emma furthered this when she identified the use of technical language as an indicator of someone with a science identity:

> When students use language related to the topic that you're doing, I'd say that they've got good science identity, they identify maybe as a scientist, and they see themselves as a scientist. (SSI: Emma).

Emma's link to the technical language of science as a contributing factor to science identity is in contrast to Laura's much more succinct definition of science identity, which encompassed what the other participants said, as being, "enjoyment of science, doing science." She further explained the importance of "not overwhelming" the students in her diary entries in terms of student enjoyment and confidence, which she clarified when she also acknowledged the perceived and actual difficulty of science:

> I think their enjoyment of science . . . it just goes hand in hand in thinking that they can do it. So, I think it's about building confidence in the students. I think that in general it [science] is perceived . . . as a hard subject. I think back to my experience. I didn't take Physics as a degree because I thought I'd fail, because I thought it was going to be too hard. So, I want to build confidence in students. (SSI: Laura)

Based on her own experience of lacking confidence in studying a subject she enjoyed, Laura recognises the importance of providing opportunities for students to develop confidence in the subject. Moreover, Robert (SSI) noted those with a science identity probably enjoyed science more because they had those "lightbulb" moments, they understood, and they could make the links. He also commented on how he believed these students would also see themselves as being "rather clever." Robert furthered this to identify this type of student as a potential A-level (Advanced Level) student, distinguishing between a student who worked hard and was good at science and a

student who enjoyed science because they were a good scientist and probably possessed more science identity. Max (SSI) also commented about enjoyment in the lesson being an important aspect of the desire to learn more.

Jim (SSI) described what he believed was a change in his students' science identity when they made an outward show of understanding, "Oh, I can do that" and "I understood that lesson." He recognised some students found science difficult and identified how it may take several lessons before they developed the required knowledge. He described how these individual pieces of knowledge provided the students with "building blocks" on which they could develop their science identity.

Laura (SSI) described how she perceived students would feel more confident in science when they were achieving and feeling success. Max (SSI) concurred, emphasising the significance of enjoyment and success in the classroom as key factors in the development of a science identity. Arguably linking to comments made by Robert (Chapter 4.3.3) about differing expectations of 'mastery' and the levels to which the Linear Curriculum provides this, Emma linked differing levels of success for students in terms of the grades achieved, recognising success is not always measured in high grades but also in improvement:

> I think in this world, you know the grade 9's, 8's, 7's; they see that they're high achievers; maybe that's easier for them to gain science identity. I've got some students now in Y11 that just had some grades given back to them, and they say, "Well, last year I was only a 3, but this year I'm a 4-5 and I'm getting better," and they think they're better scientists because they're making progress. So, it doesn't always have to be the higher grades. (SSI: Emma)

Emma adds to the characteristics of science identity and links it not only to those who achieved the highest grades, but also to those making progress, also noting that students need to know where they are coming from, and all levels of progress should be celebrated. Along with confidence and success, student engagement with lessons also features throughout the data as an important aspect of learning and progress. Student engagement was linked to the relevance of the curriculum to students' lives and through their relationships with teachers and pedagogies employed in the classroom. In his diary reflections, Max discussed how he believed engagement within

the classroom was one of the most important features of the lesson, to prevent "off-task behaviour" and to increase interest, which he then linked with student progress. Throughout his reflections, he described the use of a variety of pedagogies to "engage" his students, as did Laura, including modelling, undertaking practical activities, and the use of mini-whiteboards and class quizzes. Jim also described engagement in his diary reflections and linked this to bringing relatable real-life scenarios into the classroom. Robert explained the importance of engagement in his early diary reflections, where students had perhaps been disengaged during the earlier stages of a topic and then fell further behind others as the topic progressed and increased in difficulty, the initial disengagement causing further disengagement. Furthermore, Emma (SSI) linked engagement in her classroom with students having an interest in the topic, and she explained how progress in the subject further enhanced engagement. She described how working with students individually helped them improve their engagement, which also improved their science identity. Jim described a lesson where he believed the engagement of the students improved their understanding of the topic, although he notes the engagement came from his teaching rather than from the curriculum topic:

> Probably better engagement because I sold it almost as a competition to see "who can do this the best . . . take out the lens without damaging the lens, the iris, which is really hard to do because it all folds up, the optic nerve." The boys quite liked the competitive element, and a lot of the girls did as well. (SSI: Jim)

However, by adding the competitive element to his teaching, Jim perceived the students' engagement then led to an increase in their knowledge, a better link between school science and real life and a better understanding:

> I think they achieved a good understanding of what different parts look like in the eye, linking the lesson to the diagram, which looks nothing like the eye in real life, does it? But hopefully, they had a good understanding of where those bits fit in and the reality of what it is actually like, what it feels like, the different parts. (SSI: Jim)

The practical element of the lesson perhaps allowed the students to participate in their own learning. Emma (SSI) built on this idea when she described how students always asked, "Are we doing a practical?" which she perceived always improved engagement.

Alongside wearing safety goggles, Emma described how the students seemed to then identify as 'being a scientist,' becoming motivated and excited to learn science. Emma furthered this when she described how completing practical work brought scientific content to life, both linking to an increased science identity. Max (SSI) agreed with Emma and found, that through using modelling or whole class practical's, concepts could be brought to life for students, which helped to make their encounters more interesting and made science more relatable. Max (SSI) described the engagement of his class when he performed a lung dissection demonstration through the many topic-related questions they asked. However, he clarified his positioning regarding practical sessions and stressed the importance of them being a teaching opportunity and not just "playtime" for the students.

Emma described a moment in her teaching where she modelled a concept her students were struggling to grasp, explaining how a visual prompt helped them to understand a visually intangible abstract concept:

> When I was doing guard cells, it was just something I did by chance because they did not have a clue what a guard cell was. I did little prayer hands and opened and closed my hands, and they were, "Oh, so the stomata is like a hole" and "I get that." It was a visual little 'light bulb' moment someone just went, "Oh yeah." (SSI: Emma)

Emma then furthered this and explained how after modelling the concept she went on to do a practical session, using microscopes so that the students could then experience the concept first-hand in the 'real world.' She considered this to improve the science identity of students as they had progressed their understanding and 'they felt good about themselves because they could do it and understood the science.'

Jim described how he considered sometimes practical sessions did not provide the opportunities students needed to demonstrate or develop their scientific skills and science identity, for which he blamed a lack of teaching time:

> I think most schools are probably guilty of this; we know what the results are going to be; we put these together, and we're looking for this. When really trying to generate a scientist or science identity, we should say, "Right, you

> design your experiment, you decide what variables you are going to change, what you're going to measure, and then off you go." But obviously, we haven't got time for that, have we? That's the problem. (SSI: Jim)

This links back to the statement made earlier by Max, when practical sessions like this are perhaps not the best choice of teaching time and when students are simply told what to do and do not engage the skills the participants considered as important in developing a science identity are probably more of a 'play-time' situation. When further discussing students' understanding, Jim (SSI) described providing the "bigger picture," which he explained could potentially have opposite impacts on different students by either providing them with insight into where the topics fit into real life or if the content is too challenging or too much, it could result in "switching students off." Jim acknowledged that despite the Linear Curriculum providing some links to real life, he considered it to be an area that needed to be developed to further improve the curriculum offer. He described a lesson where he put the students in the scenario of being a surgeon when they were completing a heart dissection and explained how the link between science careers and school science appeared to have a positive impact on the students in terms of their perceptions of school science:

> I think some of those who are toying with the idea of working in the healthcare sector liked the idea, and some people who don't have any science identity, because they thought, 'I could do this as a job,' 'I understand the heart system,' 'I can do this.' How someone may use this in the wider world. It's what we are about, trying to make connections to what you're doing in the lesson to their lives; otherwise, it doesn't make any sense to them, and they don't see what the point is. (SSI: Jim)

Jim noted the connections to the wider world as being an important aspect of increasing enjoyment and engagement with science for all students. In his diary entries, Max described a lesson he taught Y8 about smoking. He considered his students to be engaged in the lesson because not only was it topical at the time, but he recognised most of the children would know somebody who smoked or had seen others smoking, and so it was a real-life situation to which they could relate. Robert (SSI) also described how, when teaching 'life cycle assessments,' in the past he would

link the lessons to real-life current crises in the world. However, he said his participation in this research made him realise that making these links more explicit in the classroom was essential to help students see the importance and relevance of the topic in their own lives.

Laura described in her diaries how students began to increase their science identity as they started to recognise the links between what they were being taught and how these related to and worked in real life. Whilst Robert (SSI) recognised the importance of including relevant real-life examples when teaching, he acknowledged that often these could not be incorporated into the curriculum because new concepts come to the market constantly. Robert reflected on his perceptions of engagement and disengagement and acknowledged that disengagement in lessons was not a "new thing" and was not a reflection of the new Linear Curriculum.

When students start to lose interest, Max (SSI) noted they also lose their science identity. Jim (SSI) explained how he believed science identity may be "fluid," when students lose identity and then regain it based on what they are learning and whether they have any understanding of the topic. In his diary entry, Jim wrote about students "establishing their identities," elaborating later (SSI) that he believed younger students had an "immature identity" that they developed as they moved through education. Emma (SSI) also described how she thought science identity could "disappear" and agreed with Jim that if students have a "knockback or a bad test and they lose confidence," it will affect their science identity. She furthered this by describing how a lack of acknowledgement of how science can be of use to them in real life or a future career could also impact their science identity.

Max (SSI) described how a science identity can be influenced from one lesson to the next, or topic by topic. However, he also described how if a student had a greater interest in one strand of science (Biology, Chemistry, or Physics), it did not matter because they still possessed a science identity. Laura emphasised how she too believed science identity could be fluid, and how it was influenced by experiences within school and the wider community:

> I think it's totally fluid. So, I think even if you had a science qualification, if you then don't keep up with reading about it and interested in watching about it on

> the telly and stuff like that, I think you can absolutely lose your science identity. (SSI: Laura)

Laura's description of identity as 'fluid' and experience-dependent reflects a view of science identity as something continually shaped by context. This perhaps suggests that despite the best efforts of teachers within schools, factors beyond the control of the school can negatively impact a student's science identity. In the final focus group interview, the participants were asked again what they thought science identity was. Although they elaborated on their initial responses, they did not change their earlier perceptions. Despite differences in their perceptions of science identity, they accepted each other's ideas and built on them to develop an overview of what they thought science identity was. These characteristics are summarised below in Table 4.1 and discussed further in Chapter 5.6.1.

4.4.3 The Extent to Which the Linear Curriculum Develops Science Identity

In the questionnaire, all the participants agreed they perceived the Linear Curriculum would improve science identity, which was explored further in the semi-structured individual interviews (Appendix 10). Emma described how she considered the incorporation of the Triple Science content in the Linear Curriculum provided a greater breadth of topics and how this would provide greater opportunities with which to engage students:

> The sheer volume of what you've got to teach, so it should grab students' attention. I mean some students will say in terms of science identity . . . "I'm really good at Biology, but not Chemistry," so they don't see themselves as being good, maybe at say a particular science, but they do see themselves good at a different science. (SSI: Emma)

Emma exhibits an awareness of differences between students and also how students do not always find all three science subjects equally interesting. Laura agreed with the vastness of the curriculum and also highlighted the academic difficulty of the subject. She explained how the Linear Curriculum helped to make the content more accessible to the students by gradually building the conceptual difficulty across and through the years, highlighting the importance of this in developing resilience, confidence, and motivation in students:

> I think that's a big barrier to our students, so they just think science is hard, but I think doing it this way [Linear Curriculum], builds their resilience. It starts off easier and then develops. So, I think the booklets do that as well. They start with lessons where they're re-capping or it's just "right, you need to learn this stuff," and it helps build confidence, and then students become more onboard; the more motivated they are, then they'll build their own science identity. (SSI: Laura)

Laura links the development of confidence with the development of science identity, and confidence coming from a curriculum that gradually builds on prior knowledge. Throughout the data generation period, Robert was the only participant who mentioned how skills were developed in the *How Science Works* section of the *National Curriculum in England*. This phrase was used pre-2016 and was replaced with *Working Scientifically* in the 2016 revision (Childs and Baird, 2020). *Working Scientifically* is also a section within the GCSE specification that details all the skills students are expected to develop and use as scientists. Robert suggested this as a starting point with which the curriculum could be improved, although he also identified areas of the curriculum that already did this in terms of how the curriculum already incorporated investigative practicals where students planned their own investigations:

> I think we cover that fairly well whenever we start talking about CID and SAM [variables] . . . It is something that we've got room for improvement because we find ourselves now, as Y11s are getting ready for their exams; it's something that we felt we needed to have intervention sessions on. (SSI: Robert)

Although Robert recognised points within the curriculum where skills were already being developed, he noted that there was a definite lack in other parts, and this was noted especially as students were preparing for their external examinations. Whilst considering the acquisition of skills as being important in developing a science identity, Robert (SSI) described how, at the beginning of the data generation period, he grappled with its definition, being unclear whether this described someone who behaved like a scientist or someone good at science. He continued to explain how he believed the curriculum itself could not necessarily enhance a science identity, and he

thought it was more linked to the person at the front of the classroom. Relationships within the classroom, teacher identity, and professionalism are explored further in Chapter 5.7.

Whilst not acknowledging any specific aspect of the Linear Curriculum that supported the development of a science identity, Emma explained how by not making students choose at an earlier age, whether they do Triple or Double Award Science, and also not selecting students, the department was preventing the possibility of damaging the students' science identity. She also described how she perceived other factors probably also influenced students' science identity, linking it to the relationship between the teacher and the student and the ethos of the department and school:

> And the five-year curriculum does give better access. But I didn't think that just a five-year curriculum itself was the reason why a student would become a better scientist. Yes, it will help, but it's also all the extra work or the way you are in the classroom, the way your department is led, and the way you share resources and ideas. (SSI: Emma)

The link made to other aspects of teaching, and the development of a science identity is an important one and is examined in Chapter 5.4. How the participants perceive the Linear Curriculum and how their teacher roles support the potential increase and gain in science identity of their students is summarised in Table 4.1.

Table 4.1: How Can Science Teachers and the Linear Curriculum Develop Science Identity?

How does the teacher help to develop science identity? • Through everything that is not in the curriculum • Use of a variety of pedagogies • Giving rewards and praise • Providing time for students to express their interests and thoughts on topics • Making lessons 'fun' • Make students feel important • Give them the skills they need to feel confident • Knowing the strengths of each child (topics/subjects) • Students do not have to choose Double or Triple Science at an early age, taking the pressure off them • Mixed ability classes provide weaker students with the capacity to develop some science identity through conversations with other students with more • Make the subject interesting by using modelling, etc.
How does the Linear Curriculum help to develop science identity? • Practical lessons • Topics related to real life and relevant • Increased engagement through incremental increases in challenge • Prior knowledge built into the learning model • No repetition of topics to prevent disengagement • Linear Curriculum is designed to build resilience

Table 4.1 illustrates how the participants perceive science identity is developed in students. It is not limited to a singular attribute, but rather to a complex mix of teacher pedagogy, relationships in the classroom, school ethos and the structure of the curriculum.

4.4.4 Definitions of Cultural Capital

In the questionnaire (Appendix 8), participants were asked whether they thought the Linear Curriculum could provide cultural capital for all students, to which they all agreed it could. So, it was pertinent to seek and determine how the participants defined and described cultural capital. None of the participants could provide a specific definition; however, their descriptions broadly fell into two groups. The first was that students should all be provided with the same opportunities in school, with Emma and Jim explaining how what the student was offered in terms of curriculum and the accompanying experiences could provide cultural capital:

> Every student, no matter from what background you are from, should have the same entitlement and the same access to the curriculum. (SSI: Emma)

> The simplest idea for me is that they all get the same experiences regardless of background, school, where they live and give them the best experiences regardless of context. (SSI: Jim)

These descriptions of what is provided for the student in the classroom differ from those offered by other participants. The second group discussed providing extra opportunities beyond the taught curriculum in terms of knowledge but outside the scope of the National Curriculum:

> For me, cultural capital just means, rather than just learning the curriculum, that you are learning a wider, more broad education on the wider world, rather than just "this is the *National Curriculum*" and learning that. (SSI: Laura)

> It's all this extra stuff that we throw in that isn't mentioned in the scheme of work that's just going to make them function better in society and give them the leg-up, the advantage in all sorts of different areas. Whether it's socially, whether it be academically, or whether it be professionally. (SSI: Robert)

Robert added an alternative view of how students could develop cultural capital, beyond the written curriculum, linking it to the attributes he deemed essential to their future lives within society. Max described how he considered he provided cultural capital to his students when he taught beyond the curriculum and used an example of a conversation he had with a student during a lesson where they discussed science-related topics the students had either experienced or had knowledge of, outside of school:

> I think it's about instilling, relating things to what they might have seen in real life. . . it's about thinking about science in their daily lives. I've had some students who ask me questions about things that they've perhaps seen on the news, things they might have even seen just on the Internet. (SSI: Max)

Max shared an example in his teaching when he had a conversation with a student about an expiry date on a piece of plastic, that the student had observed:

> I had someone ask me the other day why water bottles have an expiration date. It wasn't related to the lesson, but I thought it was quite interesting. I told

> them it's due to the plastic bottle; it's interesting, I suppose it's being curious and finding out things, relating them to real-life scenarios. (SSI: Max)

This example illustrates how incidental moments in the classroom can serve as valuable opportunities to broaden students' cultural capital, especially when they relate directly to students' lived experiences. In the focus group interview, the participants were asked again to reflect on their understanding of the concept of cultural capital. Jim and Emma referred to their previous descriptions, and Jim reiterated, "Every single student has the same opportunities and the same experiences," which Emma agreed with. Jim then furthered this and explained taking students on trips was a misconception held by some. Laura concurred her initial perceptions were unchanged and, whilst acknowledging her uncertainty, challenged the description given by Jim and Emma. Laura appeared to consider the knowledge gained from the *National Curriculum* to be separate from the cultural capital her students would potentially gain at school:

> I thought, because again, I'm not 100% sure what it means. I thought rather than it being everybody getting the same, it was that we try to make sure that the kids have more than what is the bare minimum. So, if the Government is saying that you need to teach them this, that if they are gaining cultural capital, it's because we are giving them more than the bare minimum of what we have got to teach them. (FG: Laura)

Laura indicated that she considered the Combined Science route, the minimum and expected route for the majority of students, to be the normal and somewhat limiting and through teaching content from the Triple Sciences, her students were placed in a greater position to offer them the potential to develop cultural capital. While clarifying his initial perceptions of "making sure they'd got enough to get by in life regardless of what choice they wanted to make," Robert also challenged the definitions given by both Jim and Emma because he considered that students were not equal, with some requiring more from their teachers and school than others:

> I didn't see it as they all got the same, but by necessity, those children disadvantaged by background and with parents who didn't get them to read

> and students who don't have access to books, we really have to do more for them if they are going to leave with enough. (FG: Robert)

The idea of all students not being equal through their family background led to further discussions in the focus group interview where they began to share their interpretations of how cultural capital manifests within individuals in society. The next section builds on these perceptions and explores how participants perceived they could visualise cultural capital in society and their students.

4.4.5 How Cultural Capital Manifests in Society

Linked to Robert's comment about all students not having the same start in life, Emma continued fine-tuning her understanding when she highlighted that "socioeconomic factors can disadvantage." She explained this through her perceptions of differences in experiences of those who possessed an advantageous position in terms of wealth:

> So, if you are well-travelled, speak lots of languages, eat different meals, go to different places, museums, books, read, then it will give you that background and that wealth of knowledge, more so than if you've not. (FG: Emma)

This highlighted several points the participants considered as equating to a higher cultural capital, gained from the family home. At this point, both Jim and Emma had begun to recognise that cultural capital could potentially present in different forms, and what one person recognised as a higher cultural capital was not necessarily concordant with others' beliefs. Jim described this in terms of how people perceived what was acceptable as a healthy diet:

> All students should know what's in a balanced diet and have the opportunity to have that experience, that education. But that's not the case, is it? If you go into different people's homes, they are going to have different ideas of what is healthy and what is not healthy. (FG: Jim)

Here, Jim explained how despite having the same access to the same knowledge, a student and their family may interpret that knowledge differently, depending on their circumstances. Despite her previous comments about socioeconomic factors potentially being disadvantageous, Emma noted a lack of wealth did not mean a person lacked cultural capital because "those people who don't do that [have wealth]

have got different skills that other people don't have." To explain her thoughts, Emma shared her personal experience when, as a child, she failed to achieve a place at the grammar school, that her family expected her to attend. She recalled the family consensus at the time was, "You won't do as well if you go there [secondary comprehensive], because all the 'posh' people go there [grammar school] and get better opportunities." She also described how she thought, "Uh, I'm going to the 'thick' person's school." Emma's reflection offers a powerful example of how perceived symbolic capital can be internalised and resisted, shaping both her self-concept and her professional drive to offer equitable opportunities to students. However, she highlighted the importance of her supportive family, which combined with "some very good teachers" resulted in her achieving "maybe better than what I would have done going to the grammar school." This conversation then led to a discussion of how, as a group of teachers, they perceived they increased the cultural capital of their students. Participants' understanding of cultural capital is discussed further in Chapter 5.6.2.

4.4.6 Perceptions of How the Linear Curriculum Provides Cultural Capital for Students

When considering how the Linear Curriculum itself provided opportunities for students to develop their cultural capital, Emma began by looking at how the Linear Curriculum provided the same opportunities for all students, no matter their background or previous levels of attainment and compared it to her perceptions of the curriculum offer of other schools:

> In a way that's nice, how we are doing the 'Triple,' because it isn't just for another school down the road, we are saying, "You're good enough to do that" and "You can access this here, and whether or not you choose to do it." You know, you come to our school, and you can do the same as what a private school can do, or a selective school can do." (FG: Emma)

Emma then furthered her description of the Linear Curriculum by explaining how by offering the Triple Science content to all students, they were not being labelled as good or bad scientists at an early age, when they joined the school. Emma also considered some of the interventions the department had implemented to provide all students with the same opportunities and experiences. Firstly, all students were being taught the same science curriculum, which she likened to that provided by a 'private

school' and by a 'selective school,' inferring this was the best possible curriculum pathway. When she discussed how Y7 students were not selected to study Triple Science, she was referring to the fact that the Triple Science had been made accessible to all students who could then have access to either the Combined Science or Triple Science examination route in Y11, which she explained was positive for those students who did not know what they wanted to do for a future career. Jim (FG) furthered this and arguably inferred that by providing access to Triple Science for all students, students would perceive a gain in cultural capital due to its link to higher levels of cultural capital in those students who would have previously been chosen to take that route through science:

> What we were finding was the kids who opted to do 'Triple,' the small number, were the kids already with the higher cultural capital anyway, very supportive parents... (FG: Jim)

Here Jim appears to be suggesting that providing access to Triple Science, may help to reduce the attainment gap and increase cultural capital among students who might not otherwise have been selected under previous models. The association of Triple Science with the brighter and often the more advantaged students was also picked up by Laura when she described how providing all students with access to the Triple Science content, potentially gave them greater opportunities to gain more cultural capital:

> We're not sticking to the script we are going, "OK, so you [the student] might not be doing 'Triple,' but you are going to learn Triple," and they are gaining in that way. (FG: Laura)

Laura's comment here about providing access to knowledge beyond what schools are normally expected to provide for all students supports those made previously by Emma and Jim where they explained their understanding of providing opportunities for students to develop their cultural capital as being linked to providing them all with the same content. This perhaps brings the earlier definitions together, where Laura links the gain of knowledge associated with the Triple Science GCSEs to a greater gain in cultural capital.

Laura supported the teaching of the Triple content to all and furthered its usefulness in providing the students with cultural capital by not segregating the students through restricting access to certain knowledge. “Never, ever do we say, ‘This is for Foundation, and this is for Higher,’ it’s ‘we all do this together.’” Here, Laura agreed with Emma, who in her interview had described how teaching all students the same and giving them all access to all the knowledge available prevented students from adopting the mindset of “I’m only Foundation; I must be rubbish.” Jim and Robert also agreed, acknowledging the differences in content required for the Foundation tier and the Higher tier GCSE examination entries arguably provided some students with access to more knowledge, and potentially a greater gain in cultural capital.

However, Emma (SSI) raised concerns about teaching some of the more difficult content, found in the Higher tier Triple specification, to students of lower ability because she perceived this as potentially not providing those students with any advantage and possibly disadvantaging them through overloading with unnecessary information. However, Laura (FG) disputed this and considered those students were not being “disadvantaged; they won’t get a lower grade than what they would have done.”

Max (FG) joined the conversation and suggested another intervention the department had put into place to arguably provide all students with the same opportunities and experiences was to teach students in mixed-ability groups. Both Emma and Jim (FG) agreed this had a positive influence on the students since there was no “creaming off the highest achievers” and there were no “lower ability groups” or “horrible ‘sink’ groups.” Emma and Jim explained the perceived benefits of this teaching group intervention in terms of a ‘balance’ of social and cultural capital in classrooms, which translated to calmer environments with fewer behavioural issues. Emma also described how she believed this grouping reduced conversations where students questioned their abilities, comparing themselves to other students as being intelligent or not:

> “Are we in the bright group?” “Are we in the thick group?” “What’s B4? Is that higher than B1?” You’ve got none of that. (FG: Emma)

This illustrates how mixed-ability grouping not only mitigates damaging comparisons but may also help to alleviate and potentially remove hierarchies among students, potentially supporting more inclusive classrooms. In teaching all students from the same curriculum plan, all students were treated equally. In the questionnaire, participants were asked whether they considered they could improve their students' cultural capital, to which four of the five explained why they thought this was possible. Laura and Max both explained in terms of what happens in school, linking the students' gain in cultural capital to their roles as teachers:

> Not all students have equal opportunities outside of school; we can provide the difference. (QA: Laura)

> By engaging teaching, making use of modelling, relating things to the bigger picture, promoting participation on school trips (QA: Max)

Both Laura and Max seemed to consider themselves as being central to bringing equity into the classroom and ensuring all students could access the learning materials by adapting their pedagogies. Conversely, Robert and Jim, whilst both perceiving they could improve their students' cultural capital, also linked the gain of cultural capital to experiences outside of the classroom, noting that school activities can only have a small impact on students' cultural capital:

> Although it is the student's job to do the work, it is the role of the teacher and parent to inspire and teach them the value of that work. (QA: Robert)

> Can be improved but not as much as influences at home. (QA: Jim)

Both Robert and Jim consider it is the person themselves who can determine how much cultural capital they gain through determining how much effort they want to put into gaining new knowledge and also by how much their families influence this. These points linked to how the participants ranked the importance of different influences on the child (Appendix 8, Section 4): the students themselves, the school, home influences, and the students' hobbies. Although there was no overall agreement as to which aspect was the most important for developing cultural capital, the average scores of each category revealed participants considered school (1.4) and the students themselves (2.4) to be the most important aspects in developing students' cultural

capital. Home (3.0) and hobbies (3.2) were seen on average as less important (the lower the number, the greater the perceived importance).

Although Robert agreed with this when asked about how the Linear Curriculum helped to develop cultural capital in students, he explained how some cultural capital came from home, but he furthered this by explaining the role of the school in supporting those students, where the support was not provided by the home environment:

> They'll get some at home . . . but many don't, and we know they don't. There are a lot of things that are supposed to happen at home for a lot of students that just doesn't happen. Whether it be the 'birds and the bees' talk or anything else. So as ever, we are asked to step up to the mark and fill that gap. (SSI: Robert)

Here Robert describes how he considered the basic needs of a student were not always being met by the home environment, due to the lack of shared knowledge. This highlights the importance of the teacher's role in the development of students beyond the written curriculum. The next section investigates how and to what extent the Linear Curriculum does or could provide all students with opportunities to increase their cultural capital in the science classroom.

4.4.7 The Extent to Which the Linear Curriculum Develops Cultural Capital in Students

In week 2 of his diary entries, Robert discussed how he considered the booklet resources (used synonymously to describe the Linear Curriculum) did "little for it" and contained "very little real life." He questioned himself as to whether the cultural capital in his lessons came from the 'stories' he told about his own real-life experiences and used an example of when he taught terminal velocity to a Y11 class, and his story brought a 'wow' moment to the lesson. Robert perceived students' gain in cultural capital was reliant on the "individual teaching styles and teacher's prior experience and general knowledge" and reflected on the lack of stories shared with students when he observed the lessons of his peers. He perceived opportunities to develop cultural capital in students were not explicit enough in the curriculum and concluded "it boils down to who is standing at the front," resulting in "a very different provision" in science for students. In his final diary entry, Robert described how he believed most of the booklet resources lacked opportunities to develop both science identity and

cultural capital in students, but he perceived if they were included, levels of engagement and interest in science would be improved. When asked whether these 'stories' could be added to the curriculum and shared between teachers, Robert shared an example of where he had collaborated with another teacher who had then used his 'stories' to enhance their lessons. He acknowledged there was potential for all teachers to contribute their experiences, which could then enhance the teaching skills of those lacking real-life application.

In his diary entries, Jim explained how he had started his reflections examining the impact of his practice on developing science identity and cultural capital in his students, but over time he changed his focus to reflect on the Linear Curriculum and its impact. Jim linked the gain of cultural capital in his students to their gain in knowledge, which they could then apply to their own experiences and lives, which he also noted improved their engagement in the lesson.

In the individual interview, Max noted the relationship between the teacher and student as an important factor in increasing the students' gain of cultural capital. He explained how the teacher-student interaction potentially helped the students to "feel that they are part of the class, and they want to learn, and they want to progress." He then furthered this, explaining how he believed this was "probably one of the most important things in developing cultural capital." When asked specifically about the role of the Linear Curriculum in cultural capital development, Max described how the development of knowledge from its foundations through to more difficult concepts helped to develop student confidence and helped them to progress, and through this gain in knowledge, provided students with the opportunity to gain cultural capital. He also added the importance of relating tasks to real-life scenarios and the enjoyment of the student as important factors in developing cultural capital.

In week 2 of her diary entry, Emma used examples of her teaching from the curriculum to demonstrate the importance of providing the same opportunities for all students. She described how ensuring all students took part in dissection practical sessions, including those such as the eye, only found in the Triple Science curriculum, provided them all with the same opportunities and experiences, which she believed provided cultural capital to her students. Emma extended this response in her interview to

include not only the curriculum but, in a similar way to Robert and Max, how the relationships in the classroom were also important in developing cultural capital. Linked to previous comments made by Robert (SSI) about how he perceived schools 'filled the gap" where home could not, Emma acknowledged her role in this too. When asked whether she believed the Linear Curriculum enabled the development of better scientists, she explained that providing all students access to the Triple Science content in the curriculum potentially offered students access to more cultural capital, which she linked to making them better scientists. Emma (SSI) explained by teaching all the available content, she believed the "sheer volume" would mean at some point a particular topic should "grab students' attention," which would help in developing both a science identity and gaining cultural capital. Emma also described incidences through her diary entries where she perceived her students gained cultural capital, and although the curriculum dictated what she taught, her explanations were down to her individuality and the pedagogies she had developed over time. This highlights the impact of life and professional experiences in mediating how the curriculum is enacted, particularly in terms of its capacity to support cultural capital development.

Unlike the other participants, Laura ranked home as the most important aspect of developing a child's cultural capital. She explained herself in her interview as being "biased, because her friendship group are all very sciencey, their homes are very stable, and time spent with children is seen as learning opportunities." When asked about how the curriculum builds on this in school, Laura explained the design of the Linear Curriculum, starting with simpler topics and building up to more complex concepts, helped to build student resilience, which helped to build confidence and motivation. This then led to the gain of new knowledge, which helped to build a science identity and cultural capital. Laura believed the curriculum design was important because science is often perceived as a 'hard' subject in secondary school, and this was a barrier to a lot of students. Laura also mentioned the importance of the teacher-student relationships in the classroom and the importance of appreciating what students know. She emphasised the need to use the same methods consistently as the student moved through school to continue building confidence and cultural capital.

4.5 Impact of Curriculum Development on Teachers

Throughout the data were aspects related specifically to how the teachers worked together and how the development and implementation of the Linear Curriculum affected their working conditions. In this section, teacher identity is explored as a relational and evolving sense of self, shaped by values, beliefs, and experiences in the classroom, whereas professionalism is conceptualised in terms of teachers' practice, autonomy, collaboration, and adherence to the structural and ethical responsibilities of the role.

4.5.1 Teacher Identity

Teacher identity emerged as a fluid and personal construct shaped by values, classroom experiences and engagement with curriculum change. Participants reflected on how the Linear Curriculum and their participation in this research encouraged deeper reflection of their role and impact on students' science identities.

On four occasions, three within the focus group interview, when discussing the curriculum in terms of how it developed science identity and cultural capital, Robert commented on how he perceived the person at the front of the room was best placed to provide this:

> There is only so much you can get on paper and in the booklet . . . also depends on the person at the front, what they hear, and what they get told that isn't in the booklet. Where you share your experience, and that won't be the same between each person. (FG: Robert)

Here Robert is highlighting the inconsistency that may occur in classrooms when stories are shared and move beyond the written curriculum. He links this to the experience of the teacher, which can be linked to teacher identity, agency and professionalism. The first mention of this in the focus group interview prompted a discussion about the differing skills, knowledge, and experiences of the participants. Some were very experienced and older and had experienced more than others, whereas Max was new to his teaching career, straight from university, and relatively much younger. Emma identified the skills newer teachers had on entry to the teaching profession were still valid but were not necessarily a replacement for the 'stories that pad out a scheme of work,' acknowledging these personal anecdotes and classroom

interactions helps construct identity, not only for themselves but also for their students. Jim supported this, adding newer teachers would be equipped with more up-to-date subject knowledge gained during their more recent undergraduate and postgraduate studies, alongside newer teaching and learning strategies gained through the more up-to-date teacher training programmes. Emma's identification of the importance of the newer skills brought to the classroom and Jim's comments about up-to-date subject knowledge add to the story of professional identity, partly constituted through what the teacher brings beyond the curriculum content *per se*. Emma described her early experience as a student, noting how the teachers treated her and how they behaved in the classroom:

> Why am I a scientist? Probably because of my very good science education. The teachers at the time gave me their time, the way they talk . . . I was torn between science and art. (SSI: Emma)

This highlights how past educational experiences and inspirational teachers shaped both her science and teacher identities. This reinforces the role of early influences in teacher identity formation. Similarly, she added, "I think my identity is stronger in those subjects because of the teacher," underscoring how personal experiences with role models influence professional self-concept.

Max agreed that real-life scenarios, outside of the curriculum, were easy to share between staff and then students and as such, could be added to the curriculum. However, he recognised personal experiences were not as easy to share. Despite a few reservations, Laura described how teaching with the Linear Curriculum made her feel in terms of her autonomy and professional identity:

> It feels less like we are just teaching to the test . . . it's not a tick-box exercise anymore . . . we are teaching them about science. (FG: Laura)

This shift from being a 'tick-box' exercise of relaying information to the student, reflects a broader sense of professional fulfilment, aligning with perspectives that see teacher identity as enacted through decision-making, contextual judgement, and subject enthusiasm. Laura also commented on her early interests that shaped her own identity:

> I was never much of a reader . . . I used to read the encyclopaedia regularly . . . most of the encyclopaedia is sciences. (SSI: Laura)

This demonstrates how identity is shaped by childhood experiences and personal interests. Teacher identity was also shaped through relationships with students. Emma described how inviting a reluctant student to assist at a parent event led to visible improvement in the student's confidence and self-perception as a science learner. Professional relationships with students in the classroom were also deemed important in developing student science identity. Emma described an incident where she asked a student to help at a Parents' evening event:

> I asked another student and said, "Would you like to do it?" and they were like, "Why are you asking me? I'm no good at science." They came to the evening, and they were amazing. But that then increased their science identity because they were so honoured and pleased to be asked. (SSI: Emma)

Here Emma is not only illustrating the development of science identity in her students, but also the importance of the teacher-student relationship as a part of her own identity. Similarly, Laura noted the importance of consistency in teacher-student relationships in the classroom, so that she could perform her professional role as a teacher.

However, there were aspects of the data that suggested, that through the curriculum development, teacher identity was challenged. When describing the importance of teaching skills to her students, Emma revealed aspects of the inner conflict she was experiencing, where she was questioning the type of teacher she was:

> As much as I enjoy science, and I think we should teach around the subject and teach for enjoyment . . . at the end of the day we're here to have the students pass the exams. (SSI: Emma)

This statement reveals her internal conflict, split between developing meaningful science engagement and fulfilling accountability measures, which appear to have a potentially greater impact on her decisions and identity. This is furthered by Laura (SSI) when she discussed how she believed lower ability (Foundation tier) students could potentially achieve a grade by teaching to the test, describing the students as simple

'passing exam machines' with no science identity. This again reveals the impact of the performativity measures in which teachers work in English schools. Laura went on to support the mixed ability grouping because of the potential of gain in science identity for these students when working alongside more 'academic' children who had a lot more interest in science. Here, although her previous concern was about grades and academic performance, her personal values and identity, appear to somewhat align with this situation. She concluded by asking, "Is it more important for them to gain that science identity and enjoy it, or to pass the exam?" again highlighting the inner quarrels experienced in teaching but also attempting to justify her teacher identity with the context in which she was working.

In these examples, identity is shaped by the context the social interaction and professional judgment. Teachers position themselves not only as content deliverers but as role models and facilitators of science identity in their students. The act of teaching becomes identity work. This highlights the complex interplay between systemic expectations and personal identity.

4.5.2 Teacher Agency

Following the exploration of teacher identity, it is important to now explore teacher agency, how they exercise autonomy and intentional decision-making. While identity reflects how teachers see themselves, agency is enacted through the actions they take and the influence they exert in shaping the curriculum. The findings revealed that teachers actively navigated both opportunities and constraints, demonstrating how agency was experienced and negotiated throughout the curriculum development process. Adding to this, Robert noted how despite being given the freedom and autonomy to produce a suitable curriculum, there were some constraints:

> We were under direction because we were going to have a 'through Y7-13 curriculum' and from that point on, while we might have had a few prompts from our Head of Science (SSI: Robert)

This highlights the tension between external control (the imposed curriculum) and teacher agency (the freedom to shape its implementation). Despite the initial structure, the teachers were able to exercise agency by contributing to how the curriculum was adapted and planned. This also acknowledges limits to the teachers'

autonomy, while they had freedom in some areas, there were non-negotiable aspects of the curriculum from the school leadership. Despite this, Robert acknowledges that the teachers were afforded the trust required to develop the curriculum as they saw fit and through professional conversations, changes to the design were made:

> And then really, we've been trusted at every stage to plan it out. When there's been a problem because we've decided "Yes, that's not working in Y8," it's been taken on board. (SSI: Robert)

This reinforces how professional dialogue, and collaborative reflection enabled the participants to feel heard, ultimately strengthening their agency in the curriculum design process. This reflects a key aspect of feeling empowered in their professional role. Emma supported this by stating, "We've got the booklets . . . but what you do in that room could be different" (SSI: Emma), which shows how teacher agency is enacted in the delivery of standardised content.

Throughout the data, teacher autonomy has been described by the participants, in terms of curriculum design and implementation, while also valuing the collaborative nature of curriculum development. Working and collaborating with colleagues featured throughout the data, with all the participants always referring to the work 'we' did. During the initial interviews, each participant expressed how the curriculum was developed through teamwork. This was summarised in the focus group interview when Robert recalled how the curriculum was developed by "committee" and Emma described "lots of discussions." Throughout the data, there was an acknowledgement among the participants of the differing ideas each held and the acceptance of these differences. Emma (SSI) highlighted "we all had different viewpoints at the time," and Robert described how "lots of different ideas were brought together from different places." The collaborative nature of the work the teachers did, shows how together whilst fulfilling their professional duties, they also developed their identities as a group of teachers committed to a teaching community in which they shared values and mutual respect. This collaboration was something they participated in freely and saw as part of their role and as part of who they were, identifying them as science teachers. This highlights the relational nature of agency and how shared professional identity was collectively reinforced through collaborative practices. Laura's statement,

"I feel I had complete autonomy to be able to adapt my teaching to meet the needs of the learners," is an important affirmation of individual agency within a collaborative framework. These reflections reveal how curriculum development both empowers and constrains agency, depending on teachers' perceived autonomy. How these relationships developed and worked together is discussed in Chapter 5.7.

4.5.3 Teacher Professionalism

While identity was shown to be shaped through classroom experiences, relationships, and personal values, the data also highlighted how professionalism, particularly collaboration, reflective practice, and institutional trust, supported these identity constructions. The next section explores how teachers enacted their professionalism throughout the curriculum development process.

The professionalism of the teachers in the department was consistently evident throughout the research and data generation. Participants expressed a strong sense of responsibility and trust, closely linked to the ethos and leadership of the school. Emma explicitly linked professionalism with leadership support:

> We're trusted to do it in the best professional way that we can . . . the leadership in the school allows that. (SSI: Emma)

Here Emma makes explicit how she considers the interaction between how a school is led and the ethos it has developed in allowing the teachers to be the professionals they have trained to be. Emma highlighted that even though shared resources had been developed collaboratively, she recognised teachers all had their way of teaching and were given autonomy to exercise agency and use the most appropriate pedagogies as they saw fit:

> We share the same resource; what you do in that room could be different . . . we're trusted to do it in the best professional way that we can. (SSI: Emma)

Here Emma recognises how despite their collaboration, the participants were also being trusted to adopt their professional roles and enact their teacher identities. Robert furthers this when he explains how the context within which the curriculum was defined had been predetermined, but then within those confines, the intricacies

of the curriculum had been left to the participants to use their professionalism to complete the task.

> We were steered, and we had certain rigid things that we couldn't move from, but after that, I feel that we were all involved at every stage . . . I felt we were trusted to develop that. (SSI: Robert)

In this statement, Robert demonstrates the degree to which the teachers were afforded agency and the freedom to use their professionalism in developing the curriculum. However, some limitations were noted, when Robert described the initial context of the curriculum being presented within a framework which he considered as '*a fait accompli*,' potentially representing a feeling of exclusion from the initial design. However, participants considered they had a significant input into delivery, sequencing, and resource development. This was put very succinctly by Robert, 'Co-planning, it's still our baby, and again just trusted to get it right.' This was also particularly evident in co-planning meetings, where collaboration and mutual respect were central, as explained by Robert when discussing how during the meetings he had been involved in, they began the meeting by complementing each other. "We were, 'I like your booklet,' 'Yes, I like your ...' and 'I like how you ask questions.'" Max, a newer member of staff, noted that his fresh input was valued and could result in practical adjustments to the curriculum.

> It was nice to have a fresh input in things like, "Oh yes, I found this topic quite hard to teach in this," so it gets a fresh pair of eyes on it and then we can change things around a bit. (FG: Max)

Here Max demonstrates how he was able to exercise his agency and identity as a teacher and how it was valued by colleagues. He had the confidence to critique the curriculum which he had not developed, and felt his comments were valued. Robert affirmed this ethos of mutual support when he stated, "Co-planning . . . just trusted to get it right" (SSI: Robert), while Max appreciated being welcomed into the process with his "fresh pair of eyes" (FG: Max). These quotes demonstrate how professional identity and professionalism were strengthened through collegial trust and active participation.

The capacity to exercise agency was experienced variably in the group. Laura raised a concern in the focus group interview when participants were discussing how the curriculum had been developed, highlighting how she considered that her agency and autonomy were potentially being stifled and somewhat impacting her identity:

> I sometimes think that we have no movement now we are back to, 'We do what we do.' (FG: Laura)

She described here how she considers that perhaps with the design complete, her identity and professionalism are no longer required and her role as a teacher is reduced to providing information to students in a set format. This suggests a shift from collaborative creation to compliance, highlighting the fragility of agency in tightly structured environments. Jim acknowledges these concerns and tries to somewhat appease them when he responds, "But it's still being developed; I don't think it's set in stone." Here, he is highlighting how the process of curriculum development is never complete and as such, the professionalism of teachers is continually required to ensure the curriculum always reflects the learners' needs. Reflective practice also emerged as a key component of professionalism. Laura noted how participation in the research made her more conscious of what students were gaining from lessons and provided her with an opportunity to reflect on her teaching:

> I think it did make me think more about how to build the knowledge . . . I think it improved my teaching, thinking more about my teaching and thinking more about what the students were getting out of every lesson. (SSI: Laura)

In this excerpt, Laura acknowledged the importance of reflective practice in professional development and continuous improvement, and this led to an increased awareness of and development of her pedagogical practices, making her more intentional about the learning experiences she crafted for her students. Robert also described small changes in his pedagogy, specifically when delivering skills linked to science identity and the methodology described previously (Chapter 4.4):

> In terms of teaching practice . . . I changed the way I talk about CID and SAM [variables] as a result of this research, and that was as a result of thinking about

> science identity and methodology and the right way of doing things. (SSI: Robert)

Here Robert explained, in the context of teaching about variables, how by being reflective and considering both how students learn and how he taught, he could enhance the learning experience of his students. During the second individual interview, Robert commented on the impact this research had on him:

> Taking part in this has sort of permanently changed me . . . I'm not going to totally lose this idea of thinking about cultural capital . . . also science identity. (SSI: Robert)

Robert notes here that taking part in the research process made him actively consider his teaching practices and through reflection has adapted his pedagogies, making improvements to his teaching. This suggests that professionalism is not simply defined by standards or compliance but by the willingness to engage critically with one's own practice. Jim noted how initially, when reflecting on his teaching, he was focused on the tasks he had designed and how the students responded within each lesson. However, as the weeks progressed his focus changed to how the curriculum was informing his teaching. He noted how the curriculum itself provided opportunities to increase science identity and cultural capital in his students, explaining:

> That's what's most important: the curriculum; that's driving pupils' progress. Because obviously what I do in my lesson, what you do in your lesson, and what Emma does in her lesson could be and probably is very different in terms of how you teach. Whereas the curriculum is the thing that is a common thread, isn't it? (SSI: Jim)

The significance of this excerpt lies in Jim's shift in focus from an individual lesson to a broader understanding of the role of the curriculum, highlighting how reflective practices improved his professional view of teaching. There is an acknowledgement of the central role of the curriculum in influencing teaching practices and driving student progress and outcomes and represents a more holistic view of teaching and learning in the broader context of education.

However, the development of these reflective approaches also highlighted concerns the participants had about the curriculum. Here Emma discusses her concerns about teaching irrelevant content to her students, whilst also exhibiting her professional traits of attempting to consider structural solutions:

> I just feel uncomfortable at the moment teaching them some Triple stuff when they're not understanding some of these foundation topics . . . it's not that I don't think they should have access to it; I do think they should, but maybe in Y11, I just feel easier, maybe having foundation, higher, Triple groups. (SSI: Emma)

Emma's concerns about the progression of her students are central to her role as a teacher and exhibit the professional role she is undertaking. This research provided the participants with the opportunity to reflect on their teaching, interactions within the classroom, and the learning opportunities provided by the curriculum through the completion of diary entries across the term.

4.6 Summary

The findings of this hermeneutic study provide a holistic overview of teachers' perceptions of the secondary Science Linear Curriculum they co-developed and implemented. This study revealed the complex working and interaction of a group of teachers with a range of demographics personally and professionally. While their differing viewpoints were acknowledged, they shared the target of providing their students with the best science education. The data revealed times where their identities shifted, through their role as teachers and as curriculum developers. They perceived an increase in their professionalism, through the autonomy and agency granted and the trust endowed upon them to create their curriculum model.

The participants described the curriculum as linear, as it gradually built on prior knowledge, increasing in conceptual difficulty as students moved through their education. They agreed that the high-quality curriculum, incorporating the Triple Science content, although challenging, was accessible to all students. They considered the Linear Curriculum supported the development of science identity and cultural capital in their students. They also acknowledged there were limitations in the curriculum and explained how they were addressing these.

The participant group came to a consensus on the concept of science identity, based on their characteristics, and described how this could be developed in their students. However, they struggled with the concept of cultural capital, likening it to a tangible object or experience they could provide. Despite this, they recognised an unequal distribution of cultural capital among their students, caused by factors such as home life, reading habits, and availability of enriching experiences. Additionally, SES was identified as a key factor in determining the type and quantity of cultural capital possessed. There was an acknowledgement of teachers being well placed to enhance the cultural capital of their students, through their relationships in the classroom and the use of a range of pedagogies. There was also an understanding that some students required more support than others, to enable equitable outcomes, a concept introduced in Chapter 2.5.1 and explored further in Chapter 5.6.2.

Chapter 5 Discussion

5.1 Introduction

The findings from this hermeneutic research highlight the multi-faceted considerations surrounding curriculum development as an intervention in secondary science. Although this study is rooted in the English education system, its findings contribute to a wider understanding of science curricula within the international field of science education and science curriculum development. The themes determined in this research are not confined to an English setting but align with global discussions on science identity (Vincent-Ruz and Schunn, 2018) and cultural capital (Jæger, 2011). Given the limited research involving teachers' perceptions of intervention programmes globally, this study provides important new knowledge about teachers' experiences in developing and implementing a curriculum model, the 'Linear Curriculum,' which may be used as an intervention to raise aspirations and achievement in secondary science. A hermeneutic analysis of these experiences revealed the Linear Curriculum exhibited many positive attributes, including being well-structured, progressive, challenging, and engaging. It arguably aimed to provide equality for all students, providing opportunities to increase their science identity and cultural capital. However, some limitations were determined, and ongoing dialogue and reflexivity were acknowledged as instrumental in further developing and improving the curriculum. Additionally, the depth of increased teacher agency, identity, and professionalism were found to be unexpected consequences of both the development of the Linear Curriculum and this research. This chapter considers the extent to which each of the research questions (Chapters 1.7 and 3.2) is addressed by the data through examination and discussion of each theme. It also discusses in detail the main contributions of the study findings and highlights how the knowledge gained supports or contradicts the relevant education literature.

The context of the study was based on the field of the Linear Curriculum, within which there were interactions between the teacher and the Linear Curriculum and between the teacher and the student. Additionally, professional changes in the teacher were also identified. This chapter starts with an evaluation of the Linear Curriculum model in the context of the wider field and the history of curriculum model development. It

then continues by examining each of the themes in turn. The first theme, (Table 3.3 and Figure 3.2) focuses on the benefits and limitations of the Linear Curriculum and will address RQ1. The second theme focuses on the teachers' impact on the Linear Curriculum and will examine the effect of teacher *habitus* and prejudices, addressing RQ2. The third theme examines the interaction between the Linear Curriculum, the teacher, and the student, addressing RQ3. Finally, the fourth theme of the impact of curriculum development on the teacher will examine perceived changes in their professionalism, agency and identity and will address RQ4.

5.2 Evaluation of the Linear Curriculum Model

Taba (1962, p.9) described how the 'decisions about learning experiences necessary to implement major objectives belong in the realm of curriculum design.' When considered alongside Bourdieu and Passeron's (1977) concerns about power relationships and cultural reproduction in the classroom, this reinforces the rationale for the Linear Curriculum. Its democratisation of Triple Science content maintains student progress through links to prior knowledge, without relying on a spiral structure, reducing the repetition of content and the associated potential disengagement. The teacher-led development aligns with Stenhouse's 'process' ideals, positioning teachers as curriculum developers rather than just implementers. Developed through a hybrid approach, the Linear Curriculum was designed to address equity gaps in a low SES setting, distinguishing it from other more traditional curriculum models.

The 'Linear Curriculum' was a name adopted by the participants as they developed their curriculum model. It reflected how they organised concepts within it, in sequential order in terms of conceptual difficulty. This structure resonates most closely with the one proposed by Tyler (1949) (Chapter 2.2) because of the linear progression of and organisation of the learning outcomes, choice of content and evaluation by the participants as they developed and used it. This provided consistency across classrooms and its objective mapping reduced the opportunity for gaps in knowledge, fostering progression to post-compulsory study. However, there are notable theoretical tensions between the design of the Linear Curriculum and other theorists' models. For example, the rigid and standardised structure of the Linear Curriculum

contrasts with the student-centred, flexible approach advocated by Stenhouse (1983), enabling personalised learning.

The method in which the Linear Curriculum was developed, with a bottom-up, teacher-led approach, aligns with the work of Taba (1962). This approach offers a degree of professional agency (Chapter 5.7.2), although the curriculum remained linear rather than adaptive. The student was central to the development of the Linear Curriculum which also aligns with Taba's theories. Taba noted the importance of teacher-input, in curriculum development, based on what they determined were the needs of their learners, with content organised to support learning. The desire to make the curriculum accessible to all students and build resilience and confidence also aligns with Taba's concept of a student-centred curriculum. Despite the student being central to the curriculum development, the structure of the Linear Curriculum clashes with the theories of Stenhouse (1983), due to its rigid structure. This is touched upon in the data when the restrictiveness of the curriculum is highlighted as a barrier to developing science identity in students. However, the data suggests that teachers were provided with the opportunity to express their autonomy within the classroom, in ways that best suited both the teacher and their students, aligning with Stenhouse's theories. Similarly, the continual reflections and conversations during the development of the Linear Curriculum, provided opportunities for CPD, again aligning with Stenhouse, who determined there could be no curriculum development without teacher development (Hizli Alkan and Priestley, 2019). This is discussed further in Chapter 5.7.

The Linear Curriculum was designed within the confines of the *National Curriculum in England* (DfE, 2014), so despite the drivers in its development being linked to equality, equity, and social justice, it still reflected the dominant cultural norms of the content taught, as described by Apple (2018). The *National Curriculum* is a framework in England that specifies the subjects and content that must be taught in schools. It is often central to the design of curricula and sets national expectations for students learning at various stages. As will be discussed later (Chapters 5.5 and 5.7.1), the data revealed the importance of the teacher-student classroom relationship in reducing the impact of these dominant features of the curriculum favouring those students with more dominant scientific backgrounds.

The *National Curriculum in England* has a repetitive nature, whereby key concepts are returned to in each Key Stage, with objectives determining the requirement of teaching and learning to a deeper level of understanding, mirroring Bruner's 'spiral curriculum' (Walker, 2014). Whilst the Linear Curriculum predominantly takes the stance of a progressive model, the lack of re-visiting topics was seen as a barrier to student progress. This was identified across the data and aspects of re-visiting key or 'critical' knowledge were seen as an essential addition to the Linear Curriculum. The lack of revisiting topics to a greater depth was acknowledged in the data as a potential barrier to developing student understanding as described by Bruner. This is discussed further in Chapter 5.4.

While various international models of science curricula aim to promote engagement or equity in science education, few integrate Bourdieu's cultural capital with science identity formation in a teacher-led, locally designed curriculum. This distinguishes the Linear Curriculum as both contextually responsive, responding to the students attending a school in a low SES area, and it is theoretically robust. The Linear Curriculum reflects elements of a number of different curriculum model theories as explained above, whilst still maintaining the 'broad and balanced' (Ofsted, 2019b, p.9) curriculum required by the Government. Its strengths and limitations, and the extent to which it develops science identity and cultural capital, are discussed further in this Chapter.

5.3 Introducing a New Theoretical Framework

During the analysis of the findings, a theoretical framework (Figure 5.1) was developed, combining the philosophies of Bourdieu and Gadamer (Chapters 2.5.1 and 3.6). This framework provides a structure through which interpretation takes place, and a richer understanding of the data collected is provided, allowing a critical consideration of the implications and consequences for curriculum development. Bourdieu's (1984, p.95) theoretical framework related to '[(*habitus*) (capital)] + field = practice,' intersects with this framework and helps to understand how changes in the field impact how practitioners can mediate their personal and professional *habitus* within the context of curriculum development.

The pictorial representation of this framework (Figure 5.1) represents the stages involved in Gadamer's hermeneutic interpretation and understanding, incorporating concepts associated with Bourdieu. As discussed in Chapter 3.6, the decision to use the theories of Gadamer provided a way of ethically generating research data from colleagues, reducing research bias, and supporting a subjective epistemology. The decision to incorporate Bourdieu's theories evolved early in the research process when conducting the literature review. Given the Linear Curriculum was designed to provide cultural capital to fulfil the requirements of the Ofsted *EIF* document (2019b), the incorporation of a Bourdieusian lens was deemed appropriate.

5.3.1 Creation of the Framework

This framework is an original contribution of this research, combining Bourdieu's theory of practice ([(*habitus*) (capital)] + field = practice) (Bourdieu, 1984, p.95), with Gadamer's hermeneutic circle to explore curriculum development as both a structured and interpretative process. It consists of multiple layers and concepts, which are addressed throughout this Chapter. Examination of the findings using this structure offers a novel lens through which the perspectives of participants can be understood, during the complex development of a science curriculum in secondary education and allows the data to be explored in relation to Research Question 4. While Bourdieu's concepts have been applied to education, such as Archer's concept of science capital (2010), this framework uniquely integrates these with Gadamer's hermeneutic concepts to capture how teachers' reinterpretations of curriculum change over time. The model conceptualises the dynamic interplay between Bourdieu's sociological concepts of field, *habitus*, capital and *doxa*, and Gadamer's hermeneutic philosophy, incorporating prejudice, fusion of horizons and understanding. The framework was borne out of the need to address the methodological and epistemological tensions between structure (Bourdieu; Chapter 2.5.1) and interpretation (Gadamer; Chapter 3.6) and locates symbolic power and understanding as co-constitutive within sociology.

The framework emerged iteratively, informed by the data gathered in this research, alongside the theoretical demands of linking structure and understanding. It was designed to align the differing philosophies, to help the researcher in interpreting qualitative data and potentially reducing researcher bias. It aimed to identify the situation of the participant and their context, in terms of the field in which they

considered they were positioned. It also aimed to identify the personal and professional expectations participants held for themselves and the expectations of others, seated within familial and professional traditions, impacting and shaping their situation. The establishment of this provided the context within which the analysis of data and interpretation could occur. The inclusion of reflexivity throughout the analysis process is emphasised in the framework, with its inclusion essential as part of the iterative hermeneutic cycle. The arrows indicate reflexivity is not a static concept and its consideration continues and changes throughout the analysis, negotiating intersects between social, temporal, and epistemological dimensions. Additionally, the temporal dimension encompasses how time affects interpretation and understanding, linked with the Bourdieusian concept of hysteresis, acknowledging the delay in adjustment of *habitus*, following gained new knowledge.

The centre of the framework, 'Symbolic power and understanding,' aligns with the intersection where meaning is both constructed and contested. This meaning comes through consideration of *habitus* and prejudices, *habitus* bringing the sub-conscious characteristics of an individual and prejudices, based on these, and forming the conscious pre-understanding of the context. Both *habitus* and prejudices are formed within the particular field of focus and these 'fields of tradition' are informed by the '*doxa,*' which are arguably defined by the dominant capital within the field. The identification of types and amount of capital possessed can be used to determine interactions within the field, each interaction impacting *habitus* and prejudices and overall impacting the horizon held by each participant.

The framework is displayed in Figure 5.1, and Chapter 5.3.2 explains how each of the concepts is framed and utilised in coding the data ready for analysis.

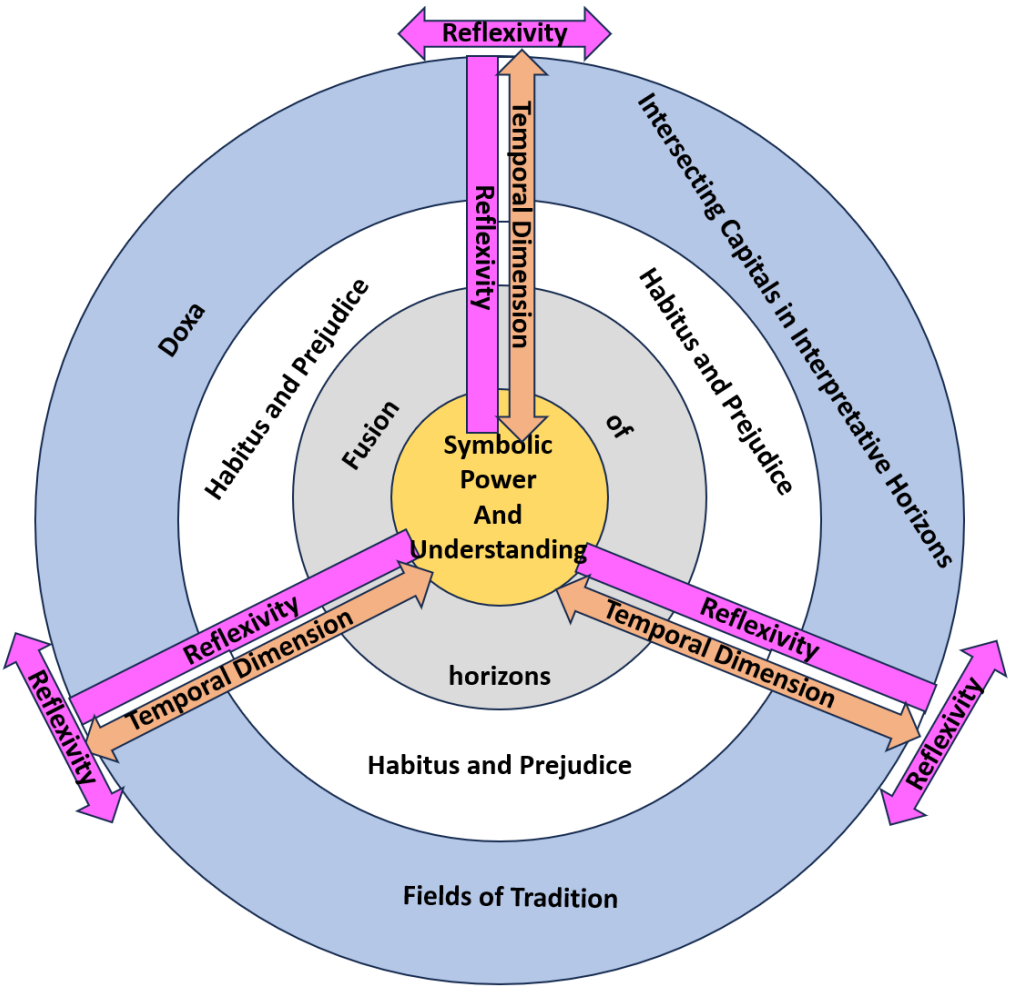


Figure 5.1: Theoretical Framework Combining the Philosophies of Bourdieu and Gadamer

5.3.2 Terms Used in the Framework

Interpretation occurs as stages in the findings are visited and revisited, interspersed by periods of reflexivity. The framework is not static and can be entered at any point in the circle, with each preceding stage informing the next as understanding develops and symbolic power is reached. Below explains how each component contributes to this process.

'Fields of Tradition' incorporates Bourdieu's concept of fields, representing distinct social spaces with their own rules and dynamics. This is extended to incorporate Gadamer's notions of tradition, whereby the cultural traditions within the field influence individuals' *habitus*, shaping their understanding. Here the data were examined for aspects of the participants' lives that had shaped their outlooks personally or professionally. For instance, social injustices and their expectations of the role of education. Data were also examined within the context of the school setting

and the expectations of how science should be taught to the majority of students, within the context of low SES, and the 'expectations' of these students.

'*Doxa*' is a Bourdieusian concept and represents the taken-for-granted beliefs of a society. These can be viewed within the context of Gadamer's notion of horizons, where *doxa* influence individuals' prejudices and contribute to the horizons within which interpretations take place, highlighting the interplay between ingrained beliefs and interpretative processes. The data were examined here from the context of the participants' lives and their experiences, but also for how they interpreted the rules encompassing their roles as both educators and curriculum developers, within the specified context.

'Intersecting Capitals in Interpretative Horizons' captures the different forms of capital (economic, social, and cultural) described by Bourdieu, which can be viewed as intersecting with Gadamer's idea of horizons. The different forms of capital contribute to individuals' interpretative horizons, influencing how they engage with and make sense of their social environments. The capitals possessed by the participants were examined through the lens of cultural, social, and economic capital. For example, within the concept of cultural capital, the institutionalised capital possessed by the participants in the form of their qualifications was explored.

'Reflexivity' is another Bourdieusian concept and incorporates Gadamer's concept of dialogical engagement. The framework encourages researchers and participants to critically examine their *habitus*, pre-understandings, prejudices, and positions in the field. This reflexive stance enhances the interpretative process and acknowledges the dynamic nature of social understanding. This concept was linked to any aspect of the data when the participants were engaging in any type of reflective behaviour, whether this resulted in either a positive or negative aspect, with opinions either being reinforced or changed, through either verbal or written dialogue.

'*Habitus* and Prejudice' are concepts of Bourdieu and Gadamer. They represent the internalised dispositions and structures that shape individuals' prejudices, which form the pre-understanding individuals bring to their interpretations. Examining the data for these characteristics depended on the interpretation of how the participants thought of themselves and also linked to their motivations within the curriculum development.

'Fusion of Horizons' is the point of shared understandings reached through interpretations, which are shaped through the temporal dimension and *hysteresis* of *habitus*. A fusion of horizons is reached following written and/or verbal dialogue and following its interpretation. A fusion of horizons was coded in the data when dialogue led to a shared understanding of a different perspective.

'Symbolic Power and Understanding' encompasses Bourdieu's concept of symbolic power, particularly linked to cultural capital, and is aligned with Gadamer's emphasis on understanding as a dialogical and interpretative process. Symbolic power influences individuals' interpretations and understanding, which yields power. Examination of the data for this aspect aimed to identify where participants had already demonstrated a 'fusion of horizons' and from that platform were able to display confidence in the role they were playing in the curriculum development. Once their understanding was established and agreed upon, they were then able to demonstrate a dominant role in the field.

'Temporal Dimension' acknowledges the importance of time in shaping interpretations through Bourdieu's concept of hysteresis, representing a delay in the adjustment of *habitus* during changing conditions, and Gadamer's temporal process of understanding. The data were examined for aspects where either thoughts or understandings remained constant or were developed, as time moved on through the data gathering period.

In alignment with Gadamer's writing (2013), meaning comes from a cycle of reading, reflection, interpretation, and researcher reflexivity, and so this model is formatted in a circle. Moreover, Fleming, Gaidys and Robb (2003) explained each stage of the hermeneutic circle may be completed simultaneously and not necessarily in sequence, and accordingly, entry into this framework may be at any point and revisited many times.

5.3.3 Purpose of the Framework in This Research

In this research, the framework provided a critical lens for analysing how participants' interpretative horizons were shaped by both their positions within the field of education and the field of curriculum development and their engagement with the research process. It allowed for a dual reading of the data by accentuating the

structural constraints which affected their social positioning, and also by engaging with dialogical emergence of reconstructed meaning through reflexive practices. By using this structure, the research findings could accommodate the production of and transformation of meaning within the complex interplay of multiple traditions, power relationships and reflexivity. The framework has the potential to offer a lens for studying teacher-led reform globally, particularly where inspection policies interact with professional autonomy.

5.4 The Strengths and Limitations of the Linear Curriculum (RQ1)

The development of the Linear Curriculum was significantly influenced by the Ofsted policies *Inspecting the Curriculum* (2019a) and the *Education Inspection Framework* (2019b), along with the requirement to ensure the curriculum remained 'broad and balanced,' equipping students with the 'cultural capital they need to succeed in life' (*ibid*., 2019b, p.9).

The avant-garde nature of the Linear Curriculum challenges the cultural tradition and disrupts the *nomos* of secondary education through the removal of distinct curricula for KS3 and KS4 and through the order of content delivery, which was acknowledged by the participants (Chapter 4.4.6). The participants described the Linear Curriculum as well-structured, progressive, and engaging, with this being attributed to providing the correct level of challenge at each stage of the curriculum. These findings align with those of Guseva and Solomonovich (2017), who examined methods of stimulating students' knowledge, by teaching new knowledge rather than spending time practising concepts students had already mastered. The participants of this research explained the importance of 'foundational knowledge' and the requirement of a scaffold using 'prior knowledge,' before developing more complex concepts, to support the students' understanding and progress. This principle, upon which the Linear Curriculum is built, appears to address the concerns raised in the policy, *Key Stage 3: The Wasted Years?* (Ofsted, 2015a), which was probably the precursor to *Inspecting the Curriculum* and the *EIF* policies (Ofsted, 2019a, 2019b), with the Linear Curriculum providing challenges throughout, in incremental and manageable steps. The provision of the appropriate level of challenge and support across the five years of secondary science education has the potential to maintain engagement and consequently enjoyment and

progress. The data demonstrate student engagement in classrooms, where the content delivered moved the students beyond the knowledge already covered and practised. However, as described by Aubrey and Riley (2019), achievement of the correct level of challenge is not always straightforward and can lead to disengagement, a concept that was also identified in the data, leading to students feeling overwhelmed and unable to 'do science.' At points where the challenge was perceived to be 'too challenging,' errors in sequencing were identified. Amanda Spielman highlighted the importance of a well-sequenced curriculum in her speech to headteachers (2020), and when reporting about issues in primary science in England, Bianchi, Whittaker and Poole (2021) also highlighted the importance of sequencing, with the lack of it resulting in limited student progression.

Perhaps the most distinctive feature of the Linear Curriculum is its Triple Science content. Specification points from the three GCSEs in Biology, Chemistry, and Physics were mapped across the five years of secondary science education, alongside the Science *National Curriculum* for KS3 and KS4, with all students regardless of ability or background, taught the same, providing them with the same opportunities and experiences. As described by Archer *et al.* (2017c, p.298), the study of Triple Science is normally linked to a select group of students achieving 'good grades' or to those described by other students as being 'brainy.' Archer *et al.* (2017c) also linked the study of Triple Science to students from socially advantaged backgrounds with the inequality of uptake in England linked to differing levels of cultural, social, and economic capital. The decision to teach all students Triple Science appears to arise from a combination of the personal experiences of the participants and their depth of knowledge and understanding of the school and students they teach (discussed in detail in Chapter 5.5). Bourdieu and Passeron (1977, p.5) described schools as places of social reproduction where 'pedagogic action seeks to reproduce the cultural arbitrary of the dominant.' Social reproduction in the classroom then leads to symbolic violence for those who do not exhibit the dominant culture within the field. Nash (2004, p.620) determined educational practices maintained inequality through the 'transmission of curriculum.' Archer *et al.* (2021), when investigating the impact of informal science education as a means of raising aspirations in young people, determined a shift in the field, challenging the dominant relationships and disrupting the *doxa*, may be a means

of reducing inequalities. Through the incorporation of the Triple Science content and changing the order of what is taught in the classroom, as seen in the research school, it can be argued this may change the conditions of the field and its associated *doxa*, potentially shifting the relationship between the dominant and subordinate cultures. Nonetheless, with the link between Triple Science and the dominant culture, it would also be pertinent to consider the possibility of this increasing symbolic violence in classrooms (Figure 5.1).

However, evidence from the data suggests this was not the landscape the participants were aiming for, and through changing the conditions of the field, they aimed to change the *doxa* to provide a more equitable experience for all students and to raise their aspirations and self-belief in their ability in science. Through changing the conditions of the field using the Linear Curriculum, the *doxa* also changed, with the entitlement of all students to study the Triple Science content (Figure 5.1). This arguably provided the students with the *illusio* of belonging and the willingness to play a game worth playing (Bourdieu, 1990). This *illusio* of science learning can impact the student's identity in science and is discussed in Chapter 5.6.1. In support of the other Linear Curriculum goals, in terms of raising aspirations and progress to post-16 study, Francis *et al.* (2023) explored the differing future pathways of students studying either the Double Science GCSEs or Triple Science and determined those studying Triple Science were far more likely to continue into post-16 study. This furthered the work of DeWitt, Archer and Moote (2019), who identified the self-fulfilling prophecy of students not studying Triple Science when the students considered themselves to not be good enough and consequently, did not consider studying it further. The decision taken by the school to provide all students with the opportunity to study the apparent hierarchical Triple Science subjects does appear to provide a potential intervention in which the rules of the field may be changed, arguably reducing the social reproduction and symbolic violence observed in education today.

The perceptions of the participants suggest changes seen in the classroom, through the implementation of the Linear Curriculum, appeared to have an impact on students' science identity and cultural capital. As is discussed in Chapter 5.6, science identity and cultural capital were linked to incidences of enjoyment, engagement, and achievement. The participants attributed these outcomes to the structure and design

of the Linear Curriculum, referencing how it gradually built from foundational topics to more difficult concepts, helping to build confidence and resilience in the students. These findings complement those of Godec *et al.* (2018), who affiliated engagement with the alignment of student *habitus* and capital within the field, suggesting the Linear Curriculum resonated more closely with their students' abilities. As discussed in the previous paragraph, the arguable change in the conditions of the field through the implementation of the Linear Curriculum, introduced new *doxa* and potentially changed the dynamics within the classroom, providing the *illusio* for students to succeed. Success was perceived as being available to all, regardless of background, and offered the opportunities to arguably change student *habitus*, bringing it more in line with the teacher *habitus*. As Godec *et al.* (2018) reported, when teacher and student *habitus* are aligned in the field, student engagement is recognised, potentially supporting the purported intervention of the Linear Curriculum by changing the conditions of the field. The participants also perceived that when topics were put into the context of the students' environment or experience, barriers of difficulty were removed. This aligns with the work of Levinson (2018), who described the disaffection observed in students because school science is detached from their lives, and also with the work of Hamlyn *et al.* (2020), who considered a lack of relevance of science to the lives of students to be a factor in poor engagement. The ASPIRES 3 Project (2022), a longitudinal study of student aspirations in science, also identified a lack of relevance to students' lives to be the greatest critique of the science curriculum by students themselves. Conversely, Levinson (2018) commented how, despite curricula detachment to everyday life, some students enjoy the challenge of pattern-seeking and problem-solving, both of which are often incorporated into science curricula. This raises the concerns shared by others, such as Essex (2018), of the differing roles and expectations of the school science curriculum, trying to prepare a small number of students to become the scientists of tomorrow, while aiming to provide most students with the scientific literacy they need in the modern world. This brings into contention whether the Linear Curriculum is serving the majority of students well. Francis *et al.* (2023), when exploring the perceived gains and losses of Triple Science versus Double Science, described how the Triple Science specification went into greater depth, but it also provided a greater breadth of content. This was highlighted in the diary entries and discussed further in the individual interviews when the participants described

lessons where they were teaching topics only found in the Triple Science course, such as when the students were doing an eye dissection. This practical session was perceived as an enriching experience for the students and was also perceived to have the potential to increase the breadth of students' knowledge. The participants discussed, throughout the data generated, how they considered that by giving all students the same opportunities and experiences in the classroom, they were providing equality to all. Practical lessons are enjoyed by students and identified in the ASPIRES 3 study (2022), as a means of improving the science curriculum, second to making the content more relevant. Similarly, the participants perceived students valued practical lessons and teacher demonstrations as a means of making the knowledge more accessible and easier to understand. Limiting the students who participate in, for example the eye dissection, is arguably symbolic violence and adds to the same emotion experienced when students were selected or not selected to study Triple Science, leaving them feeling less worthy in the science classroom field (Archer *et al*., 2017b). In support of all students studying the Triple Science content, participants described how they considered the extra breadth of content potentially contained the 'hook' that inspires students. They also support their decision to incorporate Triple Science into the Linear Curriculum in terms of what they considered a potential extra gain in cultural capital. Participants' perceptions of cultural capital are discussed further in Chapter 5.6.

Despite the overall belief in the Linear Curriculum model, the person at the front of the classroom was identified by the participants as key to engaging and encouraging students. Teacher-student relationships were seen as paramount to the progress of the student, with the curriculum being seen simply as the guide. The importance of teacher-student relationships was highlighted by Giles (2011), who concluded the relationship is essential to the experience of education. He clarified that teacher-student relationships always exist and are always in flux. When the relational experiences appear to be taken for granted, teaching and learning occur between the teacher and student. However, when the relational experiences are seemingly indifferent, the teaching and learning experience is diminished, concurring with the findings in this research and the importance of relationships in the classroom. Giles (2011, p.89) noted this type of relationship is more likely to occur when teachers

become constrained by 'compliance systems and pressures,' which would suggest that when teachers take charge of their curriculum, as is the case here, there is a greater opportunity for positive relationships to develop and increase learning in the classroom.

5.5 The Relationship Between Teachers' *Habitus* and Prejudices and Curriculum Development (RQ2)

The small-scale study data provides an insight into the lives of the teachers as described in the Pen Portraits (Chapter 4.2 and Appendix 14). While their ages and personal and professional experiences differ (Table 3.1), they had a shared driver in their teaching of science to their students, focused on success, interest, and enjoyment of science. These drivers arguably arose from their personal experiences, shaping their *habitus* and informing their prejudices, ascertained, and analysed using the theoretical framework (Figure 5.1). Following this next discussion, Figure 5.2 provides a brief insight into how the theoretical framework was used in interpreting the data.

Bourdieu and Passeron (1977) described how the inculcation of a cultural arbitrary must be sustained over time to effectively shape and impose upon a *habitus*. A cultural arbitrary would have been imposed upon and experienced by these teachers when they were themselves students in secondary school. Analysis of their perceptions reveals how they each likely experienced a degree of cultural reproduction, thereby shaping their primary *habitus*. Drawing on Gadamer's (2013) hermeneutics, this process can be seen as the transmission of tradition, where the prejudices or preconceptions instilled by the education system become the lens through which the participants, as students, interpret scientific knowledge. The fusion of horizons that Gadamer sees as essential for understanding is thus limited by the way education reinforces certain dominant cultural arbitrariness, shaping the horizons of students and future teachers in ways that align with existing power structures.

The question that surfaces here is whether teachers can reshape their horizons to prevent social and cultural reproduction and continued symbolic violence. The data suggest there was indeed a shift in horizons, with a renewed focus on the need for equity and equality. This shift appears to arise from two situations: first, the personal experiences of the participants, and second, perhaps more importantly, their shared

understandings regarding the situatedness of their students and the school context. However, the process through which a fusion of horizons may occur is not straightforward, nor should it be. The differing *habitus* and prejudices teachers bring with them introduce the challenge of intersecting capitals and opposing horizons, which inform their interpretative horizons. To move beyond these differing horizons, the findings demonstrate the importance of acknowledging pre-understandings through reflexivity.

Dewey (1933) described reflective thinking as when suggestions are not accepted at face value. He also determined that when being reflective, thoughts needed to be consecutive, with each thought influencing and supporting the next, resulting in understanding. Archer (2003, p.4) further explains this as an 'internal conversation which intervenes between the *habitus* and the field.' Hizli Alkan and Priestley (2019) emphasised the importance of teacher reflexivity and decision-making during curriculum reform, with the lack of it potentially hindering curriculum development, as was found in this research (Chapter 4.5). This research determined that using diary entries was a helpful tool in enabling participants to move from mere reflection into deeper reflexivity and was noted particularly towards the end of the data generation period. Schön (2016) adapted and extended Dewey's principles to suit the complexities of professional practice. He explained his theories in terms of 'reflection-in-action' and 'reflection-on-action,' which was noted when the participants described how they had begun to look at the relationships between the curriculum and the lessons and how they as teachers developed new pedagogies from this new understanding.

The differing interpretative horizons arguably caused clashes between participants. However, these clashes provided an opportunity for dialogue and conversation, which Gadamer (2013) explained as being an essential element to understanding. During the initial design of the curriculum, the teachers used written dialogue in the form of their 'curriculum poster' (Chapter 4.3.1) to express their pre-understandings. This, along with the verbal conversations generated from the poster, marked the starting point of their hermeneutic circle towards a shared understanding (Figure 5.1). This dialogue was crucial in developing a sense of team spirit, which was evident throughout the data, with participants referring to the 'teamwork' involved and the 'cooperative' nature of their work (Chapter 4.3.1) and was seen as an important element by all the

participants during curriculum development. As the research progressed and teachers' *habitus* underwent a period of hysteresis, their horizons converged and fused. This fusion resulted in a new shared understanding, centred on providing opportunities for students and addressing perceived social injustices. This led to a shift away from the traditional field of Triple Science reserved for only the 'brainy' (DeWitt, Archer and Osbourne, 2013), reinforcing the shared goal of equity, equality, and social justice, which were observed as the main drivers of their curriculum reform and provided the participants with symbolic power over their curriculum design. Figure 5.2 follows, demonstrating how the theoretical framework (Figure 5.1) was used to interpret and understand the findings.

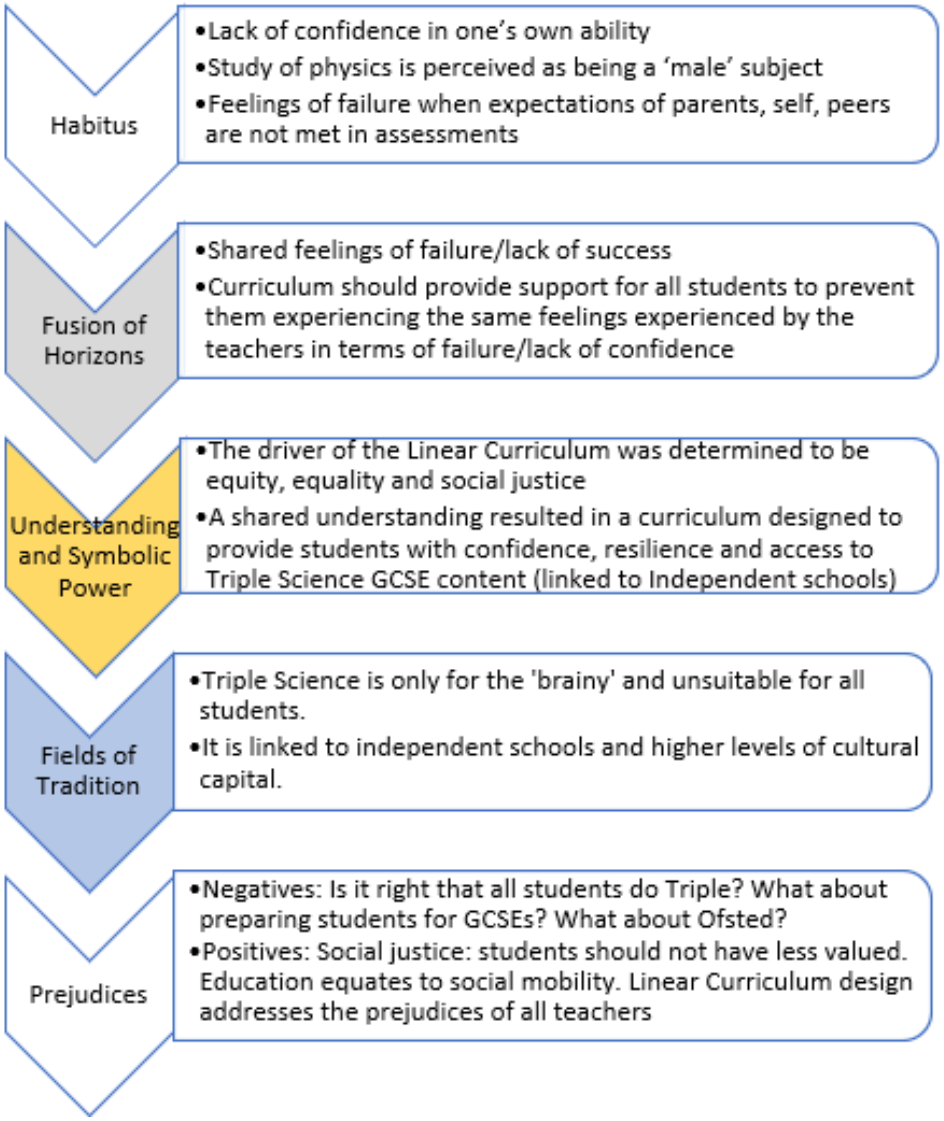


Figure 5.2: Illustration to Show the Application of the Theoretical Framework

5.6 Teachers' Perceptions of How Science Identity and Cultural Capital Manifest in Their Students (RQ3)

In this section, teachers' definitions and understandings of science identity and cultural capital are discussed. These will be explored in the context of current literature, examining whether there was a fusion of horizons, what factors potentially caused this, and also consider the understanding and symbolic power achieved.

5.6.1 How Science Identity Manifests in Students

Science identity was described by Vincent-Ruz and Schunn (2018, 2019) as a topical identity, developed through experiences, involving the self-recognition of being or wanting to be a 'science-type-person' and of being socialised into the norms and *doxa* of the science field (Figure 5.1). Carlone and Johnson (2007, p.1191) furthered this definition to include being recognised by others as a 'science person.' Surprisingly, not all the participants in this research self-identified as scientists, with the alternative description of being a 'nerd' used. DeWitt, Archer and Osborne (2013), when investigating how parents and their children viewed a scientist, found the term 'geek/nerd' was used to describe what they perceived to be a stereotypical scientist. So, it would seem reasonable to accept that despite the difference in terminology and the defiant, 'I'm not a scientist,' in fact, outside of the classroom, the two constructs of being a 'scientist' and being a 'nerd' are the same within the science classroom.

Figure 5.3 displays a summary of how the participants perceived science identity is developed. Each of these will be discussed in relation to the literature.

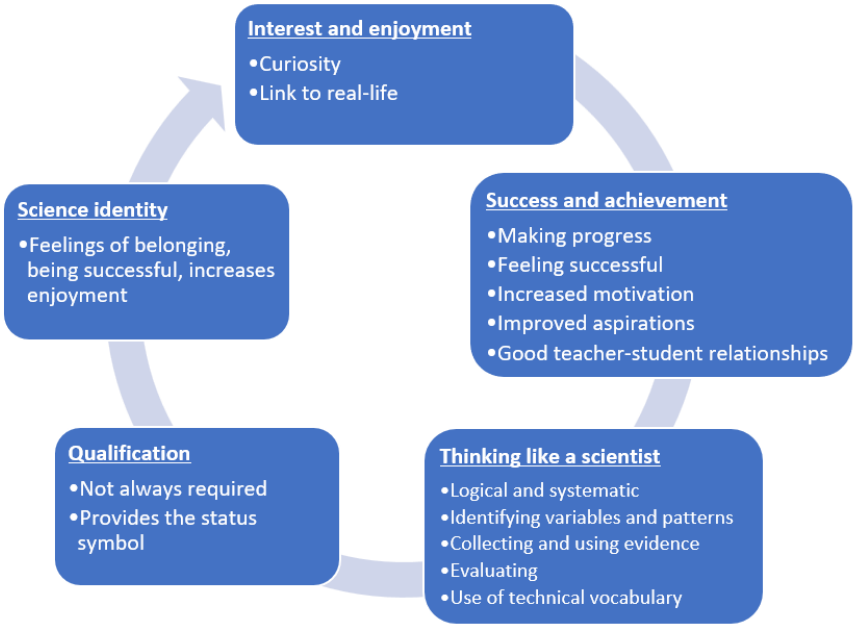


Figure 5.3: Summary of Science Identity Characteristics

As already discussed in Chapter 5.4, making the science curriculum relevant to students' lives was determined to be the most important aspect in improving science lessons (ASPIRES Research, 2022), so its appearance here is not surprising. The participants remarked on how the addition of relevant real-life material brought science to life, making it more interesting and important to the lives of the students. One of the participants particularly considered the sharing of 'stories' and real-life experiences as important in putting the curriculum into context. The importance of sharing real-life experiences or scenarios was also noted by other participants, as described in Chapters 4.4.4 and 4.4.7. In the context of science identity, the ability to link classroom science to everyday life was perceived to be an early indicator of an interest in science.

The importance of feeling success is supported in the work of Archer *et al*. (2017c), who explain when students with non-dominant cultures within the classroom are seen to be valued, then they are more likely to develop a science identity and to have increased science aspirations. This is supported by Calabrese Barton and Tan (2010), who described how when students can position themselves within a particular field, where they can experience and be seen to be exhibiting success, they can develop a science identity, enabling greater participation in the learning of school science. Within the field of the Linear Curriculum, the change in *doxa*, potentially offers more

opportunities for students to be successful, as described by the participants, thereby developing a greater sense of science identity. Calabrese Barton and Tan's (2010) research focused on children from low-income families, which further supports these findings in the context of this research, whereby the importance of providing the students with the space to develop a science identity is underlined.

The presence of 'Thinking like a scientist' is not surprising and summarises some of the key skills designated as essential science skills in the *Working Scientifically* section of the *National Curriculum in England* and the science GCSE specifications. However, perhaps what is surprising is that it is not the only consideration in developing science identity in students and presents the question of what these skills provide for the students. Archer *et al.* (2013a) posited those students who see the importance of science in terms of the skills acquired and their transferability, then use these qualifications in alternative career pathways, supporting the findings here, where the participants differentiated between being a scientist and being good at science. Those deemed 'being good at science' were identified as those students who work hard to achieve a good grade in science but are not invested in the subject and have no particular interest beyond the classroom and potentially do not develop as great a science identity, if any at all. The participants explained these students sometimes move into science A-levels because of their high GCSE grades. However, due to their lack of science identity and their lack of some of the fundamental skills described in the *Working Scientifically* section of the *National Curriculum in England*, they struggle to make progress, potentially accounting for low numbers of students progressing into undergraduate science. This is a concern for the long-term impact of shortages of scientists and underlines the importance of developing science identity and links to components beyond the curriculum, including teacher-student relationships as discussed in Chapter 5.4.

DeWitt, Archer and Mau (2016, p.2434) linked science identity to a person's *habitus*, formed through their experiences within an environment of 'what is normal, possible, and desirable for "people like me."' When investigating success in a music classroom, Wright (2008) highlighted the importance of the alignment of the *habitus* of the teacher and the student in the design of the curriculum, although it was noted power relationships still existed, with the teacher *habitus* being dominant in the field. In

contrast, the Linear Curriculum design did not engage pupils in conversation. Rather, the teachers attempted to align themselves with their students in terms of how they would perceive the difficulty of topics and when they were taught. The participants then attempted to align these, alongside careful consideration of pedagogies with which to engage the students in the lessons. This stance is supported by Godec *et al.* (2018), who agreed *habitus* of the student can be affected by the field, which they defined as being the classroom in which teaching occurs. Within this research, the conditions of the field were somewhat changed by the implementation of the Linear Curriculum which defined what was taught in the field of the classroom. To support students in their learning of more difficult concepts, the participants described the development of foundational knowledge in the earlier years, which was then used as prior knowledge, in readiness for the teaching of the more difficult concepts. The data revealed this scaffolding of learning provided the students with more opportunities in which they could develop their confidence and increase their gain of science identity (Figure 5.3).

The findings determined a science identity was important in raising aspirations in science education, concurring with the work of Aschbacher, Li and Roth (2010). However, in contrast to the work of Archer *et al*. (2015b), although the participants considered success to be important, they did not consider an academic qualification as a prerequisite for a science identity, although they also concurred that success probably often led to some form of science qualification. The importance of the design of the curriculum, the quality of the teaching, and the relationship between teacher and student were highlighted when the participants discussed how they believed science identity was 'fluid.' They discussed the fluidity of science identity linked to poor understanding of topics or poor assessment results. They also identified how a loss of science identity may occur when 'scientists' do not use or read about science, losing interest in it. When investigating why students continued or withdrew from science courses, Aschbacher, Li and Roth (2010) also noted when students' achievement slipped, so did their confidence, leading to a shift in their science identity. Their findings also suggested a link between the enthusiasm of the adults in the lives of the students and the resilience of the students' science identity, linking to previous discussions on the importance of relationships (Chapter 5.4). This aligns with the

findings of this research, which suggested the importance of strong teacher-student relationships within a supportive environment to work alongside the Linear Curriculum and provide opportunities for students to feel success and achievement. Additionally, the use of a range of pedagogies was identified as important to use alongside the curriculum to foster relationships and science identity in students. Figure 5.4 represents the importance of science identity in nurturing student perceptions of being a scientist as opposed to simply being good at science and achieving good grades, ascertained in this research.

Figure 5.4: Diagram Showing the Potential Student Outcomes in Science Education

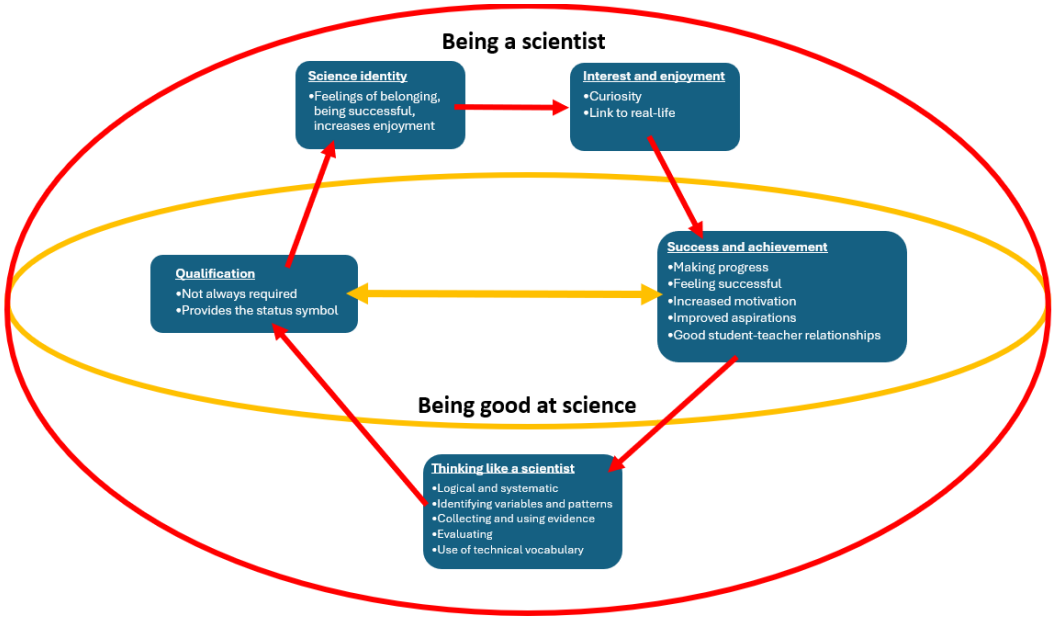


Figure 5.4 represents how the participants differentiated between students who worked hard in science and those who possessed the skills and *habitus* they perceived as being important for a scientist. They perceived a student who achieved good grades and made progress, as motivated by their successes, leading to them studying harder and ultimately achieving good GCSE grades. However, those students, the participants considered to 'behave like a scientist,' additionally possessed the ability to 'think like a scientist' and were interested in science and the world around them, which was linked to the possession of a science identity (also see Figure 5.3). The participants used this distinction to identify those students who having been successful at GCSE level, they considered as 'Being good at science' rather than 'Being a scientist,' chose to study

science post-16 and then floundered because of their lack of skills required to be a scientist. In these cases, the participants described students who worked hard and were successful but did not have some of the skills identified as being typical of someone with a science identity. The skills identified were found predominantly among those depicted in the *National Curriculum in England* and examination specifications in the *Working Scientifically* section. This is perhaps somewhat unexpected since the *National Curriculum* is the policy upon which science teaching has been based since its introduction in 1988 (DES, 1988), with its implicit expectation that these skills be taught alongside the content. Analysis of the data exposed how the participants regarded the explicit teaching of these skills as still lacking in the Linear Curriculum, despite their understanding of what they considered was important in developing science identity (Figure 5.3), which partly explains why they still considered the curriculum as a work in progress. This is also interesting since much of the literature, as shared in Chapter 2.5, indicates science identity as being important and a focus of many interventions to raise aspirations in science. However, as Calabrese Barton and Tan (2010) found when investigating science aspirations in children from low socioeconomic backgrounds, science agency appeared to have more impact than science identity on student engagement in science. They explained science agency as the ability to engage with the role science plays in the world within a given context. The context they explained includes the relationships, the resources, and the cultural norms, all of which have been discussed here. As such, rather than looking solely at science identity, science agency offers an alternative lens through which the Linear Curriculum may be investigated in the future to further this research.

5.6.2 How Cultural Capital Manifests in Students

The diversity of definitions offered for cultural capital by participants is perhaps unsurprising since Bourdieu himself failed to provide a definitive statement as to what cultural capital is and how it could be measured. Some of the participants had heard of the phrase prior to the commencement of the research during in-house CPD, but the majority had not heard of the phrase before.

The findings reveal a range of understandings of the term cultural capital; however, there was a consensus of it being a tangible 'object' that could be given to students. One definition focused on the 'object' being a collection of extra knowledge and skills

offered through teaching the Triple Science content, with the content offered beyond the Combined Science specification seen as providing these students with knowledge not offered to their peers in similar schools. The alternative definition focused on the 'object' as being a set of extra experiences provided for the students that went beyond the written curriculum. However, conversation and dialogue led to a fusion of horizons with a shared understanding, whereby it was agreed that 'trips' as an experience were not enough *per se* to provide cultural capital (Figure 5.1). This supports the work of Basford (2019, p.24) who explained that a tick-list of activities, including 'cultural experiences' to museums, for example, was not the answer to enriching students' cultural capital and potentially risked alienating families and ultimately having the reverse effect than the one intended. Through the period of data generation, the temporal dimension provided the opportunity for hysteresis to occur, impacting and altering interpretations (Figure 5.1). The data revealed the participant's agreement and fusion of horizons, that the Linear Curriculum through the incorporation of the Triple Science content, offered both additional knowledge and experiences. This was explained in terms of opportunities available in the curriculum to all students, such as eye dissections, which would not be included by other schools that provided only the Double Science Award. Their agreement in these intimates the potential of the Linear Curriculum in enhancing students' cultural capital, but possibly also highlights an acute understanding of the situations experienced by students living within a low social mobility area with low SES. This aligns with how Bourdieu (1986) explained differences in social classes and SES with his concept of cultural capital, existing in the embodied, objectified and institutionalised state (Chapter 2.5.1). In the embodied form, arising from the family capital in the form of dispositions of mind and experiences, the potential lack of these, whilst not being replicated in school, may partly be mitigated by the experiences offered, especially through teaching all students the Triple Science content.

Bourdieu (1986, p.17) further described how cultural capital can exist in the institutionalised state, a form of objectified capital. He explained this may be converted into educational qualifications, which Bourdieu noted as having 'entirely original properties.' He explained this as being independent of any other capital a person may possess and a form of capital that is legally bestowed upon its owner and

with a legally recognised high cultural exchange value. So, whilst academic gain in the form of a qualification is beyond the scope of this research, it is important to consider the pathways that lead to that point. Qualifications are earned in school, following the teaching of a given content and its subsequent assessment. So, it would be prudent to consider that the teaching and learning that occurs in education, is in part, a stepping-stone to the achievement of a qualification. The knowledge gained to earn the qualification is a potential measure of gain in cultural capital. This assumption aligns with the work of Stopforth and Gayle (2022), who acknowledged the lack of a definition had led other researchers and potentially Ofsted to make definitions that suited their needs. In this instance, the possession of cultural capital students need 'to succeed in life,' as determined by Ofsted (2019b, p.9), must come from the school, and within schools lie the curricula plans that provide the instructions to the teachers of what to teach.

However, as Silock (2022, p.90) suggests, Ofsted's use of cultural capital in their *EIF* (2019b) potentially reduces cultural capital to a 'performance indicator,' which supports the understanding of the participants and arguably brings the two points together in terms of cultural capital being a measure of knowledge and experiences gained. This is arguably reflected in Amanda Spielman's speech to the National Day Nurseries Association (2019, p.6), with her vague description of cultural capital as a 'golden thread woven through everything.'

Jæger (2011) disagreed that knowledge and qualifications can be used as an indicator of gain in cultural capital and identified activities beyond the classroom, such as reading ability, as better indicators of academic success. She determined the type of cultural capital gained had a greater effect on academic success than the amount of capital gained. This in part supports the definition offered by some of the participants in terms of experiences beyond the curriculum, although, as acknowledged by Basford (2019), a list of extracurricular activities neither deepens nor broadens understanding and as such, is not the way to increase cultural capital in students. However, the Linear Curriculum offers all students the opportunity to learn about content across the suite of Triple Science courses. It could be argued the link between Triple Science and higher SES, in part, links the transmission and gain of higher value knowledge and a greater gain of higher value cultural capital, therefore evidencing how the Linear Curriculum is

potentially offering an avenue through which more valued knowledge and cultural capital may be built in students. Additionally, the Triple Science courses, through offering more knowledge beyond the traditional norm of the Double Science Award, also offer extra experiences in the classroom, for example, the eye dissection described in Chapter 4.4.7.

In accordance with the findings of Stopforth and Gayle (2022), the analysis of the data generated in this research revealed a shared understanding among the participants of the unequal distribution of cultural capital among students, linked to their low SES and homelife. Reay (2018) examined the uneven distribution of capital in students as they moved into higher education and found that despite having the same qualifications and achievements as others, their differing cultural capital maintained their alienation. Godec, Archer and Dawson (2022) examined participation differences in STEM activities and found differing levels of cultural capital impacted these, with students from lower socioeconomic backgrounds less likely to participate. The participants in this research appeared to understand the impact of lower SES on students and believed their role as teachers included the mitigation of factors contributing to lower cultural capital on entry to secondary education. However, Bourdieu (1986) maintained the importance of the cultural capital students bring with them from home as being what the education system can build upon. So, students arriving with less cultural capital are always going to be at a disadvantage, and without change to how schools operate, they will remain as places of social reproduction and symbolic violence as determined by Bates and Connolly (2022). However, in their research investigating Secondary and Primary teachers' perceptions of cultural capital, they similarly found teachers were prepared to go beyond their roles as simply teachers, to support their students by providing opportunities for students to gain experiences and knowledge.

5.7 The Impact of Designing and Implementing the Linear Curriculum on Teachers' Sense of Professionalism, Agency and Identity (RQ4)

The findings of this research suggest that the development and implementation of a Science Linear Curriculum shaped the identities, and impacted the professionalism experienced by the participants. This section considers how curriculum development

impacted teacher identity, in relation to the frameworks described in Chapter 2.5.3 and how this process affected their sense of professionalism.

5.7.1 Curriculum Development and Teacher Identity

Teacher identity is a complex and fluid construct, shaped by personal and professional experiences. In this study, identity was examined as participants navigated, negotiated, and reflected during curriculum development and implementation. The literature (Chapter 2.5.3) suggests that identity is fluid (Butler, 1988) not fixed, and affected by how a person is recognised within a particular context (Mead, 1967), through changes in life stages (Erikson, 1959), professional interactions (Beijaard *et al*., 2004) and feelings of belonging (Tajfel *et al*., 1979). This section explores how the development and implementation of the Linear Curriculum shaped participants' professional identity.

Identity as a Negotiated and Situated Construct: The findings of this research reveal the teacher identities of the participants were fluid as they negotiated the complex context of curriculum development. Parts of the findings revealed how they considered their identities differed, and while this was acknowledged and accepted, it can be explained in terms of their life stage, both in age and in their professional lives. Early life experiences were discussed and shared highlighting how these influenced their future *habitus* and prejudices the participants brought with them, influencing both their identities in science and also as teachers. This aligned with the work of Erikson (1959), when he described the development of identity as one moves through their lifecycle. However, despite arguably having different types of identity and being at different stages in identity development, each of the skills participants brought to their teacher role and also to the group of teachers, was seen as important and acknowledged as a part of the wider professional duties of a teacher. This reveals a cross between the theories presented in Chapter 2.5.3, with this linking more with the writing of Tajfel *et al*. (1979) who posit the importance of participants within a group, possessing a feeling of belonging. Discussions between the participants about the importance of the differing skills offered by each member of the team suggested there was an acceptance that they each had different skills which they could bring to and help develop their 'group.'

Discussions about the importance of the 'person at the front of the classroom,' also support the idea of structural symbolic interactionism and the description offered by Beijaard *et al*., (2004), who suggested that teacher identity is shaped by the school context. The context here is shaped by the classroom and the needs of the learners with respect to the taught curriculum. This also crosses into social identity theory, where the context for the group is their shared drivers for the development of their Linear Curriculum. Furthermore, the data suggest that rather than following the curriculum *per se*, the teachers move saliently through their differing identities, afforded to them by both agency and autonomy. In situations where the teachers determine their students need new information to be explained or described in a more relatable context, to better develop their understanding, teachers identity can organise their own identities hierarchically, as explained by Stryker (1980), within the context of the classroom, providing relevant 'stories' or examples to support student learning. This also linked to aspects in the findings where the teachers told stories and shared experiences, as part of their performance as a teacher. This was rewarded with positive responses from students, where the participants described how students responded and were inspired, with their aspirations and levels of confidence also increasing. These moments reflect how teacher identity is enacted relationally and can positively influence student engagement. This performance of duty is supported by Butler (1988), who described the concept of identity as a performance.

Tensions Between Personal and Institutionalised Beliefs: However, whilst negotiating their identities, tensions were evident in the data when participants tried to balance what they believed their role as teachers advocated, in passing the exams and linked to performativity (Ball, 2003), and their roles as educators teaching a love of learning. This aligns with the work of Foucault (1980), who explained how post-structuralist identity theories centred around the relationship between power and forces. The potential impact of Ofsted inspections was outlined by some participants, describing their concerns about student grades while appreciating the main drivers of the Linear Curriculum in providing equity, equality, and social justice for all. Participants reflected on their 'terrors of performativity' (Ball, 2003, p.216), specifically when discussing the teaching of Triple Science to all students. Despite the focus of curriculum development being an intervention to raise aspirations and develop cultural capital in students,

through teaching Triple Science to all, some participants revealed their inner anguishes over spending valuable teaching time, teaching students content they would never be examined on. On the one hand, they wanted to support the Linear Curriculum and its principles, but on the other, they wanted the cultural arbitrary they were accustomed to and its associated cultural reproduction by treating their students like "passing exam machines" rather than lovers of science, highlighting some of the participants' more negative prejudices. Bourdieu explained these internal conflicts and powerful emotions through his concept of *cleft habitus* (Bourdieu, 2000). He described this as when two conflicting social fields simultaneously demand things from a person, and a feeling of loss of coherence and disruption from reality may occur. Bourdieu posited those with a *cleft habitus* were more likely to experience a hysteresis effect, although, as the data suggest, the depth of this can vary. The early concerns expressed by the participants seem to have been alleviated somewhat later in the research. The data suggest the participants experienced a temporal shift in *habitus*, affecting their prejudices, with the positives of the Linear Curriculum for the student outweighing their initial negative prejudices, potentially through the development of reflexive skills. The internal conflicts expressed in the data were exacerbated by curriculum reform, positioning teachers as both agents of change and subjects of policy.

Social Identity and Belonging: This recurring notion of classroom relationships resonates with the post-structuralist description posited by Butler (1988), where she explained the behaviour of teachers as performers of their identity. Within this performance, the data described the importance of relationships in the classroom. This aspect appeared several times in the data, from differing perspectives, including, sharing the enjoyment of science, trust between teacher and student and building confidence. These are all performances of identity from a post-structuralist viewpoint, but the identity also reflects the social identity theory, where the teachers share the rules of membership with their group, which displays the drivers of the curriculum reform, as described by Tajfel *et al*. (1979).

The sense of belonging to an exclusive team was also evident from the collaboration and teamwork identified throughout the data. The participants discussed how 'we' worked as a team and provided specific examples of how they worked collaboratively in co-planning time and in producing shared resources. The importance of doing this is

described by Archer *et al*. (2015b) when examining 'science capital' as a potential measure of cultural capital specifically related to science education and science outcomes. They showed how membership to particular groups and the people they helped you collaborate with, were important in developing social capital and linked this to raising science identity in students, both linked to increasing aspirations and outcomes in science. However, the limitations of social identity theory were evident in the research where less experienced teachers, were somewhat hesitant in expressing their views. Despite this, the dialogue between participants offered a form of Bildung (Gadamer, 2013) and CPD to all, through recognition and active contribution to the dynamic workspace. Sachs (2005) explained this conversation and negotiation as identity work. Despite this being an active process, concerns were raised that once the curriculum work was 'complete' there would be no need for further development and there was a sense of a reduction in teacher identity (Sachs, 2005). This further illuminates the importance of CPD, as described by Gadamer (2013), in providing opportunities for teachers to develop and build their identity. The importance of critical self-reflection of practice was also noted in the data and plays an important role in personal growth and in developing teacher identity.

Overall, this section has shown how curriculum development provided opportunities for teachers to enact, question, and redefine their professional identities through collaboration, performance, and student interaction. It is through these acts that teacher identity emerges as not just personal but deeply professional and socially embedded.

5.7.2 Curriculum Development and Agency

The relationship between curriculum development and teacher agency emerged as both dynamic and integral to the success of the Linear Curriculum. While identity refers to how teachers see themselves in their role, agency captures the capacity they have to make decisions and shape the curriculum contextually. In this section, teacher agency is explored as a process of enacting judgement, exercising autonomy, and navigating the structural conditions of the classroom.

The findings of this research support teacher agency as being central to professionalism experienced by teachers during curriculum development. In alignment

with the work of Wallace and Priestley (2017), when they explored agency in science teachers designing the new curriculum in Scotland, agency arose as they each brought their personal capacities into the contextual conditions, where their agency and professionalism were socially mediated. The agency experienced by the participants in this research stands in stark contrast to the experiences of teachers observed by Lennert da Silva and Mølstad (2020), who described how state control over curriculum, resources, and pedagogy within a strict inspection regimen stifled self-efficacy, motivation, commitment, and perceived job satisfaction. Participants exercised agency by adapting the curriculum, critiquing its limitations, and advocating for pedagogical changes. This aligns with King and Nomikou's (2018) assertion that agency enables teachers to mediate and interpret policies rather than passively implement them.

In the face of potential constraints caused by teaching within the scope of the *National Curriculum in England*, the participants described their experience of developing the Linear Curriculum within these limitations as being positive, referring to the *National Curriculum* as a framework rather than viewing it as being restrictive. This contrasts with the description offered by Reiss (1990, p.1) who described how teachers initially considered the *National Curriculum* as being like a 'straight-jacket.' This autonomy granted to the participants aligns with the work of Wallace and Priestley (2017, p.324), who described teachers as 'intelligent decision-makers' who, when granted agency, can interpret policy documents, and modify curricula to align with their educational beliefs. As discussed in Chapter 5.5, these educational beliefs are exhibited in the *habitus* and prejudices of the participants and are reflected in the design of the Linear Curriculum, particularly in its overarching aim of promoting equity, equality, and social justice. Similarly, Lennert da Silva and Mølstad (2020) explained the link between teachers' ability to exercise agency and their capacity to mediate policy, which King and Nomikou (2018) also identified as a marker of growth in teacher agency. Additionally, the collaborative nature of the curriculum development and the importance of dialogue identified in this research support the suggestion of the growth of agency, as evidenced by the successful development of the Linear Curriculum. Furthermore, the autonomy given to the participants provided them the opportunity to exercise their agency and to express the professionalism gained through their qualifications and experience.

5.7.3 Curriculum Development and Professionalism

As explored above, teacher identity was constructed and reshaped through situated experiences, collaborative practices and critical reflection. Central to this identity formation was the ability of teachers to exercise agency in meaningful ways. Agency, however, does not exist in a vacuum and is also closely linked to how professionalism is experienced and enacted. This next section considers how the participants' involvement in curriculum development contributed to their sense of professionalism, particularly through the interplay of autonomy, trust, collaboration, and reflexive practice. It explores how the Linear Curriculum offered opportunities not only to shape pedagogical content but also to reaffirm professional status.

Forrester (2000) described the de-professionalisation suffered by experienced primary teachers as they perceived their autonomy was reduced following the implementation of the *National Curriculum in England*, whilst newly qualified teachers seemed to exhibit an acceptance of the perceived constraints. However, it was also observed that teachers attempted to adapt their work to fit the Government's requirements, with an overall acceptance of educational policy change. Now, some thirty-plus years after the implementation of the *National Curriculum*, the participants in this research appeared to accept its constraints unquestionably and did not interpret these as a reduction in their autonomy. This arguably led to opposing experiences, with the trust afforded them by school leaders enhancing their feelings of autonomy and professionalism. This trust appeared to have a re-professionalising effect on the participants and was evident throughout the data, where participants perceived themselves as a team working on a joint project, using their professional autonomy, and exercising agency to direct and redirect the curriculum plan as they saw fit. The lack of control and monitoring from both the Head of Science and school leaders enhanced this trust process, and as described in Chapter 2.6, it was more likely to have the required impact on curriculum and school improvement. This increase in teacher autonomy contrasts with the work of Ball (2017) and Winter (2017) who both described a reduction in autonomy caused by teaching from the *National Curriculum*. The differences in perceptions between this research and that of Ball (2017) and Winter (2017), may be attributable to changing traditions and an alternative cultural arbitrariness, seen in this research, compared to the situation when the *National*

Curriculum was first introduced. Furthermore, Birkenshaw and Temple Clothier (2021) suggested the inclusion of cultural capital in the *EIF* (Ofsted, 2019b) may be seen as an attempt to dictate pedagogy, but the findings here suggest that the participants did not experience such restrictions on their autonomy or professionalism.

Dialogue between the participants was an essential part of the curriculum development process. Through conversation, the field of interpretation experienced by each participant was shaped and reshaped, until a fusion of horizons occurred (Figure 5.1). This collaboration was essential, not only in the development of the Linear Curriculum but also in the promotion of professional relationships in the workplace. Tamah and Wirjawan (2022) investigated collaborative working among secondary teachers and found that support experienced when working with colleagues created an environment conducive to personal and professional growth. This in part perhaps explains how, during the data generation period of this research, participants developed their understanding over time, thereby enhancing their professionalism and supporting collaborative working as a means of providing *Bildung* (Chapter 2.6) to all participants. The lack of any specific curriculum development CPD was noted here, despite its importance being highlighted by Wallace and Priestley (2017) and Hughes and Lewis (2020) when investigating curriculum reform in Scotland and Wales. Although the Linear Curriculum was designed more as an intervention rather than to fulfil the needs of a new *National Curriculum*, a purpose-designed CPD programme would probably have supported the participants in their design and would potentially have addressed some of the limitations highlighted in Chapter 4.3.3 and discussed in Chapter 5.4, preventing the backtracking the participants described.

Despite the lack of CPD provided before the development of the Linear Curriculum, the findings suggested the intersecting capitals of colleagues and dialogue between participants provided them with, to a greater or lesser degree, some form of *Bildung*. This could potentially be linked to the degree to which the participant had developed their reflexivity and the extent to which they perceived the importance of developing themselves as professionals. Interestingly, the usefulness of the diaries was noted during the analysis as a successful means for both the researcher and the participant to begin developing their reflexive skills through their new understanding of their prejudices (Figure 5.1). The use of diary entries appeared to provide a solid grounding

in understanding the drivers in the development of the Linear Curriculum, however, their use as a form of CPD requires further investigation.

5.8 Summary

The development and implementation of the Science Linear Curriculum inadvertently acted as a means of alternative intervention, aimed at improving aspirations and progress for all students. It was found to have many positive attributes, including its challenging nature, while also being accessible to all. Through this, it was also deemed to be able to build resilience and confidence in students. Integral to its design, the Linear Curriculum aimed to develop science identity and cultural capital in students. The participants had a shared understanding of science identity, based on their personal experiences as students and how they saw themselves in their roles as science teachers. However, the participants' understanding of cultural capital did not reflect the original meaning as ascertained by Bourdieu and Passeron (1977) and they redefined it as knowledge and experiences beyond the normal curriculum. Despite the focus of the research being the development of a potential intervention to raise aspirations in science, the development process undertaken by the participants also revealed a growth in a sense of professionalism, agency, and identity. To understand how the participants came to their understanding of science identity and cultural capital, a theoretical framework combining the philosophies of Bourdieu and Gadamer was developed.

The theoretical framework (Figure 5.1) presented in this thesis offers a structure through which the interpretation of dialogue between the researcher and participant and between participants could occur. The framework guided the analysis stages, leading to a richer understanding of the data and enabling a critical consideration of the implications and consequences for curriculum development, particularly concerning the Linear Curriculum. Through combining the two philosophies, a new lens was developed, with each aspect of the lens providing a different viewpoint with which to analyse the data, providing new and fresh insights. By linking the two philosophies for the analysis, the chance of bias was somewhat reduced, leading to a purer interpretation of the individual viewpoints and personalities of each participant. It also enabled each piece of data to be analysed individually and collectively, providing a

more detailed picture of the individual. However, as with all new frameworks, some points require further development for their continued use. Such as when investigating 'Intersecting capitals,' these were not always evident in the data, as the structured questions used in this research were focused on the Linear Curriculum and did not lend themselves to providing relevant information. The following Chapter draws the issues highlighted in secondary science education together with the main findings of this research and considers implications for practice. It also explores contributions to knowledge, limitations, and strengths of this research and examines how this research may be extended in the future.

Chapter 6 Conclusion

6.1 Introduction

The research presented in this thesis explores teachers' perceptions of the extent to which a Science Linear Curriculum enhances science identity and cultural capital among secondary students. Although this research is focused within one secondary school in England, and limited by the English education system, the findings contribute to a wider understanding of science curriculum in the international field of science education and science curriculum development. The themes determined and discussed here are not confined to an English setting but align with global discussions, for example, science identity is examined by Vincent-Ruz and Schunn (2018) in the USA, cultural capital is explored by Jæger (2011) in Sweden and classroom relationships in New Zealand are examined by Giles (2011). Despite the initial aim of the Linear Curriculum being to raise aspirations and improve progress in science through the development of cultural capital, this research has further determined its use as an intervention for all students in an English classroom. Since the introduction of the *National Curriculum in England* (DES, 1988), science has been categorised as a core subject, studied by all students up to the age of 16. However, following the removal of science SATs in KS2 and KS3, both teachers and parents expressed concerns (Murphy *et al*., 2010) about a perceived imbalance of the importance of science, with mathematics and English being prioritised.

Science is a conceptually difficult subject (Archer *et al*., 2010), and low student motivation has been noted. This has translated into poor achievement in the subject, with national and international assessments revealing stagnation over the past two decades (Ingram *et al*., 2023; Richardson *et al*., 2020). Furthermore, these assessments identify a widening gap between the highest and lowest achievers, often linked to socioeconomic differences, with the most advantaged students making the most progress. As students transition from primary to secondary education, Ofsted (2015a) identified a lack of challenge as a contributing factor. Ofsted also acknowledged their role in stifling progress, as over the years teachers became increasingly focused on examination grades and school league tables, arguably leading to a 'teaching to the test' culture (Kelly, 2009, p.149; Winter, 2017, pp.65-66).

The introduction of the new inspection framework, *EIF* (2019b) by Ofsted, served to shift the focus of inspections from outcomes to the curriculum offer. This change inspired the development of a Science Linear Curriculum. Although initially not developed as an intervention, its design and characteristics offer a promising alternative for raising aspirations in science education. Extensive research, such as the longitudinal ASPIRES projects (Archer *et al*., 2013a, 2020; ASPIRES Research, 2022), has explored how students' science aspirations change over time and has examined possible reasons for these changes. Interventions have focused on addressing these points through targeting changes in student attitudes or skills. However, more recent literature has suggested that altering the educational field itself could be a key strategy for altering the *habitus* of students and improving grades and aspirations. For instance, Moote *et al*. (2020) and Archer *et al.* (2021) have proposed that changes in the field and the orthodoxy of its rules (*doxa*) enhance engagement and help develop a sense of belonging in students in the classroom, ultimately leading to better academic outcomes.

6.2 Addressing the Research Questions

The design and implementation of the Science Linear Curriculum, though not initially conceived as an intervention, aimed to improve academic success by making the content more accessible to more students. As a result, an intervention emerged, which became the focus of this thesis. Rather than exploring how students feel and think about science, this research shifts the perspective to teachers, offering new insights into how they perceive such an intervention might work. This thesis demonstrates the impact of designing and implementing this curriculum model and offers an exclusive insight into its usefulness from the perspective of practising teachers. The following section revisits the research questions and evaluates the extent to which the findings have addressed them.

6.2.1 What are the Perceived Strengths and Limitations of the Linear Curriculum? (RQ1)

The Linear Curriculum was designed with the principle of equality, equity and social justice for all students, ensuring the Triple Science route was accessible to everyone, regardless of ability. The curriculum design embraces this principle by developing a

scheme that is intended to be inclusive, though it has led to some tension between traditional and innovative practices. This is evident in the seemingly ad-hoc yet organised way topics are structured over the five years of secondary education, guided by examination specifications and the *National Curriculum* frameworks.

One of the greatest strengths of the Linear Curriculum is its potential as an intervention in science education. While some might argue the curriculum's nature makes it inaccessible to some students, it offers the opportunity for all students to study the content of the Triple Science Award, or the individual GCSEs in Biology, Chemistry, and Physics. Historically, Triple Science has been reserved for a select group of 'brainy' students (Archer *et al*., 2017a, p.93) (Chapter 2.3.3), so this approach can be seen as a move towards greater educational equality and social justice. It could be argued this is a means of changing the conditions of the field within the science classroom. Through a change in the conditions of the field, new *doxa* arose, and through those, the students were arguably offered the *illusio* of success within science. This success was observed in aspects of the students' *habitus* and prejudices they brought to lessons, in the form of engagement, enjoyment, and success, fostering a sense of belonging.

However, there were aspects of the design that required further improvement to avoid limiting student progress. These included issues in the sequencing of topics, where participants identified challenges where aspects of the curriculum were perceived as too difficult because the necessary foundational knowledge had not yet been taught. While this was recognised as an area of ongoing investment and curriculum re-development, it was also highlighted as a priority because when students perceived content as being too difficult, their engagement tended to decrease along with their sense of science identity. Since the curriculum was built on the principle of starting with foundational topics and gradually increasing in complexity as students acquire the necessary knowledge and skills, it is essential to identify and organise these foundational topics as a matter of urgency. Additionally, the lack of links to real life observed with some topics remained a limiting factor to student progress. As highlighted by others, such as that completed for the ASPIRES Research (2022), making topics relevant to students was seen by them as a key component of a successful curriculum. This research revealed this aspect of the curriculum was somewhat

circumnavigated through relationships developed in the classroom, whereby some of the participants described the sharing of their personal experiences and their anecdotes of real life. However, it was recognised in the Findings (Chapters 4.4.7 and 4.5) that this was ad-hoc, and, when not explicitly indicated within the curriculum plan, was unlikely to happen in all classrooms.

The design of the Linear Curriculum would appear to support the development of science identity through its accessibility and associated changes in *doxa*. These changes were perceived to foster a sense of belonging among students, providing a field in which the *illusio* of the situation was legitimised as more dominant. The incremental increases in challenge within the curriculum were also perceived as a means of enabling students to experience success, which in turn boosted motivation, aspirations, engagement, and progress.

Teachers perceived the Linear Curriculum offered students opportunities to acquire cultural capital through knowledge and experiences beyond that provided by the standard Combined Science double award, through its accessibility for all students regardless of ability or background. Whether students were examined on the separate GCSEs in Biology, Chemistry, and Physics, or the Combined Science Award, all students had access to the same classroom learning opportunities. The data revealed the participants considered the Linear Curriculum to provide an increase in knowledge and experience, which was a tangible representation of cultural capital.

Nevertheless, the analyses of the data revealed that despite the positive perceptions of the Linear Curriculum, the additional content and experiences would not, on their own, level up the disparities seen between students from different backgrounds and cultural reproduction would persist. Nevertheless, the participants noted that despite these persistent gaps, all students would experience an improvement in cultural capital. Moreover, students who had studied under this curriculum may have gained more cultural capital than their peers in other schools that do not offer the Triple Science suite of examinations.

6.2.2 How do Teachers' Habitus and Prejudices Impact Curriculum Development? (RQ2)

Teachers involved in curriculum development bring with them their prejudices, shaped by their personal experiences including their own educational experiences, which in turn inform their *habitus*. These experiences contribute to the ongoing social and cultural reproduction of the cultural arbitrary within the curriculum and the classroom. To interpret and understand the findings of this research, a theoretical framework (Figure 5.1) was developed, linking the concepts of Bourdieu and Gadamer. This theoretical framework was then used to explore the interactions between participants and between participants and the curriculum.

The findings revealed a strong yearning among participants to challenge and change the dominant cultural positioning within school science. This desire stemmed from the participants' experiences, shaped by both positive and negative prejudices. While enjoyment of the subject was paramount, it was a deep understanding of the school context and students' backgrounds that drove them to develop a curriculum with equity, equality, and social justice at its heart. In the situation of the Linear Curriculum, each participant came with their horizon and prejudices. Their differing backgrounds, both personally and professionally, provided them with differing capitals that intersected within an interpretative horizon. Conversation and dialogue led to a fusion of horizons, where their shared interpretations evolved into a shared understanding. This was pivotal in shaping the Linear Curriculum, as it influenced both its design and its organisation.

The importance of teacher reflexivity was also highlighted, aligning with the findings of previous research (Hizli Alkan and Priestley, 2019). The findings of this research suggested a lack of reflexivity negatively impacts curriculum development, with teachers struggling to navigate the complex process. However, the use of reflective diaries (Chapter 3.7.3 and Appendix 9) presented an opportunity for teachers to reflect on their practice whilst engaging with the Linear Curriculum. To varying degrees, this reflection tool began to illuminate reflexive practices among the participants. Arguably, participation in this research also impacted participants' capacity to enhance their reflexive skills.

6.2.3 How do Teachers Perceive Science Identity and Cultural Capital Manifest in Their Students? (RQ3)

Science identity is commonly defined in the literature as recognising oneself as a 'science person' and being recognised as such by others (Vincent-Ruz and Schunn, 2018, 2019; Carlone and Johnson, 2007) (Chapter 2.5). The findings of this research align with these definitions but also provide a richer description of what teachers perceive are the characteristics observed in their students. Figure 5.3 illustrates these characteristics. While these qualities have been identified in existing literature, this research has led to linking them in a cyclical format. Each of these qualities is seen as a prerequisite for the next, with science identity increasing as the circle is navigated, or decreasing if characteristics disappear.

Attributes such as having an interest in science, increased aspirations (Aschbacher, Li and Roth, 2010), enjoyment and success (Archer *et al*., 2017b; Calabrese Barton and Tan, 2010) have been noted in previous research. However, in this small-scale study, participants specifically referenced some of the skills outlined in the *National Curriculum in England* under *Working Scientifically*. Although this might not be surprising, participants used these skills to differentiate between being 'good at science' and someone being a 'good scientist,' as illustrated in Chapter 4.4.3 and Figure 5.4. The key distinction between these categories was the presence or absence of the *Working Scientifically* skills or scientific 'methodology,' as identified in the findings. These skills were seen as crucial for making science content more accessible, leading to greater success. Without them, this research suggests students could still be successful in science but might not identify as scientists because they find the subject challenging. Additionally, Godec *et al.* (2018) noted science identity has a fluid nature and can be negatively affected by one of the factors described; a finding that is echoed in this research, with fluidity of identity being linked to learning difficult concepts or a poor test result.

Bourdieu and Passeron (1977) developed the concept of cultural capital to explain unequal relationships in society. Within fields of struggle, those with greater amounts of the correct type of capital for the field and its *doxa* will hold a more dominant position. So, the amount of capital a person holds, is an intangible attribute, manifesting in the form of economic and social power, experiences, and tradition.

However, Ofsted's use of the phrase 'cultural capital' (2019b, p.9) appears to make it a tangible object, with which they could inspect schools, to examine as part of the evidence of the Quality of Education. The findings of this research offer an alternative definition, reflecting in part, that of the one implied by Ofsted, with cultural capital being a tangible object that can be given and used by students. However, the findings reveal a two-pronged approach to understanding the term and how it is revealed in students. The first is in the form of more knowledge, above and beyond that provided to similar peers, and the alternative is in the form of experiences, which are mostly perceived to be associated with the curriculum and within the classroom. Despite conversations throughout the data generation period, the participants could not reach an agreed definition but there was a fusion of horizons when they accepted each other's definitions. These findings support those of other authors who argue that the lack of an absolute definition of cultural capital highlights the gap between the understanding in academia, policymakers' meaning, and policy enactors' interpretation (Nightingale, 2020).

However, despite the lack of a precise definition, further investigation of the Linear Curriculum, using the definition proposed by the participants, revealed how it could potentially make an impact on students' cultural capital. The underlying notion of incorporating the Triple Science content into the Linear Curriculum was a means of offering extra knowledge beyond that offered to similar students in other similar schools and social mobility areas, where most students study the double Combined Science award. This, in turn, translates to knowledge beyond what most students would normally be exposed to. This extended knowledge, often associated with those for whom the Triple Science award was originally designed, independent schools (Chapter 2.3.3), somewhat alters the cultural arbitrary, providing some of the advantages afforded to students at independent schools, to all pupils studying the Linear Curriculum. Additionally, the extended content offered by the Triple Science specifications provides opportunities for activities and experiences within the curriculum, which students not studying the Triple Science would not encounter.

The change in *doxa*, providing the *illusio* of 'doing well in science,' while following the Linear Curriculum also offered an avenue through which science identity and cultural capital could be gained. The participants described how they perceived students'

confidence and sense of belonging, reflected this. This partially aligns with the description of cultural capital proposed by Ofsted; however, the tangible nature assigned to it in this research does not align with the description proffered by Bourdieu and Passeron (1977). This said, in the context of education, the definitions used by the participants further the need for clarification of the use of cultural capital within education policy.

6.2.4 How and to What Extent Does the Linear Curriculum Influence Teachers' Sense of Professionalism, Agency and Identity? (RQ4)

The introduction of the *National Curriculum in England* led to a marked decrease in the professionalism, agency, and identity experienced by teachers (Sheikh and Bagley, 2018). This contrasts with the positive experiences of the participants in this research. Although current literature likens the introduction of the *National Curriculum* to the inclusion of cultural capital in the Ofsted inspection regime (2019b), which similarly engendered feelings of reduced autonomy (Birkenshaw and Temple Clothier, 2021), the opportunity for these participants to develop their curriculum appeared to mitigate these feelings.

The participants enjoyed the experience of being the 'intelligent decision-makers' (Wallace and Priestley, 2017, p.324) and the trust afforded them by the school leaders to do the job their qualifications had prepared them for. Despite the lack of CPD in curriculum development, the extensive dialogue, both written and verbal, fostered professional conversations and relationships and, to a degree, provided opportunities for *Bildung*. These interactions and conversations arguably supported the exchange of differing capitals between the participants, with the sharing of experience for newer and more up-to-date knowledge on teaching pedagogies.

The ability to exercise their agency was viewed very positively by all participants and fed into the feelings of improved professionalism. However, despite the philosophy of trust endowed upon them, there was still concern regarding external inspection and inspection data. These concerns reflected the persistent 'terror of performativity' (Ball, 2003, p.216), with participants balancing wanting to share their love of science and needing to get the students the best grades. Over time, as participants developed their reflexive skills, these 'terrors' appeared to diminish as they negotiated their feelings of

being trusted and the notion of mistrust (Chapter 2.6). The findings suggest that the feelings of trust increased over the period of data generation; however, while the threat of external inspection prevails, it is unlikely that the feelings of mistrust will ever disappear.

Teacher identity was also affected by the experience of developing and implementing the Linear Curriculum. The findings showed how the participants' identities were shaped by their personal experiences and life stages, from pre-school, through education and then in the classroom as teachers themselves. The opportunity to bring their personal narratives and scientific passions into the curriculum helped to develop a renewed sense of professional self, ownership, and accountability. Identity emerged as relational and performative, negotiated through collaboration, policy interpretation, and day-to-day classroom interactions.

Importantly, identity, agency, and professionalism did not operate in isolation. Rather, they intersected and reinforced one another. As teachers enacted their agency, their professional identities were developed further. Through collaboration and shared curriculum resources, their professionalism was strengthened. These dynamics reveal curriculum development as a powerful site for professional and personal transformation.

This research therefore offers an important counter-narrative to the deficit view of teachers as passive policy recipients. The participants in this study demonstrate that, when trusted and given a meaningful role in shaping curriculum, teachers can reassert their professionalism, activate their agency, and construct identities that are authentic, resilient, and contextually embedded.

6.3 Contributions to Knowledge

This research offers a perspective on factors affecting the uptake of science subjects post-16 to add to the literature. In the context of an average-sized science department in an area of low social mobility, it is suggested that this research contributes to knowledge in four areas: the proposal of a new theoretical framework used when researching colleagues, new perspectives from teachers of science identity and cultural capital in students, strengths and limitations of a Linear Curriculum as an intervention

in science education and a practical application of hermeneutics in curriculum development.

The first contribution to knowledge is the presentation of a theoretical framework developed to link the philosophies of Gadamer and Bourdieu (Figure 5.1). This framework not only supported the research process but also enabled a deeper understanding of participants' *habitus* and prejudices which they brought with them to the process of curriculum development, highlighting the importance of classroom teachers in curriculum development. Applying this theoretical framework in research (Chapter 5.3) conducted on and with colleagues has proven useful, offering significant potential for future research activities.

This framework offers a novel methodological and theoretical contribution to the field of qualitative research. It is particularly suited to research encompassing both structural and interpretative processes. It offers a scaffold for researchers to critically reflect on their own positionality and the power dynamics within the research setting. It also offers a model for bridging the gap between structural and interpretative research, whilst encouraging a temporal awareness in hermeneutic work that often omits the time aspect required to consider changes and the evolution of understanding following interpretation. The layered analysis, which can be approached from any angle, captures the complex nature of being and understanding, with the concepts of meaning-making and reflexivity central to it.

In addition to the framework's use in qualitative data analysis, it offers the potential for informing the methodological approach to conducting research on colleagues. The multiple aspects with which it is formed provide numerous avenues through which research may be focused, including from both aspects of discourse and practice, while maintaining the focus on dialogue, interpretation and understanding. This is particularly valuable for education research, where researchers and practitioners alike are often caught between policy-driven structural demands and the lived realities of classroom practice. This provides the opportunity for the researcher to interpret and understand a situation in which they are deeply involved and provides a versatile and transferable contribution to the broader academic community.

The second contribution offered by this research is an insight into how teachers perceive science identity and cultural capital manifest in secondary school students. Previous researchers (Archer *et al*., 2013a, 2020; ASPIRES Research, 2022) have developed research tools to investigate how students perceive themselves as scientists. In contrast, the data presented here provides a complementary perspective, offering an alternative viewpoint. This research provides an insight into how teachers perceive they recognise these concepts in their students and how this knowledge may be used to incorporate activities within the curriculum to maximise the opportunities within which students may immerse themselves and potentially develop a science identity and gain cultural capital. This new understanding from a teacher's perspective offers an alternative way of examining interventions used to raise aspirations in science, and the methodology may be used as a tool with which to develop and enrich the curriculum.

The third contribution to knowledge is of the strengths and limitations of this curriculum model, the Linear Curriculum, which are presented here. Although the curriculum was first designed to comply with new external inspection criteria laid out in the *EIF* (Ofsted, 2019b), the findings presented in Chapter 4.3, demonstrate its potential as an alternative intervention, aimed at changing the conditions of the field in the science classroom and benefiting all students. This intervention is targeted across all students in every science lesson throughout their secondary education, aiming to raise science confidence and aspirations. The Linear Curriculum encompasses the content from the Triple Science award, traditionally available only for the brighter students (Chapter 2.3.3). Incorporation of the Triple Science content within the curriculum model was carefully crafted to develop from Foundational knowledge, gradually increasing difficulty into more complex concepts. Additionally, the removal of the KS3 and KS4 barriers allowed topics to be moved into teaching years that the participants considered were more suitable, whilst also aiming to reduce repetition of knowledge, as seen in the *National Curriculum*, and its associated reduction of challenge and disengagement (Chapter 2.4). The non-spiral nature of the Linear Curriculum depends on students' 'prior knowledge,' consisting of what the participants described as 'Foundational knowledge,' which was explained as the basics upon which concepts are developed. Teachers' understanding of science identity and

cultural capital in their students shaped the design of the Linear Curriculum, ensuring there were opportunities for experiences as well as a gradual increase in conceptual difficulty to help develop resilience and confidence in students, highlighting a further contribution to the knowledge of curriculum development.

The final contribution offered by this research builds on the work of Hodge (2024, p.17), who suggested interpretative theory or hermeneutics offers an alternative view of curriculum development to the orthodoxical model of the teacher as simply a transmitter of information. The use of hermeneutics in education is uncommon, and he states its use in exploring 'teachers' work has not been pursued to date, at least not in a systematic way.' This research offers a practical and systematic application of hermeneutics and exhibits the potential and importance of the use of this methodology in the development of curricula. The analyses offered in this thesis, following Gadamer's hermeneutic circle, have led to a greater and deeper understanding of the participants and the school context. This revealed the *habitus* and prejudices of each participant and exposed their drivers in curriculum development. Each of their *habitus* and prejudices was interwoven into the structure of the Linear Curriculum, through careful negotiation and professional conversations, making it specific to those teaching it and providing them with an invested interest in the curriculum.

6.4 Recommendations for Practice

Data gathered in this research sit within the context of science departments in schools, particularly in areas of low social mobility. The findings have significant implications for both curriculum design in science and CPD for teachers. The following section outlines these recommendations and their implications.

The first recommendation relates to how schools undergo curriculum design. The importance of making the science curriculum relevant to students has already been reported (Archer *et al*., 2013a, 2020; ASPIRES Research, 2022), and it has been highlighted in this thesis (Chapters 4.3.3 and 5.4). To make the curriculum relevant, teachers need to have a deep understanding of their students and the school context. However, to deliver a product that works in their school, the teachers also need to understand their motives around science teaching, their *habitus*, prejudices, and pre-

understandings. To bring the curriculum to life, the teachers within the department need to develop their shared understanding and agree on the most important drivers of the curriculum. To enable this, they need a comprehensive system of CPD. What follows is a recommended pathway of CPD to support curriculum development.

1. Curriculum development should be completed by the professionals in the classroom and should not be done in isolation by the Subject leader or Faculty lead. The collaboration of intersecting capitals and the meeting of differing *habitus* and prejudices are essential aspects of producing a rounded curriculum plan, which is more likely to align with more students. Additionally, this provides teachers with the opportunity to exercise their agency and helps to build a sense of professionalism and identity, giving the teachers ownership of the curriculum.
2. Before the commencement of any dialogue concerning curriculum development, all teachers should complete a reflection of their own experiences as students, focusing on their experiences in school and how their pathway into teaching science began. They should then keep a reflective diary over an agreed period, with not less than five entries over a half term. Entries should reflect what teachers perceive happens in their classrooms, regarding the topic being taught, how the students respond, and how they feel as teachers. This will provide teachers with an understanding of what drives their own interest in science, which they can then consider against what they are teaching and how they are teaching science in the classroom.
3. Dialogue is the next stage, and this should include both written and spoken. Through pictures and words, the group needs to begin interpreting what their curriculum should look like in terms of its principles and what should be included to make it successful for their students. Dialogue needs to include a temporal dimension to enable the interpretation of information and hysteresis of *habitus*. Dialogue must continue until a point where there is a fusion of horizons. At this stage, there will be a shared understanding among the group of teachers, which is important in building confidence and providing them with symbolic power in the field of curriculum development.

4. Once curriculum development has started in earnest, teachers should continue to work collaboratively and with dialogue, whilst also continuing to be reflexive. The understanding achieved through conversation arises due to their 'unknowing' movement through the hermeneutic circle. The hermeneutic circle is continuous and can move in all directions, but the key aspect that must remain constant is teacher reflexivity. This will ensure that the curriculum they are developing remains true to the students in their classrooms.

The second recommendation is concerned with teacher CPD. The importance of CPD in curriculum development has already been shown (Hughes and Lewis, 2020); however, whilst concurring with its importance, the recommendation here is to prepare the teachers before providing them with curriculum development CPD. To do this, the use of diary entries, as per point 2 above, is recommended. To ensure their usefulness, a guide to what to include needs to be provided, using questions such as, 'When do you recall your interest in science beginning? What did you enjoy/not enjoy at school?' These should then lead to the current day and require teachers to consider what they are teaching, how they feel about it, how their students respond, and how the lesson reflects the curriculum plan. Through their recall of their journey into science and reflection on how they are teaching, the teachers can begin to develop their reflexive skills, which will be important in the early stages of curriculum development.

These recommendations form the basis of any curriculum reform and redevelopment. Although some schools opt for an 'off-the-peg' curriculum package, the teachers involved in enacting the subject in the classroom need to have ownership and be accountable for its impact on students. Teacher 'buy-in' is essential, and through the processes outlined above, the curriculum becomes unique to them and their school setting. The relevance of the curriculum should not just be considered in the context of everyday life, but its relevance should also embrace the peculiarities of individual schools and locations. The context of the school, whilst considering the cohort and their demographics, also needs to encompass the teachers within that context and their areas of expertise.

A final recommendation is to policymakers and focuses on the understanding and use of the term 'cultural capital.' This small-scale study has revealed differences in the

interpretation of this concept (Chapters 4.4.4 and 5.6.2) and also highlights the division between academia, policymakers, and policy enactors. With schools now being judged by Ofsted on their ability to provide students with the 'knowledge and cultural capital they need to succeed in life' (2019b, p.9), a more precise description of their expectations and what they would observe in the curriculum and the classroom would be useful for the policy interpreters and enactors at the chalk face.

6.5 Future Research

An area of future research lies in the refinement of the Theoretical Framework presented in Chapter 5.3. As discussed in Chapter 5.8, the data gathered in this research did not provide sufficient relevant information to adequately inform the 'intersecting capitals' part of the framework. Future research could focus on this section alongside others, to further define and demonstrate its usefulness in hermeneutic phenomenological research (Chapter 6.3).

The Linear Curriculum was seen as a 'work in progress,' however, once the limitations have been addressed, particularly those concerning sequencing, the next stage of research would be to focus on how the students perceive science under the teaching from the Linear Curriculum and student outcomes in external GCSE examinations. The ASPIRES projects (Archer *et al*., 2013a, 2020; ASPIRES Research, 2022) have delivered a large volume of information from the student perspective using their concept of science capital (Archer, DeWitt and Willis, 2014). Levels of science capital have then been used to measure the impact of interventions and to determine differences between groups of students, for example, gender (Archer *et al*., 2013b; Archer, DeWitt and Willis, 2014) and ethnic origin (DeWitt *et al*., 2011). As such, further work using a similar methodology may be useful in revealing the impact of the Linear Curriculum on students in the school where this research was completed. As discussed in Chapter 5.6.1, Calabrese Barton and Tan (2010) found science agency to be a potentially better lens through which science aspirations may be viewed. Observing students' science agency alongside the examination of students' science identity may offer a more detailed review of the Linear Curriculum. An extension of this would be to explore the impact of the Linear Curriculum, on students' aspirations to study science post-16.

As discussed in Chapter 5.6, further research into the use of diaries as a form of teacher preparation before curriculum reform is required. Diaries have formed part of data generation and are well documented as such (Bartlett and Milligan, 2015; Cao and Henderson, 2021). However, their alternative use, presented here, although based on similar principles, provides teachers with the opportunity to analyse their drivers and prejudices within the umbrella of science education. A further research opportunity would be to investigate the use of reflective diaries in Initial Teacher Training to help new teachers to understand their motives for moving into teaching and potentially help them to identify the type of schools that fit them best, whilst also supporting their professional development.

A final recommendation for further research, aimed specifically at the practitioner-researcher conducting insider research, is to consider the use of an external group of independent practitioners, or an advisory group. This external body could offer the potential to validate findings, reducing potential researcher bias and in so doing providing more rigour to the conclusions. Engagement with external peers provides a critical mirror through which assumptions can be questioned and claims better supported. This is discussed further in Chapter 6.7.

6.6 Research Limitations and Strengths

Since this research is focused on the perceptions of teachers in one school, there is a clear opportunity for this to be extended to other schools. It also offers the opportunity to extend this research into curriculum development in other subjects.

The theoretical framework combining the philosophical theories of Bourdieu and Gadamer has provided a new method through which analysis of data generated from a hermeneutic study of colleagues may be conducted. In its infancy, it has enabled me to see colleagues in a different light and to understand their drivers, which has deepened and helped to develop our professional relationships. However, more research is required to further develop the framework into a more user-friendly system to support the analysis of qualitative data.

This research aimed to answer four research questions (Chapters 1.7 and 3.2), so it is appropriate to examine the extent to which the findings answer each of these here. The first question, ‘What are the perceived strengths and limitations of the Linear

Curriculum?' was comprehensively covered by the data, as saturation occurred with the same aspects being repeated across the different data-generation tools and between participants. However, these points are limited to the perceptions of the classroom teacher and do not indicate how the Linear Curriculum aligns with the school ideologies, nor do they represent the perceptions of the students or senior leaders or the Principal.

The theoretical framework, Figure 5.1, was constructed to answer the second research question, 'How do teachers' *habitus* and prejudices impact curriculum reform?' The framework was useful in terms of organising ideas and particularly useful in helping to reduce researcher bias, which was particularly important when researching colleagues. The data provided a sound understanding of the *habitus* and prejudices of the participants, but there needs to be deliberation as to the extent and depth of information provided by the participants. Also, to protect the anonymity and the safety of all participants, some data were removed and not included in this thesis for ethical reasons. Despite this, the data gathered provided a good insight into the drivers of the teachers and provided a rich insight into their personalities, which was not visible before this research.

The data gathered only partly provided a resolution for the third research question, 'How do teachers perceive science identity and cultural capital manifest in their students?' The concept of science identity from a teacher's perspective was fully understood and is presented in Figure 5.3. However, the second part of the research question, despite the rich data, has left questions still to be answered. This research led some of the participants to do their own form of research to understand the concept of cultural capital but concluded that they still did not fully understand how it manifested in a curriculum or students. A lack of a clear definition, away from academia, somewhat hinders this research question.

The data gathered provided valuable insight into the professional lives of the participants, which was evident through the data gathered by all the tools. So, when considering the extent to which the research question, 'How does the Linear Curriculum impact teachers' sense of professionalism, agency, and identity?' was answered, the limitations here would lie in any potential bias from working within the

team of teachers and through the data generation being limited to aspects of curriculum development only.

6.7 Researcher Positionality

Conducting research within one's own practice requires significant ethical and methodological considerations. My dual roles as researcher, colleague, and science subject lead, provide access, trust, and a deep understanding of the curriculum development context, central to this research. However, an awareness of researcher positionality is crucial in understanding how pre-conceptions and assumptions may intentionally or unintentionally impact data analysis and interpretation (Czerniawski and Thomason, 2025).

Researcher positionality is linked to both personal and professional experiences, described in Chapters 1.2, 3.5 and 3.9, and these have the potential to impact the research (Ellis, 2007). While the insider positionality provides the opportunity to gather relevant and rich data about the development and implementation of the Linear Curriculum, my role as a co-creator, presented problems in terms of how I presented myself to the participants. During the semi-structured interviews, on occasions, participants asked my opinion, and I had to consider both which role I was assuming and the impact my response may make on the questions being asked, to not bias the data. These strategic decisions evolved through researcher reflexivity which was adopted throughout the research. While Gadamer's hermeneutics and his fusion of horizons philosophies embrace reflexivity, interrogation of researcher positionality must go beyond reflective journaling and dialogue with university supervisors and peers. Reflecting on how the data were examined, greater attention could have been paid to the mechanisms employed in and analysing them, to accommodate and reduce any insider-researcher bias. For example, more structured use of members within the data could have served to seek out and challenge emerging interpretations. The use of Gadamerian hermeneutics, although foundational, does not exempt the researcher from seeking analytic accountability.

Future practitioner-researchers might consider utilising coding audits with external researchers or applying frameworks such as Bourdieu's field analysis in tandem with thematic coding to enhance methodological rigour. In this study, while pen portraits

were validated by participants and the hermeneutic circle enabled interpretative depth, with the additional new theoretical framework (Figure 5.1), a more formal analytic triangulation process could have enhanced credibility. Further critique and validation could have been ascertained from an independent advisory group of external science teachers, which would have strengthened the claims made in this thesis.

Potentially, a missed opportunity in this research was the absence of a formal independent advisory group, made up of science teachers with a range of experience, external to the research school. This group could have offered both challenge and critical distance, enabling validation of, and offering an alternative version of, the interpretation of the data, while also potentially providing new insights into potential missed points or unrecognised assumptions embedded in the analysis. The validation from an alternative group of teachers, although not without its logistical barriers, would have strengthened the interpretative integrity of this thesis and contributed to its transferability. For future practitioner-researchers, the creation of a diverse and independent advisory group is strongly recommended. This could include teachers from different school types, cultural backgrounds, and career stages to ensure a multiplicity of perspectives. Even limited engagement could enhance the depth and ethical rigour of the findings and conclusions.

A further limitation of this research which potentially arose due to my positionality, was the absence of student voice. Early in the research, a decision was made to focus on teacher perceptions of the Linear Curriculum, as this aligned with the research questions about the concepts of science identity and cultural capital in students. However, with the research questions identifying these concepts to be developed in students, reflections and perceptions from a student voice could have better substantiated the findings. Student experiences could have been used to triangulate the findings, either confirming or complicating the perspectives offered by the teachers. Their inclusion could have enriched the hermeneutic process by bringing in another horizon for fusion, as advocated by Gadamer. As described in Chapter 6.5, the next stage of this research, while considering the impact of the Linear Curriculum on student outcomes, should also seek to engage students not only as data sources but as co-interpreters of the curriculum's impact. Participatory Action Research could be

employed as a methodology, using methods such as focus groups and student diary entries to facilitate student reflection on their science identities and experiences with the Linear Curriculum.

While efforts were made to include participants in this research who were 'diverse enough' (Laverty, 2003, p.49) (Chapter 3.7.3), the lack of diversity in terms of ethnicity, race, personal experiences, professional beliefs, and broader social identities (Berger, 2015) was not possible, within the confines of the research school. Given the study's engagement with social justice, identity, and cultural capital, the absence of broader representation may result in partial or constrained interpretations. This limitation is not merely demographic; it has epistemic consequences, as different identity positions offer different lenses on the curriculum and its effects. This limitation may potentially have been alleviated to a point, had a more diverse Advisory Group been employed as previously discussed. A more diverse group would have the potential to offer insights into this research which may have been missed with the restrictive lens through which data were observed and interpreted. Arguably, a lack of diversity perhaps limits the transferability and ethical robustness of this research. This is particularly important in a study concerned with social justice and the reproduction of capital in education. Future research in similar contexts should consider strategies to ensure that the range of identities and experiences reflected in the school population is proportionally present in the research sample.

Finally, the challenge of conducting academic research in the school within which you practice warrants further attention. Navigating roles as both subject leader, teacher of science and researcher requires balancing the boundaries of each role contextually and flexibly. For others following in my footsteps, I would suggest and highlight the importance of incorporating external challenges. This in itself may be a challenge where school leaders, although granting permission to conduct the research, fear detrimental observations and discussions of the inner workings of the school (Czerniawski, 2023). However, triangulation of data using teacher voice, student voice and that of an external advisory group would add robustness to the findings.

This doctoral journey has highlighted the richness, but also the complexity, of conducting embedded research as a practitioner-researcher. As discussed here, my

position within the research setting enabled deep insight but also bore limitations and ethical tensions that require careful, ongoing reflexivity. Based on this experience, the key recommendations I would offer to future practitioner-researchers conducting research within their own school setting are:

1) Seek external validation by involving colleagues outside the research context, through advisory groups or feedback sessions. This can reduce bias, highlight unrecognised assumptions, and may offer alternative interpretations.

2) Ensure the diversity of participants is representative of the research focus. Where this is not possible, within the research context, consider diversity within an external advisory group as above.

Engaging in doctoral research within one's own institution is a powerful professional and personal experience. However, it requires ongoing ethical and methodological attentiveness, particularly around issues of positionality, power, and voice.

6.8 Professional Learning That Has Taken Place

Having constructed a bricolage (Figure 3.1) of my 'feelings and experiences' (Fleming, Gaidys and Robb, 2003, p.117), it would seem pertinent to reflect on this as I reach the end of this research journey. The principle upon which the Linear Curriculum was developed, 'equality,' reflects my working-class background and arguably aligns with that of many of the students for whom this curriculum was developed. My personal experience of gaining social mobility was my driver in reducing social injustice for my students, and one shared with colleagues when the Linear Curriculum was developed. Social justice permeates through the Linear Curriculum in its design, making knowledge more accessible and developing aspirations, resilience, and success in all students of science. At the beginning of this research, I considered the Linear Curriculum could potentially act as an intervention, raise aspirations, and build confidence in students (Table 3.2). Although my beliefs have not altered, I see the importance of embedding the *Working Scientifically* skills to develop the 'Thinking like a scientist' skills, displayed in Figure 5.3, to ensure the students are more likely to be good scientists, rather than simply being good at science as shown in Figure 5.4. Similarly, despite this research journey, the tangibility of the term cultural capital (Chapter 4.4.4) is difficult to argue against due to Ofsted's debatable divisive, ill-

informed or ‘aerosol’ use of the term. Smyth and Shacklock (1998, p.21) described aerosol words as ‘the latest bouquet words to be sprayed around over our ever-so-slightly decaying educational institutions’, which resonates with me from its inclusion in the *EIF* (Ofsted, 2019b).

With a scientific background and experience only in quantitative data, my Doctoral journey involved a steep learning curve in qualitative academic writing. This journey has not been smooth, with the COVID-19 pandemic interrupting the earlier stages of this journey. Writing this final section, there is still a long path to follow, and reflecting on how I have grown and the commitment and resilience I have developed, I am proud of the research I have completed. The presentation of my findings at an international (Copeland, 2022) and a national conference (Copeland, 2023) have been two of the highlights of this journey.

I began this research thinking the curriculum was an object designed by a group of professionals or experts, and as noted in Table 3.2, my initial interpretation of senior leaders' expectations was arguably not what was expected. However, as the Linear Curriculum took shape, it became something the Science team and I were very proud of and something we believe will improve the aspirations and success of our students. As curriculum development progressed, I came to understand how the *habitus* and prejudices of the teachers involved in curriculum development shape the curriculum and how the importance of understanding the school context is paramount. This research process has contributed to my learning and professional practice in unexpected ways.

My position as Head of Science, whilst presenting potential ethical issues as discussed in Chapter 3.10, placed me in a privileged position. Despite having worked with my colleagues, some for many years, as a participant in this research they chose to reveal and share their personal backgrounds and experiences, which before this research I did not know of. With this newly gained information, I developed a greater understanding of each participant, both personally and professionally. Concerns around perceived power relationships, with my primary role as Head of Science, were contemplated throughout the research process. On every occasion when I assumed the role of researcher, I endeavoured to put the participants at ease and assured them everything

they shared with me was important. The trust participants had in the research process and with me as Head of Science and researcher was demonstrated particularly well in the focus group interview, where participants appeared relaxed and willing to share their viewpoints, both positive and negative. Trust in colleagues' professionalism throughout this research has emphasised to me its importance in moving the department forward. As discussed in Chapter 2.6, trust is an important aspect in enhancing the feeling of professionalism experienced in teaching and is also linked to school improvement. The honesty and trust exhibited by the participants throughout this research have been extraordinary. In line with the literature (Chapter 2.6), the trust afforded the participants provided them with CPD opportunities, and as described by them in Chapter 4.5, the research process has improved their pedagogies and their classroom practices. A leadership style that encourages trust among colleagues would appear to be essential in moving both teachers and the school forward. The exploration of my leadership style and that of senior leaders in the school where this research was conducted is beyond the remit of this research but presents an interesting avenue for further study at a more opportune time.

Although some participants were more reticent to take centre stage, the respect and value of relationships within the group seemed to provide a safe environment, which helped to reveal aspects of participants' *habitus* that I had not already ascertained. This new knowledge and understanding of each participant have helped to enrich my role as Head of Science. This was gained through the analysis process, using the theoretical framework (Figure 5.1), which is something other researchers and curriculum developers might also find useful. Additionally, before implementing an 'off-the-shelf' curriculum into a school, I would now recommend schools consider the school context to ensure the curriculum design is sympathetic to the situation of the school and students' lives.

As a teacher, I have learnt the true meaning and importance of reflexivity and its role in my interactions with others, both colleagues and students. I have learnt to value my interactions with others and to understand their motivations. All my participants expressed how much the research process impacted them professionally and how it fundamentally changed their practices. Relationships in the staffroom are forever

changed for the better, and discussions in meetings are now much more focused and research based.

References

Ajjawi, R. and Higgs, J. (2007). Using Hermeneutic Phenomenology to Investigate How Experienced Practitioners Lear n to Communicate Clinical Reasoning. *The Qualitative Report*. 12 (4). pp. 612–638.

Alharahsheh, H.H. and Pius, A. (2020). A Review of Key Paradigms: Positivism vs Interpretivism. *Global Academic Journal of Humanities and Social Sciences*. [Online]. 2 (3). pp. 39–43. Available from: https://www.researchgate.net/publication/338244145. [Accessed: 12 December 2020].

Alsaigh, R. and Coyne, I. (2021). Doing a Hermeneutic Phenomenology Research Underpinned by Gadamer's Philosophy: A Framework to Facilitate Data Analysis. *International Journal of Qualitative Methods*. 20. pp. 1–10.

Altrichter, H., and Kemethofer, D. (2015). Does Accountability Pressure Through School Inspections Promote School Improvement? *School Effectiveness and School Improvement*. 26 (1). pp. 32–56. https://doi.org/10.1080/09243453.2014.927369I.

Apple, M.W. (2001). Comparing Neo-Liberal Projects and Inequality in Education. *Comparative Education*. 37 (4). pp. 409-423.

Apple, M.W. (2018). Critical Curriculum Studies and the Concrete Problems of Curriculum Policy and Practice. *Journal of Curriculum Studies*. [Online]. 50 (6). pp. 685-690. Available from: https://www.tandfonline.com/doi/full/10.1080/00220272.2018.1537373. [Accessed: 15 February 2020].

Archer, L., Dawson, E., DeWitt, J., Godec, S., King, H., Mau, A., Nomikou, E. and Seakins, A. (2017c). Killing Curiosity? An Analysis of Celebrated Identity Performances Among Teachers and Students in Nine London Secondary Science Classrooms. *Science Education*. 101 (5). pp. 741–764.

Archer, L., Dawson, E., DeWitt, J., Seakins, A. and Wong, B. (2015b). 'Science Capital': A Conceptual, Methodological, and Empirical Argument for Extending Bourdieusian Notions of Capital Beyond the Arts. *Journal of Research in Science Teaching*. 52 (7). pp. 922–948.

Archer, L., Dawson, E., Seakins, A., Dewitt, J. and Wong, B. (2015a). Author Response. *Science Education*. 99 (6). pp. 1147–1149.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. and Wong, B. (2010). 'Doing' Science Versus 'Being' a Scientist: Examining 10/11-Year-Old Schoolchildren's Constructions of Science Through the Lens of Identity. *Science Education*. 94 (4). pp. 617–639.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. and Wong, B. (2012). Science Aspirations, Capital, and Family Habitus: How Families Shape Children's Engagement and Identification With Science. *American Educational Research Journal*. 49 (5). pp. 881–908.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. and Wong, B. (2013b). 'Not Girly, Not Sexy, Not Glamorous': Primary School Girls' and Parents' Constructions of Science Aspirations. *Pedagogy, Culture and Society*. 21 (1). pp. 171–194.

Archer, L., DeWitt, J., Osbourne, J., Dillon, J., Wong, B. and Willis, B. (2013a). *ASPIRES Report: Young People's Science and Career Aspirations, Age 10-14*. London.

Archer, L., DeWitt, J. and Willis, B. (2014). Adolescent Boys' Science Aspirations: Masculinity, Capital, and Power. *Journal of Research in Science Teaching*. 51 (1). pp. 1–30.

Archer, L., Francis, B., Miller, S., Taylor, B., Tereshchenko, A., Mazenod, A., Pepper, D. and Travers, M.C. (2018). The Symbolic Violence of Setting: A Bourdieusian Analysis of Mixed Methods Data on Secondary Students' Views About Setting. *British Educational Research Journal*. 44 (1). pp. 119–140.

Archer, L., Godec, S., Calabrese Barton, A., Dawson, E., Mau, A. and Patel, U. (2021). Changing the Field: A Bourdieusian Analysis of Educational Practices That Support Equitable Outcomes Among Minoritized Youth on Two Informal Science Learning Programs. *Science Education*. 105 (1). pp. 166–203.

Archer, L., Moote, J., Francis, B., DeWitt, J. and Yeomans, L. (2017a). The 'Exceptional' Physics/ Engineering Girl: a Sociological Analysis of Longitudinal Data From Girls Aged 10-16 to Explore Gendered Patterns of Post-16 Participation. *American Educational Research Journal*. 54 (1). pp. 88–126.

Archer, L., Moote, J., Francis, B., DeWitt, J. and Yeomans, L. (2017b). Stratifying Science: A Bourdieusian Analysis of Student Views and Experiences of School Selective Practices in Relation to 'Triple Science' at KS4 in England. *Research Papers in Education*. [Online]. 32 (3). pp. 296–315. Available from: http://dx.doi.org/10.1080/02671522.2016.1219382. [Accessed: 2 April 2020].

Archer, L., Moote, J., MacLeod, E., Francis, B. and DeWitt, J. (2020). *ASPIRES 2: Young People's Science and Career Aspirations, Age 10–19*. [Online]. 2020. London: UCL Institute of Education. Available from: https://www.sciencecentres.org.uk/documents/492/Aspires_2_full_report.pdf. [Accessed: 6 February 2022].

Archer, L., Nomikou, E., Mau, A., King, H., Godec, S., DeWitt, J. and Dawson, E. (2019). Can the Subaltern 'Speak' Science? An Intersectional Analysis of Performances of 'Talking Science Through Muscular Intellect' by 'Subaltern' Students in UK Urban Secondary Science Classrooms. *Cultural Studies of Science Education*. 14 (3). pp. 723–751.

Archer, M.S. (2000). *Being Human: The Problem of Agency*. Cambridge: Cambridge University Press.

Archer, M.S. (2003). *Structure, Agency, and the Internal Conversation*. Cambridge: Cambridge University Press.

Archer, M.S. (2007). *Making Our Way Through the World*. [Online]. Cambridge: Cambridge University Press. Available from: https://www.google.co.uk/books/edition/Making_our_Way_through_the_World/q7-enLkoT1QC?hl=en&gbpv=1&pg=PP1&printsec=frontcover. [Accessed: 16 July 2023].

Arnold, M. and Wilson, J.D. (1960). *Culture and Anarchy*. [Online]. Cambridge: Cambridge University Press. Available from: https://repositories.lib.utexas.edu/handle/2152/39127%0Ahttps://cris.brighton.ac.uk/ws/portalfiles/portal/4755978/Julius+Ojebode%27s+Thesis.pdf%0Ausir.salford.ac.uk/29369/1/Angela_Darvill_thesis_esubmission.pdf%0Ahttps://dspace.lboro.ac.uk/dspace-jspui/ha. [Accessed: 7 September 2024].

Aschbacher, P.R., Li, E. and Roth, E.J. (2010). Is Science Me? High School Students' Identities, Participation and Aspirations in Science, Engineering, and Medicine. *Journal of Research in Science Teaching*. 47 (5). pp. 564–582.

ASPIRES Research (2022). *ASPIRES 3 Project Spotlight2: 'Make It More Relevant and Practical': Young People's Vision for School Science in England*. [Online]. 2022. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/941351/TIMSS_2019_National_Report.pdf. [Accessed: 26 June 2023].

Aubrey, K. and Riley, A. (2019). *Understanding and Using Educational Theories*. 2nd Ed. J. Clark (ed.). London: Sage Publications.

Avraamidou, L. (2019). Stories We Live, Identities We Build: How are Elementary Teachers' Science Identities Shaped by Their Lived Experiences? *Cultural Studies of Science Education*. [Online]. 14 (1). pp. 33–59. Available from: https://doi.org/10.1007/s11422-017-9855-8. [Accessed: 5 March 2023].

Ball, S.J. (2003). The Teacher's Soul and the Terrors of Performativity. *Journal of Education Policy*. 18 (2). pp. 215–228.

Ball, S.J. (2015). What is Policy? 21 Years Later: Reflections on the Possibilities of Policy Research. *Discourse: Studies in the Cultural Politics of Education*. 36 (3). pp. 306–313.

Ball, S.J. (2017). *The Education Debate*. 3rd Ed. Bristol: Policy Press.

Ball, S.J., Maguire, M. and Braun, A. (2012). *How Schools Do Policy. Policy Enactments in Secondary Schools*. London: Routledge.

Bartlett, R. and Milligan, C. (2015). *Diary Method. Research Methods*. London: Bloomsbury Academic.

Basford, J. (2019). An Essential Guide to Cultural Capital. *Nursery World*. (September). pp. 23–26.

Basit, T.N. (2010). *Conducting Research in Educational Contexts*. London: Continuum International Publishing Group.

Bates, B. (2018). *Learning Theories Simplified.* 2nd Ed. London: Sage Publications.

Bates, G. and Connolly, S. (2022). 'Different People, Different Backgrounds, Different Identities': Filling the Vacuum Created by Policy Views of 'Cultural Capital'. *Curriculum Journal*. (August 2022). pp. 1–16.

Bates, J., Lewis, S. and Pickard, A. (2011). *Education Policy, Practice and the Professional*. London: Continuum International Publishing Group.

Baxter, J., Ehren, M. and Paterson, A. (2018). Distrust : Context, Culture and Corruption : The case of Governance of South African Education. *Research Gate*. pp. 1–17.

Beauchamp, C. and Thomas, G. (2010). Reflecting on an Ideal: Student Teachers Envision a Future Identity. *Reflective Practice*. 11 (5). pp. 631–643.

Beijaard, D., Koopman, M. and Schellings, G.L.M. (2022). Reframing Teacher Professional Identity and Learning. In: I. Mentor (ed.). *The Palgrave Handbook of Teacher Education Research*. Springer International Publishing, pp. 1–23.

Beijaard, D., Meijer, P.C. and Verloop, N. (2004). Reconsidering Research on Teachers' Professional Identity. *Teaching and Teacher Education*. 20 (2). pp. 107–128.

Berger, R. (2015). Now I See It, Now I Don't: Researcher's Position and Reflexivity in Qualitative Research, *Qualitative research.* 15 (2). pp. 219–234. Available at: https://doi.org/10.1177/1468794112468475.

Berger, N. and Archer, J. (2018). Qualitative Insights into the Relationship Between Socioeconomic Status and Students' Academic Achievement Goals. *Society of Psychology Education*. 21. pp. 787–803.

Bhuttah, T. M., Xiaoduan, C., Ullah, H., Javed, S. (2019) Analysis of Curriculum Development Stages from the Perspective of Tyler, Taba and Wheeler. *European Journal of Social Sciences*, 58(1). pp. 14–22.

Bianchi, L., Whittaker, C. and Poole, A. (2021). The 10 Key Issues with Children's Learning in Primary Science in England. The University of Manchester: Manchester UK.

Biesta, G., and Tedder, M. (2007). Agency and Learning in the Lifecourse: Towards an Ecological Perspective. *Studies in the Education of Adults*. 39 (2). pp.132–149. https://doi.org/10.1080/02660830.2007.11661545

Birkenshaw, C. and Temple Clothier, A.L. (2021). The Strange Case of Querying Gove's Cultural Capital Legacy. *Pedagogy, Culture and Society*. [Online]. 00 (00). pp. 1–17. Available from: https://doi.org/10.1080/14681366.2021.1933144. [Accessed: 2 February 2022].

Blaike, N. and Priest, J. (2019). *Designing Social Research*. 3rd Ed. Cambridge: Polity Press.

Board of Education (1944). *Education Act 1944*. [Online]. 1944. Available from: http://www.legislation.gov.uk/ukpga/Geo6/7-8/31/contents/enacted. [Accessed: 23 December 2019].

Boncori, I. and Smith, C. (2020). Negotiating the Doctorate as an Academic Professional: Identity Work and Sensemaking Through Autoethnographic Methods. *Teaching in Higher Education*. 25 (3). pp. 271–285.

Borda, E.J. (2007). Applying Gadamer's Concept of Disposition to Science and Science Education. *Science and Education*. 16 (9–10). pp. 1027–1041.

Bourdieu, P. (1984). *Distinction: A Social Critique of the Judgement of Taste (Translated by Richard Nice).* London: Routledge and Kegan Paul, Ltd.

Bourdieu, P. (1986). The Forms of Capital. In: J. Richardson (ed.). *Handbook of Theory and Research for the Sociology of Education*. New York: Greenwood Press, pp. 241–258.

Bourdieu, P. (1990). *The Logic of Practice (Translated by Richard Nice)*. Stanford: Stanford University Press.

Bourdieu, P. (2000). *Pascalian Meditations (Translated by Richard Nice)*. Stanford CA: Stanford University Press.

Bourdieu, P. and Passeron, J.-C. (1977). *Reproduction in Education, Society and Culture*. London: Sage.

Bradfield, K.Z. and Exley, B. (2020). Teachers' Accounts of Their Curriculum Use: External Contextual Influences During Times of Curriculum Reform. *Curriculum Journal*. 31 (4). pp. 757–774.

Braund, M. and Reiss, M. (2006). Validity and Worth in the Science Curriculum: Learning School Science Outside the Laboratory. *Curriculum Journal*. 17 (3). pp. 213–228.

Brickhouse, N.W. and Potter, J.T. (2001). Young Women's Scientific Identity Formation in an Urban Context. *Journal of Research in Science Teaching*. 38 (8). pp. 965–980.

British Educational Research Association (2018). *Ethical Guidelines for Educational Research*. 4th Ed. [Online]. London. Available from: http://www.bera.ac.uk/publications. [Accessed: 12 June 2021].

Broadbent, J. and Laughlin, R. (1997). Contracts and Competition? A Reflection on the Nature and Effects of Recent Legislation on Modes of Control in Schools. *Cambridge Journal of Economics*. 21 (2). pp. 277–290.

Brooks, R., Maguire, M. and te Riele, K. (2014). Identity, Power and Positionality. In: *Ethics and Education Research*. London: Sage Publications, pp. 100–116.

Brown, C., Spiro, J. and Quinton, S. (2020). The Role of Research Ethics Committees: Friend or Foe in Educational Research? An Exploratory Study. *British Educational Research Journal*. 46 (4). pp. 747–769.

Butler, J. (1988). Performative Acts and Gender Constitution: An Essay in Phenomenology and Feminist Theory. *Theatre Journal*. 40 (4). pp. 519–531.

Calabrese Barton, A. and Tan, E. (2010). We Be Burnin'! Agency, Identity, and Science Learning. *Journal of the Learning Sciences*. 19 (2). pp. 187–229.

Calado, S., Neves, I.P. and Morais, A.M. (2013). Conceptual Demand of Science Curricula; A Study at the Middle School Level. *Pedagogies*. 8 (3). pp. 255-277.

Callaghan, J. (1976). *The Great Debate*. [Online]. 1976. Available from: https://education-uk.org/documents/speeches/1976ruskin.html. [Accessed: 17 October 2019].

Cao, X. and Henderson, E.F. (2021). *Exploring Diary Methods in Higher Education Research: Opportunities, Choices and Challenge.* London: Routledge.

Carlone, H.B. and Johnson, A. (2007). Understanding the Science Experiences of Successful Women of Color: Science Identity as an Analytic Lens. *Journal of Research in Science Teaching*. 44 (8). pp. 1187–1218.

Carlone, H.B., Webb, A., Archer, L. and Taylor, M. (2015). What Kind of Boy Does Science? A Critical Perspective on the Science Trajectories of Four Scientifically Talented Boys. *Science Education*. 99 (3). pp. 438–464.

Childs, A. and Baird, J.A. (2020). General Certificate of Secondary Education (GCSE) and the Assessment of Science Practical Work: An Historical Review of Assessment Policy. *Curriculum Journal*. 31 (3). pp. 357–378.

Claussen, S. and Osborne, J. (2013). Bourdieu's Notion of Cultural Capital and Its Implications for the Science Curriculum. *Science Education*. 97 (1). pp. 58–79.

Cohen, L., Manion, L. and Morrison, K. (2017). *Research Methods in Education*. 8th Ed. Abingdon: Routledge.

Copeland, C. (2022). A Bourdieusian View of a Linear Curriculum Through the Perceptions of Secondary Science Teachers. Poster presented to the AERA Annual Conference 2022, San Diego, America, 21-26 April. Available from*:* https://aera22-aera.ipostersessions.com/default.aspx?s=4F-1A-80-85-4C-31-47-75-F8-7B-D9-2B-1F-89-22-47 [Accessed: 23 November 2024].

Copeland, C. (2023). A Gadamerian Exploration of Teacher Perceptions of a Secondary Science Linear Curriculum Through a Bourdieusian Lens. Paper presented to the BERA Annual Conference 2023, Birmingham, UK, 12-14 September.

Czerniawski, G. (2023). Power, Positionality and Practitioner Research: Schoolteachers' Experiences of Professional Doctorates in Education. *British Educational Research Journal.* 49 (6). pp. 1372-1386.

Czerniawski, G and Thomason, M. (2025). Researcher Positionality, Power and Doctoral Research. In: Roffey-Barentsen, J. and Burnell Reilly, I. (eds.). *Completing Your EdD: The Essential Guide to the Doctor of Education.* 2nd Ed*. Emerald Publishing Limited, pp. 118-139.*

Davies, B. (2010). The Struggle Between the Individualised Subject of Phenomenology and the Multiplicities of the Poststructuralist Subject: The Problem of Agency. *Reconceptualizing Educational Research Methodology* 1 (1). pp. 54–68. doi:10.7577/rerm.171.

Day, C. (2019). What is Teaching About? Professionalism and the Limitations of Standards and Competences. *European Journal of Education*. (July). pp. 315–318.

Day, C., Elliot, B. and Kington, A. (2005). Reform, Standards and Teacher Identity: Challenges of Sustaining Commitment. *Teaching and Teacher Education*. 21 (5). pp. 563-577.

Debarger, A.H., Penuel, W.R., Moorthy, S., Beauvineau, Y., Kennedy, C.A. and Boscardin, C.K. (2017). Investigating Purposeful Science Curriculum Adaptation as a Strategy to Improve Teaching and Learning. *Science Education*. 101 (1). pp. 66–98.

Denscombe, M. (2014). Phenomenology. In: *The Good Research Guide. For Small-Scale Social Research Projects*. Berkshire: Open University Press, pp. 95–105.

DES (1981). *The School Curriculum*. [Online]. 1981. Circular 6/81. Available from: http://www.educationengland.org.uk/documents/des/schoolcurric.html. [Accessed: 11 March 2023].

DES (1988). *Education Reform Act 1988*. [Online]. 1988. Available from: http://www.legislation.gov.uk/ukpga/1988/40/pdfs/ukpga_19880040_en.pdf. [Accessed: 3 November 2019].

Dewey, J. (1933). *How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process*. Chicago, IL: Henry Regnery. doi: 10. 1002/9780470773260.ch3.

DeWitt, J., Archer, L. and Mau, A. (2016). Dimensions of Science Capital: Exploring its Potential for Understanding Students' Science Participation. *International Journal of Science Education*. 38 (16). pp. 2431–2449.

DeWitt, J., Archer, L. and Moote, J. (2019). 15/16-Year-Old Students' Reasons for Choosing and Not Choosing Physics at A level. *International Journal of Science and Mathematics Education*. 17 (6). pp. 1071–1087.

DeWitt, J., Archer, L. and Osborne, J. (2013). Nerdy, Brainy and Normal: Children's and Parents' Constructions of Those Who are Highly Engaged with Science. *Research in Science Education*. 43 (4). pp. 1455–1476.

DeWitt, J., Archer, L., Osborne, J., Dillon, J., Willis, B. and Wong, B. (2011). High Aspirations But Low Progression: The Science Aspirations-Careers Paradox Amongst Minority Ethnic Students. *International Journal of Science and Mathematics Education*. 9 (2). pp. 243–271.

DfE (1992). *Education Act 1992*. [Online]. 1992. Available from: http://lcweb5.loc.gov/glin/jurisdictions/United_Kingdom/pdfs/213056-187978.pdf. [Accessed: 16 December 2019].

DfE (2010a). *Academies Act 2010*. [Online]. 2010. Available from: http://www.legislation.gov.uk/ukpga/2010/32/contents. [Accessed: 26 October 2019].

DfE (2010b). *The Importance of Teaching: The Schools White Paper 2010.* [Online]. 2010. Available from: https://www.gov.uk/government/publications/the-importance-of-teaching-the-schools-white-paper-2010. [Accessed: 23 December 2019].

DfE (2011). *The Framework for the National Curriculum. A Report by the Expert Panel for the National Curriculum Review.* [Online]. 2011. Available from: http://www.educationengland.org.uk/documents/pdfs/2011-nc-review-panel-report.pdf. [Accessed: 27 December 2019].

DfE (2014). *The National Curriculum in England. Key Stages 3 and 4 Framework Document*. [Online]. Available from: https://www.gov.uk/national-curriculum/key-stage-3-and-4. [Accessed: 6 February 2022].

DfE (2016). *Educational Excellence Everywhere*. [Online]. 2016. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/508550/Educational_excellence_everywhere__print_ready_.pdf. [Accessed: 30 November 2019].

DfE (2017a). *Social Mobility Index: 2017 Data*. [Online]. 2017. Available from: https://www.gov.uk/government/publications/social-mobility-index-2017-data%0Ahttps://www.gov.uk/government/publications/social-mobility-index-2017-data%0Ahttps://www.gov.uk/government/publications/social-mobility-index-2017-data. [Accessed: 8 January 2023].

DfE (2017b). *Social Mobility Delivery Plan. Stoke-on-Trent. Opportunity Area 2017-20.* [Online]. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/696855/Social_Mobility_Delivery_Plan_Stoke-on-Trent_v8_FINAL_WEB.PDF.PDF. [Accessed: 14 August 2019].

DfE (2021). *Teachers' Standards. Guidance for School Leaders, School Staff and Governing Bodies*. [Online]. Available from: https://www.gov.uk/government/publications/teachers-standards. [Accessed: 14 September 2024].

DfE (2024a). *Secondary Accountability Measures*. [Online]. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1134998/Secondary_accountability_measures_2022_guidance_for_maintained_secondary_schools__academies_and_free_schools.pdf. [Accessed: 15 September 2024].

DfE (2024b). *National Professional Qualification (NPQ) Courses*. [Online]. 2024. Available from: https://www.gov.uk/guidance/national-professional-qualification-npq-courses. [Accessed: 14 September 2024].

DfEE (1998). *Teachers: Meeting the Challenge of Change*. [Online]. London: Green Paper. Available from: https://www.education-uk.org/documents/official-papers/1998-gp-teachers-challenge-change.html. [Accessed: 3 June 2023].

Dhillon, J. and Thomas, N. (2019). Ethics of Engagement and Insider-Outsider Perspectives: Issues and Dilemmas in Cross-Cultural Interpretation. *International Journal of Research and Method in Education*. 42 (4). pp. 442–453.

Ebneyamini, S. and Moghadam, M.R.S. (2018). Toward Developing a Framework for Conducting Case Study Research. *International Journal of Qualitative Methods*. 17 (1). pp. 1–11.

Edwards, J. (2021). Ethical Autoethnography: Is it Possible? *International Journal of Qualitative Methods*. 20. pp. 1–6.

Egelandsdal, K. and Riese, H. (2020). Never Mind the Gap: Formative Assessment Confronted with Dewey's and Gadamer's Concept of Experience. *European Journal of Education*. 55 (1). pp. 91–104.

Eger, M. (1997). Achievements of the Hermeneutic-Phenomenological Approach to Natural Science: A Comparison with Constructivist Sociology. *Continental Philosophy Review*. 30 (3). pp. 343–367.

Ehren, M., Paterson, A. and Baxter, J. (2020). Accountability and Trust: Two Sides of the Same Coin? *Journal of Educational Change*. [Online]. 21 (1). pp. 183–213. Available from: https://oro.open.ac.uk/68545/9/baxter.pdf. [Accessed: 31 October 2024].

Ellis, C. (2007). Telling Secrets, Revealing Lives. Relational Ethics in Research with Intimate Others. *Qualitative Inquiry*. [Online]. 13 (1). pp. 3–29. Available from: https://doi.org/10.1177/1077800406294947. [Accessed: 14 January 2023].

Ellis, C., Adams, T.E. and Bochner, A.P. (2011). Autoethnography: An Overview. *Qualitative Social Research*. 12 (1). pp. 1–12.

Erikson, E. (1959). Erik Eikson's Theory of Identity Development. In: *Identity and the Life Cycle*. [Online]. pp. 42–57. Available from: https://www.bpi.edu/ourpages/auto/2018/11/21/57748242/theory of identity erikson.pdf. [Accessed: 13 April 2025].

Essex, J. (2018). Why 'Science for All' is Only an Aspiration: Staff Views of Science for Learners with Special Educational Needs and Disabilities. *Support for Learning*. 33 (1). pp. 52–72.

Fairbrother, R. and Dillon, J. (2009). Triple Science Back on the Agenda. *School Science Review*. 91 (334). pp. 65–69.

Fleming, V., Gaidys, U. and Robb, Y. (2003). Hermeneutic Research in Nursing: Developing a Gadamerian-Based Research Method. *Nursing Inquiry*. 10 (2). pp. 113–120.

Follows, M. (2001). Reflections on Ofsted's Seven-Year Reign. *Management in Education*. 15 (4). pp. 26–29.

Forrester, G. (2000). Professional Autonomy Versus Managerial Control: The Experience of Teachers in an English Primary School. *International Studies in Sociology of Education*. 10 (2). pp. 133-151.

Forrester, G. (2005). All In a Day's Work: Primary Teachers 'Performing' and 'Caring.' *Gender and Education*. 17(3), 271-287.

Forrester, G. and Garratt, D. (2016). *Education Policy Unravelled*. 2nd Ed. London: Bloomsbury Academic.

Foucault, M. (1980). *Power / Knowledge. Selected Interviews and Other Writings 1972-1977. (Translated by C. Gordon, L. Marshall, J. Mepham, K. Soper)*. C. Gordon (ed.). New York: Pantheon Books.

Francis, B., Archer, L., Hodgen, J., Pepper, D., Taylor, B. and Travers, M.C. (2017). Exploring the Relative Lack of Impact of Research on 'Ability Grouping' in England: A Discourse Analytic Account. *Cambridge Journal of Education*. 47 (1). pp. 1–17.

Francis, B., Henderson, M., Godec, S., Watson, E., Archer, L. and Moote, J. (2023). An Exploration of the Impact of Science Stratification in the English School Curriculum: The Relationship Between 'Double' and 'Triple' Science Pathways and Pupils' Further Study of Science. *Research Papers in Education*. [Online]. 00 (00). pp. 1–23. Available from: https://doi.org/10.1080/02671522.2023.2283417. [Accessed: 18 February 2024].

Gadamer, H.-G. (2013). *Truth and Method (Translation revised by Joel Weinsheimer and Donald G. Marshall).* 2nd Ed. New York: Bloomsbury Academic.

Galton, M. (2002). Continuity and Progression in Science Teaching at Key Stages 2 and 3. *Cambridge Journal of Education.* 32 (2). pp. 249-265.

Garcia-Huidobro, J.C. (2018). Addressing the Crisis in Curriculum Studies: Curriculum Integration That Bridges Issues of Identity and Knowledge. *Curriculum Journal*. 29 (1). pp. 25–42.

Gathercole, S.E. and Pickering, S.J. (2000). Working Memory Deficits in Children With Low Achievements in the National Curriculum at 7 Years of Age. *Education*. pp. 177–194.

Gericke, N., Hudson, B., Olin-Scheller, C. and Stolare, M. (2018). Powerful Knowledge, Transformations and the Need for Empirical Studies Across School Subjects. *London Review of Education*. 16 (3). pp. 428–444.

Gewirtz, S. (1996). Choice, Competition and Equity: Lessons From Research in the United Kingdom. *Journal of Curriculum and Supervision*. 11 (3). pp. 205–228.

Gibbs, B. (2014). Reconfiguring Bruner: Compressing the Spiral Curriculum. *Phi Delta Kappen*. 95 (7). pp. 41-44.

Giddens, A. (1984). *The Constitution of Society: Outline of the Theory of Structuration*. University of California Press.

Giles, D. (2011). Relationships Always Matter: Findings From a Phenomenological Research Inquiry. *Australian Journal of Teacher Education*. 36 (6). pp. 80–91.

Godec, S., Archer, L. and Dawson, E. (2022). Interested But Not Being Served: Mapping Young People's Participation in Informal STEM Education Through an Equity Lens. *Research Papers in Education*. [Online]. 37 (2). pp. 221–248. Available from: https://doi.org/10.1080/02671522.2020.1849365. [Accessed: 12 November 2022].

Godec, S., King, H., Archer, L., Dawson, E. and Seakins, A. (2018). Examining Student Engagement with Science Through a Bourdieusian Notion of Field. *Science and Education*. 27 (5–6). pp. 501–521.

Godfrey, D. (2017). What is the Proposed Role of Research Evidence in England's 'Self-Improving' School System? *Oxford Review of Education*. 43 (4). pp. 433–446.

Goffman, E. (1951). Symbols of Class Status. *The British Journal of Sociology*. 2 (4). pp. 294–304.

Gordon, P. (1988). UK Commentary: The New Right, Race and Education - Or How the Black Papers Became a White Paper. *Race and Class*. 29 (3). pp. 95–103.

Graham, D. (1991). National Curriculum - National Standards. *RSA Journal*. 140 (5424). pp. 61–69.

Graham, D. and Tytler, D. (1993). *A Lesson For Us All: The Making of the National Curriculum*. London: Routledge.

Groenewald, T. (2004). A Phenomenological Research Design Illustrated. *International Journal of Qualitative Methods*. 3 (1). pp. 42–55.

Guseva, L.G. and Solomonovich, M. (2017). Implementing the Zone of Proximal Development: From the Pedagogical Experiment to the Developmental Education System of Leonid Zankov. *International Electronic Journal of Elementary Education*. 9 (4). pp. 775–786.

Guzel, G. and Sahin H. (2019). A Qualitative Study for The Evaluation of The 1-4. Classes' Mathematics Curriculum in Content in Terms of Spiral Program Approach. *International Online Journal of Educational Sciences*. 11 (2). pp. 188-200.

Hacker, R.G. and Rowe, M.J. (1998). A Longitudinal Study of the Effects of Implementing a National Curriculum Project upon Classroom Processes. *The Curriculum Journal*. 9 (1). pp. 95–103.

Hall, J., Allan, A., Tomlinson, M., Kelly, A. and Lindorff, A. (2021). Negative Capital: A Generalised Definition and Application to Educational Effectiveness and Equity. *Oxford Review of Education*. 47 (3). pp. 316–334.

Hamlyn, B., Hanson, T., Malam, S., Man, C., Smith, K. and Williams, L. (2020). *Young People's Views on Science Education*. [Online]. 2020. Science Education Tracker 2019. Available from: https://wellcome.org/sites/default/files/science-education-tracker-2019.pdf. [Accessed: 15 May 2021].

Harden, R.M. and Stamper, N. (1999). What is a Spiral Curriculum? *Medical Teacher*. 21 (2). pp. 141-143.

Harrison, L.J., Wong, S., Press, F., Gibson, M. and Ryan, S. (2019). Understanding the Work of Australian Early Childhood Educators Using Time-Use Diary Methodology. *Journal of Research in Childhood Education*. 33 (4). pp. 521–537.

Harwood, J. (2020). Social Identity Theory. *The International Encyclopaedia of Medical Psychology*. pp. 1–7.

Heidegger, M. (1962). *Being and Time (Translated by John Macquarrie and Edward Robinson)*. New York: Harper and Row.

Hickey, P.J. (2012). Unlearning to Learn: Investigating the Lived Experience of Learning English. *English Teaching*. 11 (2). pp. 145–162.

Hizli Alkan, S. and Priestley, M. (2019). Teacher Mediation of Curriculum Making: The Role of Reflexivity. *Journal of Curriculum Studies*. [Online]. 51 (5). pp. 737–754. Available from: https://doi.org/10.1080/00220272.2019.1637943. [Accessed: 28 November 2020].

Hodge, S. (2024) 'Curriculum Work and Hermeneutics', *Curriculum Journal*, 35(1), pp. 6–19. doi: 10.1002/curj.214.

Homer, M., Ryder, J. and Banner, I. (2014). Measuring Determinants of Post-Compulsory Participation in Science: A Comparative Study Using National Data. *British Educational Research Journal*. 40 (4). pp. 610–636.

Homer, M., Ryder, J. and Donnelly, J. (2013). Sources of Differential Participation Rates in School Science: The Impact of Curriculum Reform. *British Educational Research Journal*. 39 (2). pp. 248–265.

House of Commons Science and Technology Committee (2017). *Science Communication and Engagement*. [Online]. 2017. Science and Technology Committee Eleventh Report of Session 2016-17. Available from: https://publications.parliament.uk/pa/cm201617/cmselect/cmsctech/162/162.pdf. [Accessed: 7 February 2022].

Hughes, S. and Lewis, H. (2020). Tensions in Current Curriculum Reform and the Development of Teachers' Professional Autonomy. *Curriculum Journal*. 31 (2). pp. 290–302.

Husserl, E. (1999). The Essential Husserl: Basic Writings in Transcendental Phenomenology. Bloomington: Indiana University Press.

Ingram, J., Stiff, J., Cadwallader, S. and Lee, G. (2023). *PISA 2022: National Report for England December 2023*. [Online]. Available from: https://assets.publishing.service.gov.uk/media/656dc3321104cf0013fa742f/PISA_2022_England_National_Report.pdf. [Accessed: 7 January 2024].

Jackson, K. and Bazeley, P. (2019). *Qualitative Data Analysis with NVIVO*. London: Sage Publications.

Jæger, M.M. (2011). Does Cultural Capital Really Affect Academic Achievement? New Evidence From Combined Sibling and Panel Data. *Sociology of Education*. 84 (4). pp. 281–298.

Jeffrey, B. and Woods, P. (1996). Feeling Deprofessionalised: The Social Construction of Emotions During an Ofsted Inspection. *Cambridge Journal of Education*. 26 (3). pp. 325–343.

Jensen, E. and Wright, D. (2015). Critical Response to Archer *et al*. (2015) 'Science Capital': A Conceptual, Methodological, and Empirical Argument for Extending Bourdieusian Notions of Capital Beyond the Arts. *Science Education*. 99 (6). pp. 1143–1146.

Jerrim, J. and Vignoles, A. (2016). The Link Between East Asian 'Mastery' Teaching Methods and English Children's Mathematics Skills. *Economics of Education Review*. 50. pp. 29–44.

Kara, H. (2012). *Research and Evaluation for Busy Practitioners: A Time-Saving Guide*. Bristol: Policy Press.

Kara, H. (2017). *Research and Evaluation for Busy Students and Practitioners*. 2nd Ed. Bristol: Policy Press.

Kilag, O., Catacutan, A., Carreon, P., Arcillo, M., Figer-Canes, R., Mansueto, D. (2023). Lawrence Stenhouse in Curriculum Development: Integrative Review. *Excellencia: Multi-Disciplinary Journal of Education*. 1 (1). pp. 77-86.

Kelly, A. V. (2009). *The Curriculum. Theory and Practice.* 6th Ed. London: Sage Publications.

Kim, J.H. (2013). Teacher Action Research as *Bildung*: An Application of Gadamer's Philosophical Hermeneutics to Teacher Professional Development. *Journal of Curriculum Studies*. 45 (3). pp. 379–393.

King, H. and Nomikou, E. (2018). Fostering Critical Teacher Agency: The Impact of a Science Capital Pedagogical Approach. *Pedagogy, Culture and Society*. 26 (1). pp. 87–103.

Kulo, S., Odundo, P. and Kibui, A. (2021). Perception of Teachers on Readers' Theatre and Reading Comprehension: Prospects for Curriculum Planning. *Journal of Language and Linguistic Studies*. 17 (1). pp. 256–267.

Laverty, S.M. (2003). Hermeneutic Phenomenology and Phenomenology: A Comparison of Historical and Methodological Considerations. *International Journal of Qualitative Methods*. 2 (3). pp. 21–35.

Lawton, D. (1994). *The Tory Mind on Education 1979-94*. London: The Falmer Press.

Leiviskä, A. (2013). Finitude, Fallibilism and Education Towards Non-Dogmatism: Gadamer's Hermeneutics in Science Education. *Educational Philosophy and Theory*. 45 (5). pp. 516–530.

Lennert da Silva, A.L. and Mølstad, C.E. (2020). Teacher Autonomy and Teacher Agency: A Comparative Study in Brazilian and Norwegian Lower Secondary Education. *Curriculum Journal*. 31 (1). pp. 115–131.

Levinson, R. (2018). Realising the School Science Curriculum. *The Curriculum Journal*. 29 (4). pp. 522–537.

Lincoln, Y.S. and Guba, E.G. (1986). But is it Rigorous? Trustworthiness and Authenticity in Naturalistic Evaluation. *New Directions for Program Evaluation*. (30). pp. 73–84.

Lu, J. (2019). Confucius Stands on the London Eye- an Auto-Ethnographic Study. *Ethnography and Education*. 14 (1). pp. 51–64.

Maddern, K. (2011). *Slip in Status for Primary Science After SATs Dropped*. [Online]. 2011. Times Educational Supplement. Available from: https://www.tes.com/news/slip-status-primary-science-after-sats-dropped. [Accessed: 18 June 2020].

Marshall, B. (2008). The End of Testing and Future Possibilities: An Examination of the Demise of SATs in England and Possible Alternative Assessments. *English Teaching: Practice and Critique*. 7 (3). pp. 65–73.

Matthews, P. and Smith, G. (1995). Ofsted: Inspecting Schools and Improvement Through Inspection. *Cambridge Journal of Education*. 25 (1). pp. 23–34.

Mead, G.H. (1967). *Mind, Self and Society From the Standpoint of a Social Behaviorist*. Chicago: University of Chicago Press.

McCulloch, G., Helsby, G. and Knight, P. (2000). *The Politics of Professionalism. Teachers and the Curriculum*. London: Continuum.

McDool, E. and Morris, D. (2022). Gender Differences in Science, Technology, Engineering and Maths Uptake and Attainment in Post-16 Education. *Manchester School*. 90 (5). pp. 473–499.

Microsoft. (2024) *Microsoft Copilot: AI-Powered Productivity Tool.* Available at: http://microsoft.com/en-us/microsoft-365/copilot [Accessed: 1 November 2024].

Millar, R. (2011). Reviewing the National Curriculum for Science: Opportunities and Challenges. *Curriculum Journal*. 22 (2). pp. 167–185.

Moor, H., Jones, M., Johnson, F., Martin, K., Cowell, E. and Bojke, C. (2006). *Mathematics and Science in Secondary Schools: The Deployment of Teachers and Support Staff to Deliver the Curriculum*. [Online]. Available from: www.dfes.gov.uk/research/data/uploadfiles/RR708.pdf. [Accessed: 28 April 2024].

Moote, J., Archer, L., DeWitt, J. and MacLeod, E. (2020). Science Capital or STEM Capital? Exploring Relationships Between Science Capital and Technology, Engineering, and Maths Aspirations and Attitudes Among Young People Aged 17/18. *Journal of Research in Science Teaching*. 57 (8). pp. 1228–1249.

Moote, J., Archer, L., DeWitt, J. and MacLeod, E. (2021). Who Has High Science Capital? An Exploration of Emerging Patterns of Science Capital Among Students Aged 17 / 18 in England. *Research Papers in Education*. 36 (4). pp. 402–422.

Mouzelis, N. (2007). Habitus and Reflexivity: Restructuring Bourdieu's Theory of Practice. *Sociological Research Online*. 12 (6). pp. 5–10. [Accessed: 5 August 2023].

Muller, J. and Young, M. (2019). Knowledge, Power and Powerful Knowledge Re-Visited. *Curriculum Journal*. [Online]. 30 (2). pp. 196–214. Available from: https://doi.org/10.1080/09585176.2019.1570292. [Accessed: 15 February 2020].

Murphy, C., Kerr, K., Lundy, L. and McEvoy, L. (2010). *Attitudes of Children and Parents to Key Stage 2 Science Testing and Assessment*. [Online]. 2010. Wellcome Trust, Queen's University. Available from: https://wellcomecollection.org/works/ph8audtm/items. [Accessed: 18 June 2020].

Musofer, R.P. and Lingard, B. (2021). Bourdieu and Position-Making in a Changing Field: Enactment of the National Curriculum in Australia. *Curriculum Journal*. 32 (3). pp. 384–401.

Nash, R. (2004). Can the Arbitrary and the Necessary be Reconciled? Scientific Realism and the School Curriculum. *Journal of Curriculum Studies*. 36 (5). pp. 605–623.

Neubauer, B.E., Witkop, C.T. and Varpio, L. (2019). How Phenomenology Can Help Us Learn From the Experiences of Others. *Perspectives on Medical Education*. 8 (2). pp. 90–97.

Nicholl, B. and McLellan, R. (2008). 'We're All in This Game Whether We Like It or Not to Get a Number of As to Cs.' Design and Technology Teachers' Struggles to Implement Creativity and Performativity Policies. *British Educational Research Journal*. 34 (5). pp. 585–600.

Nightingale, P. (2020). 'As if by Osmosis': How Ofsted's New Deficit Model Emerged, Fully Formed, as Cultural Capital. *Power and Education*. 12 (3). pp. 232–245.

Nunes, T., Bryant, P., Strand, S., Hillier, J., Barros, R. and Miller-Friedmann, J. (2017). *Review of SES and Science Learning in Formal Educational Settings - A Report Prepared for the EEF and the Royal Society*. [Online]. Available from: https://ora.ox.ac.uk/objects/uuid:a888fbd8-c06d-4b6d-b8a5-acf8c34f020f/files/m106262695f610b87f1363f4cb1278d01. [Accessed: 15 May 2021].

Ofqual (2024). *Provisional Entries for GCSE, AS and A Level: Summer 2024 Exam Series.* [Online]. 2024. Available from: https://www.gov.uk/government/statistics/provisional-entries-for-gcse-as-and-a-level-summer-2024-exam-series. [Accessed: 15 September 2024].

Ofsted (2008). *Success in Science*. [Online]. 2008. Available from: https://dera.ioe.ac.uk/id/eprint/8196/2/Success_in_science_%28PDF_format%29.pdf. [Accessed: 22 February 2019].

Ofsted (2014). *The Report of Her Majesty's Chief Inspector of Education, Children's Services and Skills 2013/2014*. [Online]. 2014. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/384699/Ofsted_Annual_Report_201314_HMCI_commentary.pdf. [Accessed: 2 February 2020].

Ofsted (2015a). *Key Stage 3: The Wasted Years?* [Online]. 2015. Available from: https://www.gov.uk/government/publications/key-stage-3-the-wasted-years. [Accessed: 1 November 2019].

Ofsted (2015b). *The Annual Report of Her Majesty's Chief Inspector of Education, Children's Services and Skills 2014/15*. [Online]. 2015. Available from: https://assets.publishing.service.gov.uk/media/5a7f67bfed915d74e33f639e/Ofsted_annual_report_education_and_skills.pdf. [Accessed: 22 February 2022].

Ofsted (2017). *Ofsted Strategy 2017–22.* [Online]. 2017. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/648212/Ofsted_strategy_2017-22.pdf. [Accessed: 1 November 2019].

Ofsted (2018). *The Annual Report of Her Majesty's Chief Inspector of Education, Children's Services and Skills 2017-18*. [Online]. 2018. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/761606/29523_Ofsted_Annual_Report_2017-18_041218.pdf. [Accessed: 2 February 2022].

Ofsted (2019a). *Inspecting the Curriculum. Revising Inspection Methodology to Support the Education Inspection Framework.* [Online]. 2019. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/814685/Inspecting_the_curriculum.pdf. [Accessed: 15 February 2020].

Ofsted (2019b). *The Education Inspection Framework*. [Online]. 2019. Available from: www.legislation.gov.uk/uksi/2014/3283/contents/made; [Accessed: 7 July 2020].

Ofsted (2019c). *Education Inspection Framework. Overview of Research*. [Online]. 2019. Available from: www.gov.uk/ofsted. [Accessed: 15 April 2020].

Ofsted (2021). *Research Review Series : Science*. [Online]. 2021. Available from: https://www.gov.uk/government/publications/research-review-series-science/research-review-series-science. [Accessed: 15 May 2021].

Ofsted (2022). *School Inspection Handbook*. [Online]. 2022. Available from: https://www.gov.uk/government/publications/school-inspection-handbook-from-september-2015%5Cnhttps://www.gov.uk/government/uploads/system/uploads/attachment_data/file/457199/School_inspection_handbook.pdf. [Accessed: 14 April 2023].

Pajari, K. and Harmoinen, S. (2020). Teachers' Perceptions of Consumer Education in Primary Schools in Finland. *Discourse and Communication for Sustainable Education*. 10 (2). pp. 72–88.

Pantic, N. (2015). A Model for Study of Teacher Agency for Social Justice. *Teachers and Teaching: Theory and Practice*. 21 (6). pp. 759–778.

Perryman, J. (2007). Inspection and Emotion. *Cambridge Journal of Education*. 37 (2). pp. 173–190.

Perryman, J., Maguire, M., Braun, A. and Ball, S.J. (2018). Surveillance, Governmentality and Moving the Goalposts: The Influence of Ofsted on the Work of Schools in a Post-Panoptic Era. *British Journal of Educational Studies*. 66 (2). pp. 145–163.

PISA (2018). *Programme for International Student Assessment (PISA). Results from PISA 2018: United Kingdom*. [Online]. 2018. Available from: http://www.oecd.org/pisa/PISA-2015-United-Kingdom.pdf%0Ahttp://www.oecd.org/pisa/keyfindings/PISA-2012-results-UK.pdf. [Accessed: 5 February 2022].

Pitard, J. (2016). Using Vignettes Within Autoethnography to Explore Layers of Cross-Cultural Awareness as a Teacher. *Forum Qualitative Sozialforschung*. 17 (1). pp. 1–17.

Poulton, P. and Mockler, N. (2024). Early Career Primary Teachers' Curriculum-Making Experiences: Enablers and Constraints to Knowledge-Led Forms of Curriculum-Making. *Curriculum Journal*, 35(1), pp. 20–37.

Pratt, M. (2016). *Evaluation of Unsatisfactory Student Performance*. [Online]. PhD Thesis. School of Nursing. McMaster University, Ontario. Available from: https://macsphere.mcmaster.ca/retrieve/24230/Pratt_Maria_G_201608_PhD.pdf. [Accessed: 13 April 2023].

Pratt, M. (2020). Evaluation of Unsatisfactory Student Performance. *Clinical Teacher*. 17 (1). pp. 58–63.

Pring, R. (2018). Philosophical Debates on Curriculum, Inequalities and Social Justice. *Oxford Review of Education*. 44 (1). pp. 6–18.

Punch, K.F. (2014). *Social Research: Quantitative and Qualitative Approaches*. London: Sage.

QCA (2005). *Science: Changes to the National Curriculum from 2006 for Key Stage 4*. [Online]. 2005. Available from: https://www.stem.org.uk/system/files/elibrary-resources/legacy_files_migrated/13587-Science Changes to the curriculum from 2006 for key stage 4 %281847210686%29.pdf. [Accessed: 3 February 2020].

Reay, D. (2018). Working Class Educational Transitions to University: The Limits of Success. *European Journal of Education*. 53 (4). pp. 528–540.

Reid, A. (2005). Rethinking National Curriculum Collaboration. Towards an Australian Curriculum. *Commonwealth of Australia: Department of Education Science and Training (DEST).*

Reiners, G.M. (2012). Understanding the Differences between Husserl's (Descriptive) and Heidegger's (Interpretive) Phenomenological Research. *Journal of Nursing and Care*. 01 (05). pp. 1–3.

Reiss, M.J. (1990). Whither Multicultural Science? *Journal of Biological Education*. 24 (1). pp. 1–2.

Reynolds, K. (1992). 'Equal Opportunities' and Local Management of Schools - What Happens Now? *Gender and Education*. 4 (3). pp. 289–300.

Richardson, M., Isaacs, T., Barnes, I., Swensson, C., Wilkinson, D. and Golding, J. (2020). *Trends in International Mathematics and Science Study (TIMSS) 2019: National Report for England*. [Online]. 2020. Department for Education. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/941351/TIMSS_2019_National_Report.pdf. [Accessed: 15 May 2021].

Rinke, C. R. (2008). Understanding Teachers' Careers: Linking Professional Life to Professional Path. *Educational Research Review*. 3 (1). pp. 1– 13.

Roberts, N. (2022). *The Pupil Premium (England)*. [Online]. 2022. House of Commons Library Number 6700. Available from: https://researchbriefings.files.parliament.uk/documents/SN06700/SN06700.pdf. [Accessed: 4 August 2023].

Rogers, L. and Spours, K. (2020). The Great Stagnation of Upper Secondary Education in England: A Historical and System Perspective. *British Educational Research Journal*. 46 (6). pp. 1232–1255.

Rushton, E.A.C., Rawlings Smith, E., Steadman, S. and Towers, E. (2023). Understanding Teacher Identity in Teachers' Professional Lives: A Systematic Review of the Literature. *Review of Education*. 11 (2). pp. 1–52.

Sachs, J. (2005). Teacher Education and the Development of Professional Identity: Learning to be a Teacher. In: *Connecting Policy and Practice*. Routledge, pp. 5–21.

Savin-Baden, M. and Howel Major, C. (2013). *Qualitative Research: The Essential Guide to Theory and Practice.* Abingdon: Routledge.

Schäfer, I. (2018). Opportunities for Professional Learning Dialogue Generated by Cross-Phase Collaboration in Languages Between Primary and Secondary Initial Teacher Education Students. *Education 3-13*. [Online]. 46 (3). pp. 291–306. Available from: https://doi.org/10.1080/03004279.2016.1247184. [Accessed: 24 June 2023].

Schaffar, B. and Wolff, L.A. (2024). Phenomenon-Based Learning in Finland: A Critical Overview of its Historical and Philosophical Roots. *Cogent Education*. 11 (1). pp. 1-14. Available from: https://doi.org/10.1080/2331186X.2024.2309733. [Accessed: 19 April 2025].

Schagen, I. and Weston, P. (1998). Insights into School Effectiveness From Analysis of Ofsted's School Inspection Database. *Oxford Review of Education*. 24 (3). pp. 337–344.

Schön, D. A. (2016). *The Reflective Practitioner: How Professionals Think in Action*. Abingdon: Routledge. doi: 10.4324/9780203066799-32.

Sheard, L. and Marsh, C. (2019). How to Analyse Longitudinal Data From Multiple Sources in Qualitative Health Research: The Pen Portrait Analytic Technique. *BMC Medical Research Methodology*. 19 (1). pp. 1–10.

Sheikh, I. and Bagley, C. (2018). Towards a Policy Social Psychology: Teacher Engagement With Policy Enactment and the Core Concept of Affective Disruption. *British Educational Research Journal*. 44 (1). pp. 43–60.

Silock, R. (2022). Funds of Knowledge in Primary Education : Understanding 'Distance' in the Classroom and Curriculum as a Complex and Changing Space. EdD Thesis. School of Education. The University of Sheffield.

Smith, E. (2010). Is There a Crisis in School Science Education in the UK? *Educational Review*. 62 (2). pp. 189–202.

Smith, G. (2000). Research and Inspection: HMI and Ofsted, 1981-1996 - A Commentary. *Oxford Review of Education*. 26 (3–4). pp. 333–352.

Smyth, J. and Shacklock, G. (1998). *Re-making Teaching. Ideology, Policy and Practice.* London: Routledge.

Social Mobility Commission (2022). *State of the Nation 2022: A Fresh Approach to Social Mobility*. [Online]. 2022. Available from: https://assets.publishing.service.gov.uk/media/62b2e45b8fa8f5357a677f29/State_of_the_Nation_2022_A_fresh_approach_to_social_mobility.pdf. [Accessed: 8 January 2023].

Spencer, L., Ritchie, J. and O'Connor, W. (2003). Analysis: Practices, Principles and Processes. In: J. Ritchie and J. Lewis (eds.). *Qualitative Research Practice: A Guide for Social Science Student Researcher*. London: Sage Publications, pp. 199–218.

Spielman, A. (2019). *Speech Given at the National Day Nurseries Association*. [Online]. 2019. Available from: Amanda Spielman at the National Day Nurseries Association - GOV.UK (www.gov.uk). [Accessed: 19 March 2022].

Spielman, A. (2020). *Speech Given at the Royal Opera House, January 27, 2020*. [Online]. 2020. Available from: https://www.gov.uk/government/speeches/amanda-spielman-speaking-at-the-royal-opera-house. [Accessed: 14 April 2023].

Staffordshire University (2019). *Staffordshire University Research Ethical Review Policy*. [Online]. 2019. Available from: https://www.staffs.ac.uk/research/docs/pdf/ethical-review-policy.pdf. [Accessed: 16 January 2022].

Stenhouse, L. (1975). *An Introduction to Curriculum Research and Development*. London: Heinemann.

Stenhouse, L. (1983). The Relevance of Practice to Theory. *Theory Into Practice*. 22 (3) pp. 211–215.

Stets, J.E. and Burke, P.J. (2000). Identity Theory and Social Identity Theory. In: *Social Psychology Quarterly*. pp. 224–237.

Stopforth, S. and Gayle, V. (2022). Parental Social Class and GCSE Attainment: Re-Reading the Role of 'Cultural Capital'. *British Journal of Sociology of Education*. [Online]. 43 (5). pp. 680–699. Available from: https://doi.org/10.1080/01425692.2022.2045185. [Accessed: 13 April 2023].

Strong, T., Pyle, N.R., Johnston, D.N. and Foskett, A.J. (2008). Meaning-Making Lenses in Counselling : Discursive, Hermeneutic-Phenomenological, and Autoethnographic Perspectives. *Canadian Journal of Counselling*. 42. pp. 117–130.

Stryker, S. (1980). *Symbolic Interactionism: A Social Structural Version*. Menlo Park, CA: Benjamin Cummings.

Stryker, S. and Burke, P.J. (2000). The Past, Present, and Future of an Identity Theory. *Social Psychology Quarterly*. 63 (4). pp. 284–297.

Sullivan, A. (2002). Bourdieu and Education: How Useful is Bourdieu's Theory for Researchers? *The Netherlands' Journal of Social Sciences.* 38 (2). pp. 144-166.

Taba, H. (1962). *Curriculum Development: Theory and Practice*. W. B. Spalding (ed.). [Online]. New York: Harcourt, Brace & World, Inc. Available from: https://archive.org/details/curriculumdevelo0000taba/page/74/mode/2up. [Accessed: 13 March 2025].

Tajfel, H., Turner, J.C., Austin, W.G. and Worchel, S. (1979). An Integrative Theory of Intergroup Conflict. In: M. J. Hatch & M. Schultz (eds.). *Organizational Identity*. [Online]. Oxford: Oxford University Press, pp. 56–65. Available from: https://www.google.co.uk/books/edition/Organizational_Identity/BgBREAAAQBAJ?hl=en&gbpv=1. [Accessed: 13 April 2025].

Tamah, S.M. and Wirjawan, J. V.D. (2022). Teachers' Response to a Challenge to Change: A Portrait of Teacher Resilience to a Professional Development Program. *Power and Education*. 14 (1). pp. 17–34.

Teevan, D. (2000). Philosophical Hermeneutics and Theological Hermeneutics. *Teaching Theology and Religion*. 3 (2). pp. 62–70.

Thomas, G. (2013). *How to do Your Research Project: A Guide for Students in Education and Applied Social Sciences*. 2nd Ed. [Online]. London: Sage Publications. Available from: https://libraryguides.vu.edu.au/c.php?g=607897&p=4941444. [Accessed: 1 September 2021].

Thomson, P. and Hall, C. (2022). Cultural Capitals Matter, Differentially: A Bourdieusian Reading of Perspectives from Senior Secondary Students in England. *British Journal of Sociology of Education*. [Online]. 43 (6). pp. 860–877. Available from: https://doi.org/10.1080/01425692.2022.2083582. [Accessed: 13 April 2023].

Troman, G. (1997). Self-Management and School Inspection : Complementary Forms of Surveillance and Control in the Primary School. *Oxford Review of Education*. 23 (3). pp. 345–364.

Trowler, P. (1998). *Education Policy: A Policy Sociology Approach.* Eastbourne: Gildredge Press.

Trowler, P. (2003). *Education Policy*. 2nd Ed. Abingdon: Routledge.

Tyler, R. W. (1949) *Basic Principles of Curriculum and Instruction*. Chicago: University of Chicago Press. Available at: https://www.taylorfrancis.com/chapters/edit/10.4324/9780203017609-14/basic-principles-curriculum-instruction-ralph-tyler [Accessed: 9 March 2025].

Vidal Rodeiro, C. (2007). *A Level Subject Choice in England: Patterns of Uptake and Factors Affecting Subject Preferences*. Cambridge: Cambridge Assessment.

Vincent-Ruz, P. and Schunn, C.D. (2018). The Nature of Science Identity and Its Role as the Driver of Student Choices. *International Journal of STEM Education*. 5 (1). pp. 1–12.

Vincent-Ruz, P. and Schunn, C.D. (2019). Identity Complexes and Science Identity in Early Secondary: Mono-Topical or in Combination With Other Topical Identities. *Research in Science Education*. 51. pp. 369–390.

Vinjamuri, M., Warde, B. and Kolb, P. (2017). The Reflective Diary: An Experiential Tool for Enhancing Social Work Students' Research Learning. *Social Work Education*. 36 (8). pp. 933–945.

Walker, G. (2014). The Significance of Jerome Bruner. *The International Schools Journal*. 33 (2). pp. 8-15.

Wallace, C.S. and Priestley, M.R. (2017). Secondary Science Teachers as Curriculum Makers: Mapping and Designing Scotland's New Curriculum for Excellence. *Journal of Research in Science Teaching*. 54 (3). pp. 324–349.

Ware, J. (2014). Changing Policy, Legislation and Its Effects on Inclusive and Special Education: A Perspective From Wales. *British Journal of Special Education*. 41 (4). pp. 344–362.

Webster, S. (1995). A Five-Year Stretch. *Journal of Biological Education (Society of Biology)*. 29 (2). pp. 83–85.

White, J. (2018). The Weakness of 'Powerful Knowledge'. *London Review of Education*. 16 (2). pp. 325–335.

Whitty, G. (2017). Taking Subject Knowledge Out and Putting it Back Again? A Journey in the Company of Michael Young. In: D. Guile, D. Lambert, and M. J. Reiss (eds.). *Sociology, Curriculum Studies and Professional Knowledge: New Perspectives on the Work of Michael Young*. Abingdon: Routledge, pp. 17–30.

Whitty, G. and Wisby, E. (2016). Education in England – A Testbed for Network Governance? *Oxford Review of Education*. 42 (3). pp. 316–329.

Winter, C. (2017). Curriculum Policy Reform in an Era of Technical Accountability: 'Fixing' Curriculum, Teachers and Students in English Schools. *Journal of Curriculum Studies*. 49 (1). pp. 55–74.

Woolley, M.C. (2019). Experiencing the History National Curriculum 1991–2011: Voices of Veteran Teachers. *History of Education*. 48 (2). pp. 212–232.

Wright, R. (2008). Kicking the Habitus: Power, Culture and Pedagogy in the Secondary School Music Curriculum. *Music Education Research*. 10 (3). pp. 389–402.

Xie, C. and Ma, Y. (2019). The Mediating Role of Cultural Capital in the Relationship Between Socioeconomic Status and Student Achievement in 14 Economies. *British Educational Research Journal*. 45 (4). pp. 838–855.

Young, M. (2009). What Are Schools For? In: H. Daniels, H. Lauder, and J. Porter (eds.). *Knowledge, Values and Educational Policy. A critical perspective.* London: Routledge.

Young, M. (2015). The Progressive Case for a Subject-Based Curriculum. In: M. Young, D. Lambert, C. Roberts, and M. Roberts (eds.). *Knowledge and the Future School: Curriculum and Social Justice*. London: Bloomsbury Academic, pp. 89–109.

Young, M. (2019). *Cultural Capital and Curriculum: Will Ofsted's New Framework Encourage Better Education in Our Schools?* [Online]. 2019. IOE London Blog 9. Available from: https://ioelondonblog.wordpress.com/2019/09/09/cultural-capital-and-curriculum-will-ofsteds-new-framework-encourage-better-education-in-our-schools/. [Accessed: 7 September 2024].

Young, M. and Muller, J. (2013). On the Powers of Powerful Knowledge. *Review of Education*. 1 (3). pp. 229–250.

Appendices

Appendix 1: The Science Linear Curriculum 217
Appendix 2: Literature Search Strategy 218
Appendix 3: Summary of the Methodology Adopted in This Research 219
Appendix 4: A Conversation With Jim about a Diary Entry 222
Appendix 5: Pilot Study and Initial Questionnaire 223
Appendix 6: Participant Information Sheet 225
Appendix 7: Participant Consent Form 234
Appendix 8: Questionnaire 238
Appendix 9: Diary Entries 249
Appendix 10: Semi-Structured Individual Interview 253
Appendix 11: Follow-up Interview 254
Appendix 12: Ethical Approval 255
Appendix 13: Focus Group Interview 259
Appendix 14: Complete Pen Portraits 260
Appendix 15: Examples of Initial Open Coding, NVivo12 Nodes, Descriptions and Their Potential Relationship With the Research Questions 270

Appendix 1: The Science Linear Curriculum

The name 'Linear Curriculum' was coined from one of the key aspects of its design, describing its non-spiral structure. The Linear Curriculum was designed by all the teachers working in the schools' Science department where this research was conducted, in the early months of 2019, with a view to implementation in September 2019.

The core value of its design was equity and equality for all students, and so to maximise the opportunities available to all students, the design encompassed the content from the three GCSEs of Biology, Chemistry, and Physics, the Triple Sciences. The next stage in the curriculum development was to decide what to teach and when. As experienced teachers, we were aware of how difficult topics became as students moved into the KS4, while it was also acknowledged that KS3 was not as challenging as it could be. The decision was made to develop the curriculum starting with the foundational knowledge and then gradually build the difficulty across the five years.

Each subject area was organised into five main themes, and all the topics were assigned to one of the themes. The topics were then organised across the five years of secondary education. The curriculum plan aimed to ensure an equal distribution of each science subject across each year, and its structure aimed to organise topics so that they were taught in the correct order when the basics had been embedded.

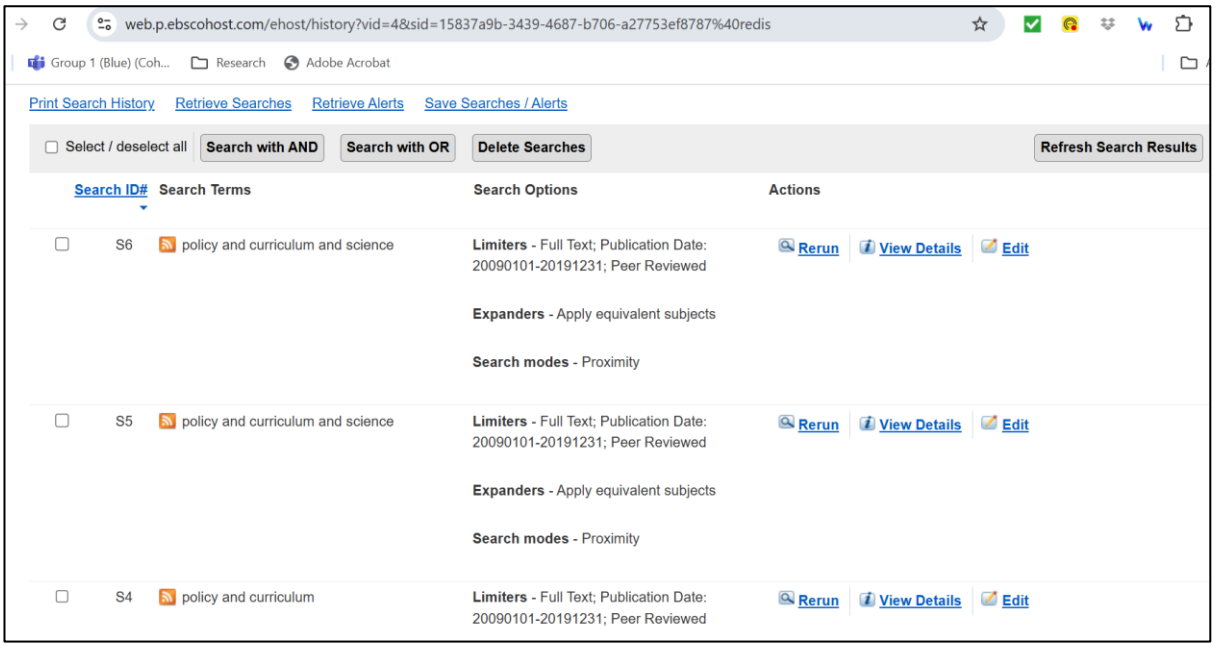
Appendix 2: Literature Search Strategy

Outlined below is a retrospective account of the literature search strategy used in this research.

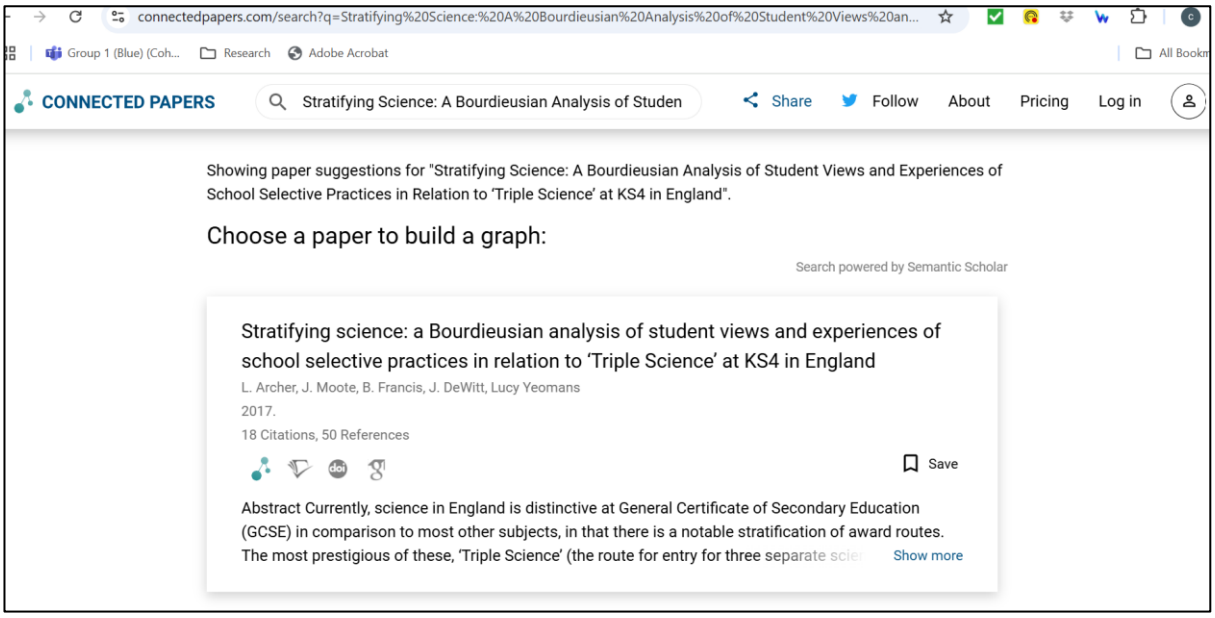
Searches predominantly started using Staffordshire University's database 'Education Research Complete.' Journals were selected, written in English, and peer reviewed. Research articles were chosen based on the year of requirement; for example, data referring to historical events such as the introduction of the National Curriculum focused between 1980 and 1995. Whereas up-to-date research in science education focused between 2019 and 2024. The table below shows an example of inclusion and exclusion criteria when using this database.

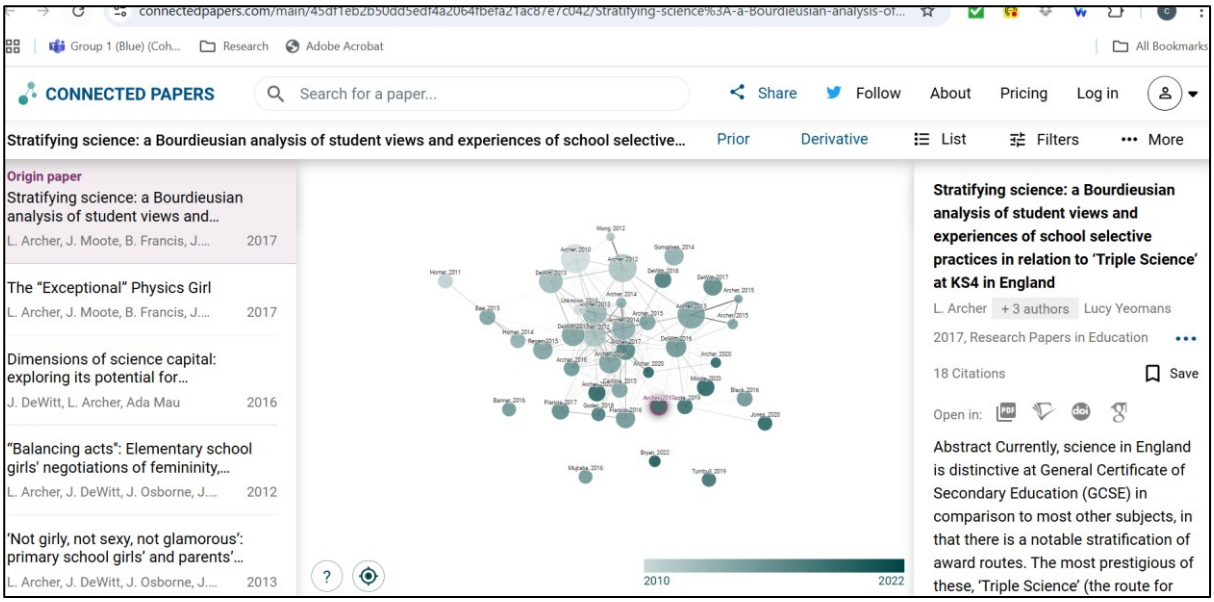
Inclusion Criteria	**Exclusion criteria**
Methods and methodology • Diary entries • Case studies • Semi-structured interviews • Focus group interviews • Phenomenology • Gadamer • Bourdieu **Literature review** • National Curriculum • Science interventions • Secondary science • Science identity • Cultural capital • Ofsted • Policy • Curriculum • Teacher professionalism/autonomy	• Outdated methods and methodologies • Written in a non-English language • Non-primary source • Articles with full text unavailable

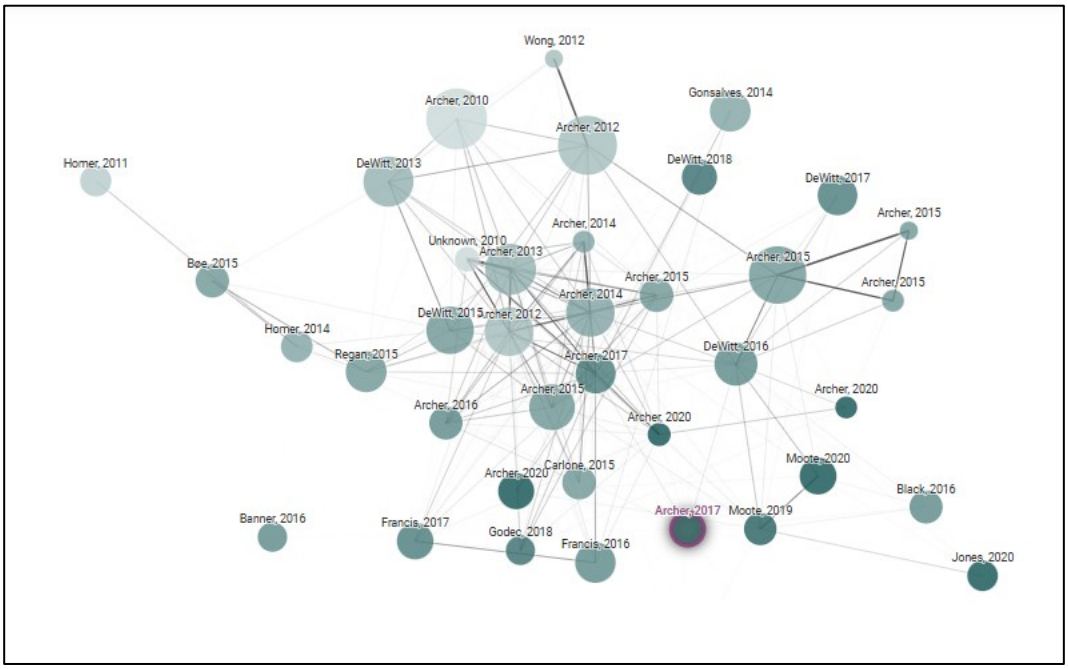
The screenshot below shows an example of saved searches on Staffordshire University database.



Connected Papers (www.connectedpapers.com) was also used in the early stages of research to gain an overview of linked literature and to determine other academics researching similar topics. The screenshots below show an example of this:




connectedpapers.com/main/45df1eb2b50dd5edf4a2064fbefa21ac87e7c042/Stratifying-science%3A-a-Bourdieusian-analysis-of...
Group 1 (Blue) (Coh...
Research
Adobe Acrobat
All Bookmarks
CONNECTED PAPERS
Search for a paper...
Share
Follow
About
Pricing
Log in
Stratifying science: a Bourdieusian analysis of student views and experiences of school selective...
Prior
Derivative
List
Filters
More
Origin paper
Stratifying science: a Bourdieusian analysis of student views and...
L. Archer, J. Moote, B. Francis, J.... 2017
The "Exceptional" Physics Girl
L. Archer, J. Moote, B. Francis, J.... 2017
Dimensions of science capital: exploring its potential for...
J. DeWitt, L. Archer, Ada Mau 2016
"Balancing acts": Elementary school girls' negotiations of femininity,...
L. Archer, J. DeWitt, J. Osborne, J.... 2012
'Not girly, not sexy, not glamorous': primary school girls' and parents'...
L. Archer, J. DeWitt, J. Osborne, J.... 2013
2010
2022
Stratifying science: a Bourdieusian analysis of student views and experiences of school selective practices in relation to 'Triple Science' at KS4 in England
L. Archer + 3 authors Lucy Yeomans
2017, Research Papers in Education
18 Citations
Save
Open in:
Abstract Currently, science in England is distinctive at General Certificate of Secondary Education (GCSE) in comparison to most other subjects, in that there is a notable stratification of award routes. The most prestigious of these, 'Triple Science' (the route for


Wong, 2012
Archer, 2010
Gonsalves, 2014
Archer, 2012
Homer, 2011
DeWitt, 2013
DeWitt, 2018
DeWitt, 2017
Archer, 2015
Archer, 2014
Unknown, 2010
Archer, 2013
Archer, 2015
Boe, 2015
Archer, 2015
Archer, 2014
Archer, 2015
DeWitt, 2015
Archer, 2012
Homer, 2014
Regan, 2015
DeWitt, 2016
Archer, 2017
Archer, 2015
Archer, 2020
Archer, 2016
Archer, 2020
Moote, 2020
Carlone, 2015
Archer, 2020
Black, 2016
Banner, 2016
Archer, 2017
Moote, 2019
Francis, 2017
Godec, 2018
Francis, 2016
Jones, 2020

Appendix 3: Summary of the Methodology Adopted in This Research

(Fleming, Gaidys and Robb, 2003)		Ajjawi and Higgs (2007)		Alsaigh and Coyne (2021)	
1	Decide upon a research question			1	Choosing an appropriate open research question
2	Identification of pre-understandings			2	Identification of pre-understandings
3	Gaining understanding through dialogue with participants	1	Immersion	3	Gaining understanding through dialogue with participants (diaries and interviews)
4	Gaining understanding through dialogue with text	2	Understanding	4	Transcribing / iterative reading / preliminary interpretation of text to facilitate coding / identifying first-order (participant's horizon) constructs
		3	Abstraction	5	Identifying second-order (the researcher's horizon) constructs = integration
		4	Synthesis and theme development	6	Meshing the horizons Themes are developed and challenged by the researcher = aggregation.
		5	Illumination and illustration of phenomena	7	Linking the literature to the themes identified
		6	Integration and critique	8	Critique of the themes Reporting final interpretation at this point in time (fusion of horizons)
5	Establishing trustworthiness			9	Establishing trustworthiness

Appendix 4: A Conversation With Jim About a Diary Entry

Jim Week 3: Diary entry:

Year 10 Eye dissection: even after a demonstration, a video, and a teacher walk-through, students struggled to structure the dissection and ended up with a badly damaged eyeball with structures difficult to identify. Most students struggled to name parts when asked, and I felt the learning experience of the dissection lacked impact. To address this issue for the next groups, I decided to change the format of the lesson by including a 'parts' challenge, whereby they wrote the main structures on the sugar paper and then worked on identifying and removing the structures to place by their labels. Students focused better on what the structures were, and most succeeded in identifying the main structures. I feel, as a whole, it was a much higher-quality learning experience. I feel dissection lessons, as a whole, could be improved in our new curriculum/booklets to promote learning and engagement.

Researcher: *Week three, Y10 eye dissection, so you talked about the first time you did it and it lacked impact. What do you mean?*

Jim: *Because you have the 'gore' factor, don't you? When you do a dissection, and you let that take over because they're so interested in it. You give them the eye, and they hack it to bits, or some of them hack it to bits, but what have they actually learnt from that experience? So I wanted to try and approach it slightly differently and get them to be more scientific in a dissection, based on what you do at A-level to the heart, and you get them to label the parts because it's such a good experience the dissection is, and I've thought personally I don't do it very well, so I wanted to change it a little bit, just make it a bit more scientific and structured. You know these are the parts; can you remove the parts and identify them?*

Appendix 5: Pilot Study and Initial Questionnaire

This pilot was conducted with three respondents, all female science teachers; two had been involved in the initial development of the Linear Curriculum model; they had a range of teaching experience, with one retired at the point of participating in the research. The pilot focused on the use and collection of quantitative and, to a lesser extent, qualitative data in a questionnaire. The questionnaire drew on an existing instrument designed and used extensively in STEM research involving primary and secondary-aged children (Archer *et al*., 2013a; ASPIRES Research, 2022) to ascertain the measure of 'science capital' possessed. In the pilot study, I decided to use all the questions but rephrased them to establish how the adult respondents considered each point applied to a child, whom they considered to have a 'higher level' of 'science capital.' Additionally, a section was added to provide an overview of how the respondents judged the Linear Curriculum model. All the questions were on a Likert scale of 1 strongly agreeing, 2 being mostly agree, 3 being agree, 4 being disagree, 5 being mostly disagree, and 6 being strongly disagree. Initially, this grading was chosen to indicate the strength of feeling of the respondents; however, with small numbers of respondents and the subjectivity of perceptions as described by Cohen, Manion and Morrison (2017), the decision was made to simplify the research tool with an easier agree, neither agree nor disagree, disagree or not applicable response. This change also addressed potential ethical issues due to the lack of a midpoint in the answer scale, not enabling an 'on the fence' response (*ibid*., p.484). Rank-ordering style questions were also included to indicate how teachers perceived the importance of the points under investigation. These were useful and were kept in the final research tool because of their potential value in understanding the differences in perceptions of the participants. Additionally, each section included an open-ended question in which participants could provide a personal statement. Cohen, Manion and Morrison (2017) suggested this provided participants with more ownership of the research and provided an opportunity to capture participants' early perceptions. Brown, Spiro and Quinton (2020, p.755) supported the use of open-ended questions alongside closed Likert questions because they explained that open-ended questions have the potential to produce 'rich, qualitative data for analysis.'

Analysis of the responses indicated some questions provided no advantage or disadvantage to the research, potentially due to the change of aspect from the emic child to the adult etic positionality, and so these were removed from the final questionnaire. Basit (2010) concurs with this finding when she states following analysis, researchers have a different perspective on the questions asked and may identify adjustments needed. Analyses also checked the questions were not leading (Cohen, Manion and Morrison, 2017), increasing the reliability of the data, and duplicate questions from different sections were removed to reduce 'intrusion' on participants' lives in terms of time required to complete the questions. In response to feedback from the respondents, the questionnaire was also shortened to reduce the risk of non-participation (Cohen, Manion and Morrison, 2017) and to reduce workload, which has also been shown to be a factor in non-completion. Furthermore, the order of the questions was adjusted to simplify the format and to help focus the respondent on the concept under question.

The pilot highlighted the similarities and differences between respondents in their understanding of terminology used in the Ofsted policy *Inspecting the Curriculum* (Ofsted, 2019a), which led me to its inclusion as a research question. Although the findings of the quantitative data were limited in the pilot, the use of questions in the survey tool was found to be useful by the participants as it provided them with the background and context for the research and, consequently, was kept as a preliminary task before the collection of the qualitative data, which will provide the data to answer the research questions.

Appendix 6: Participant Information Sheet

INFORMATION SHEET FOR PARTICIPANTS v1

Title of study

An investigation of secondary science teacher perceptions of the development of cultural capital and science identity in students following a linear science curriculum.

Invitation paragraph

I would like to invite you to participate in this research project which forms part of my Professional Doctorate in Education research. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information.

The purpose of the study

The purpose of this study is to investigate the lived experiences of teachers, during the enactment of a 5-year Linear Curriculum in science. The objectives of the research are to investigate science teachers' perceptions of the development of cultural capital and the extent to which this is manifested in their students; to explore science teachers' perceptions of the development of science identity in students; to explore the lived experiences of science teachers through the development of a Linear Curriculum and to investigate teacher perceptions of the extent to which they think the Linear Curriculum improves understanding and engagement in science.

Why have I been invited to take part?

You have been invited to take part in this study because you are a teacher who has been involved in the development, implementation and/or delivery of the 5-year linear science curriculum in the research school.

What will happen if I take part?

Taking part would involve you agreeing to complete an introductory questionnaire about your initial thoughts on science identity and cultural capital in secondary-aged students. It is anticipated that the questionnaire will take no longer than thirty minutes to complete. The questionnaire will be distributed to you in a paper format, within an envelope, and an electronic copy will be sent to your school email account. The questionnaires may be completed in either format and then returned to the email below, or in person in the original envelope. All responses collected from the questionnaires will be analysed and may be used in the final thesis. You will then be asked to complete a weekly reflective diary over five weeks to record your thoughts about how you feel the curriculum model is working in your classroom, including a focus on cultural capital and science identity development and you will also be asked to record any anecdotal examples of points that have occurred in your classroom during the week. It is anticipated that this will take approximately an hour over the week. You will be provided with a paper and an electronic copy of the 'diary' which will include prompts to help you record the information relevant to this research. You can use either version of the diary and only one entry is required each week. Each week a copy of your diary entry is to be returned to the researcher, either at the email below or the paper copy may be handed to the researcher in person, inside an envelope provided for this purpose. All responses collected from the diary entries will be analysed and may be used in the final thesis.

Finally, you will be invited to an interview, which will take no more than one hour, where you may also be asked to clarify or elaborate on any points made in the questionnaire or your diary entries. A copy of your questionnaire and all your diary entries will be returned to you before the interview to enable you to reflect on them. The interview will be conducted in a meeting room and notes will be made of your responses. The interview will also be audio-recorded, using an electronic dictaphone to ensure no loss of data or context. All responses collected from the interview will be analysed and may be used in the final thesis.

Do I have to take part?

Participation is completely voluntary. You should only take part if you want to and choosing not to take part will not disadvantage you in any way. Once you have read the information sheet, please contact me if you have any questions that will help you decide to take part. If you decide to take part, I will ask you to sign a consent form, and you will be given a copy of this consent form to keep.

What are the possible risks of taking part?

Participating in the research will not cause any personal risks or disadvantages, as I will protect your identity. Your identity and that of the research school will remain confidential. None of the information you provide will be linked to you in the final thesis, or any published academic writing such as in conference papers and journal articles. Pseudonyms will be used to ensure anonymity and all data such as transcripts of the interviews will be kept securely and will be destroyed after ten years per the University procedures. The nature of this research may lead to the school and participants being identifiable. Before the publication of the thesis, all participants will be provided with sections of the thesis regarding them, which they can check and then request any changes with which they do not agree.

What are the possible benefits of taking part?

There are no remunerations and personal benefits for the participants in this study. However, you will be contributing to an important study. The knowledge gained will be shared with the University and the school, to provide a greater understanding of curriculum models used to raise achievement in science education.

Data handling and confidentiality

Your data will be processed per the data protection law and will comply with the General Data Protection Regulation 2016 (GDPR).

Data Protection Statement

The data controller for this project will be Staffordshire University. The University will process your data for the research outlined above. The legal basis for processing your data for research purposes under the data protection law is a 'task in the public

interest' You can provide your consent for the use of your data in this study by completing the consent form that has been provided to you.

You have the right to access information held about you. Your right of access can be exercised per the General Data Protection Regulation. You also have other rights including rights of correction, erasure, objection, and data portability. Questions, comments, and requests about your data can also be sent to the Staffordshire University Data Protection Officer. If you wish to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk.

You will then be asked to complete a weekly reflective diary over five weeks to record your thoughts about how you feel the curriculum model is working in your classroom, including a focus on cultural capital and science identity development and you will also be asked to record any anecdotal examples of points that have occurred in your classroom during the week. It is anticipated that this will take approximately an hour over the week. You will be provided with a paper and an electronic copy of the 'diary' which will include prompts to help you record the information relevant to this research.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact me using the following contact details: email: claire.copeland@research.staffs.ac.uk

What if I have further questions, or if something goes wrong?

This research is being undertaken for the purpose of completing a thesis in partial fulfilment of a Professional Doctorate in Education at Staffordshire University. If you have any concerns about this research, please feel free to contact my supervisor Dr Gillian Forrester. Her email address is gillian.forrester@staffs.ac.uk

If this study has harmed, you in any way or if you wish to make a complaint about the conduct of the study you can contact the module tutor or the Chair of the Staffordshire University Ethics Committee for further advice and information:

Thank you for reading this information sheet and for considering taking part in this research

INFORMATION SHEET FOR PARTICIPANTS v3

Title of study

An investigation of secondary science teacher perceptions of the development of cultural capital and science identity in students following a linear science curriculum.

Invitation paragraph

I would like to invite you to participate in this research project which forms part of my Professional Doctorate in Education research. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information.

The purpose of the study

The purpose of this study is to investigate the lived experiences of teachers, during the enactment of a 5-year Linear Curriculum in science. The objectives of the research are to investigate science teachers' perceptions of the development of cultural capital and the extent to which this is manifested in their students; to explore science teachers' perceptions of the development of science identity in students; to explore the lived experiences of science teachers through the development of a Linear Curriculum and to investigate teacher perceptions of the extent to which they think the Linear Curriculum improves understanding and engagement in science.

Why have I been invited to take part?

You have been invited to take part in this study because you are a teacher who has been involved in the development, implementation and/or delivery of the 5-year linear science curriculum in the research school.

What will happen if I take part?

Taking part would involve you agreeing to complete an introductory questionnaire about your initial thoughts on science identity and cultural capital in secondary-aged students. It is anticipated that the questionnaire will take no longer than thirty minutes to complete. The questionnaire will be distributed to you in a paper format, within an envelope, and an electronic copy will be sent to your school email account. The questionnaires may be completed in either format and then returned to the email below, or in person in the original envelope. All responses collected from the questionnaires will be analysed and may be used in the final thesis.

You will then be asked to complete a weekly reflective diary over five weeks to record your thoughts about how you feel the curriculum model is working in your classroom, including a focus on cultural capital and science identity development and you will also be asked to record any anecdotal examples of points that have occurred in your classroom during the week. It is anticipated that this will take approximately an hour over the week. You will be provided with a paper and an electronic copy of the 'diary' which will include prompts to help you record the information relevant to this research. You can use either version of the diary and only one entry is required each week. Each week a copy of your diary entry is to be returned to the researcher, either at the email below or the paper copy may be handed to the researcher in person, inside an envelope provided for this purpose. All responses collected from the diary entries will be analysed and may be used in the final thesis.

Finally, you will be invited to an interview, which will take no more than one hour, where you may also be asked to clarify or elaborate on any points made in the questionnaire or your diary entries. A copy of your questionnaire and all your diary entries will be returned to you before the interview to enable you to reflect on them. The interview will be conducted in a meeting room and notes will be made of your responses. The interview will also be audio-recorded, using an electronic dictaphone to ensure no loss of data or context. All responses collected from the interview will be analysed and may be used in the final thesis.

Added March 2023:

In addition to the above, all participants will be invited to a second interview which will be used to clarify points from the first interview and also to address researcher impressions and interpretations. The interview will last no longer than 45 minutes and will be conducted in a meeting room and notes will be made of your responses. The interview will also be audio-recorded, using an electronic dictaphone to ensure no loss of data or context. All responses collected from the interview will be analysed and may be used in the final thesis and any future academic writing such as journal articles or shared at conference presentations. All data will be presented anonymously.

Subsequent to the interview, participants will be invited to participate in a focus group meeting. This will provide an opportunity to discuss your views on how the curriculum was co-created and its implications, through questions and prompts, participants will be invited to share and discuss their perceptions and their journey to this point.

Do I have to take part?

Participation is completely voluntary. You should only take part if you want to and choosing not to take part will not disadvantage you in any way. Once you have read the information sheet, please contact me if you have any questions that will help you decide to take part. If you decide to take part, I will ask you to sign a consent form, and you will be given a copy of this consent form to keep.

What are the possible risks of taking part?

Participating in the research will not cause any personal risks or disadvantages, as I will protect your identity. Your identity and that of the research school will remain confidential. None of the information you provide will be linked to you in the final thesis, or any published academic writing such as in conference papers and journal articles. Pseudonyms will be used to ensure anonymity and all data such as transcripts of the interviews will be kept securely and will be destroyed after ten years per the University procedures. The nature of this research may lead to the school and participants being identifiable. Before the publication of the thesis, all participants will

be provided with sections of the thesis regarding them, which they can check and then request any changes with which they do not agree.

What are the possible benefits of taking part?

There are no remunerations and personal benefits for the participants in this study. However, you will be contributing to an important study. The knowledge gained will be shared with the University and the school, to provide a greater understanding of curriculum models used to raise achievement in science education.

Data handling and confidentiality

Your data will be processed per the data protection law and will comply with the General Data Protection Regulation 2016 (GDPR).

Data Protection Statement

The data controller for this project will be Staffordshire University. The University will process your data for the research outlined above. The legal basis for processing your data for research purposes under the data protection law is a 'task in the public interest' You can provide your consent for the use of your data in this study by completing the consent form that has been provided to you.

You have the right to access information held about you. Your right of access can be exercised per the General Data Protection Regulation. You also have other rights including rights of correction, erasure, objection, and data portability. Questions, comments, and requests about your data can also be sent to the Staffordshire University Data Protection Officer. If you wish to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk.

What if I change my mind about taking part?

You are free to withdraw at any point of the study, without having to give a reason. Withdrawing from the study will not affect you in any way. You can withdraw your data from the study up until 31st December 2022, after which withdrawal of your data will no longer be possible due to data being processed and committed to the final thesis.

If you choose to withdraw from the study, I will not retain any information that you have provided me as a part of this study.

What will happen to the results of the study?

The findings will be included in a final research thesis. I also intend to disseminate the findings by publishing research papers in peer-reviewed academic journals and/or books. The findings could also be presented in academic forums such as conferences, seminars, or workshops. All data will be presented anonymously.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact me using the following contact details: email: claire.copeland@research.staffs.ac.uk

What if I have further questions, or if something goes wrong?

This research is being undertaken for the purpose of completing a thesis in partial fulfilment of a Professional Doctorate in Education at Staffordshire University. If you have any concerns about this research, please feel free to contact my supervisor Dr Gillian Forrester. Her email address is gillian.forrester@staffs.ac.uk

If this study has harmed, you in any way or if you wish to make a complaint about the conduct of the study you can contact the module tutor or the Chair of the Staffordshire University Ethics Committee for further advice and information:

Thank you for reading this information sheet and for considering taking part in this research

Appendix 7: Participant Consent Form

RESEARCH PROJECT CONSENT FORM

Title of Project: An investigation of secondary science teacher perceptions of the development of cultural capital and science identity in students following a linear science curriculum.

STAFFORDSHIRE UNIVERSITY

Researcher: Claire Copeland

I have read and understood the information sheet.	Yes ☐	No ☐
I have been given the opportunity to ask questions, and I have had any questions answered satisfactorily.	Yes ☐	No ☐
I understand that my participation in this study is entirely voluntary and that I can withdraw at any time without having to give an explanation, without this in any way affecting my treatment now or in the future.	Yes ☐	No ☐
I consent that the data collected could be used for publication in academic journals or could be presented in academic forums (conferences, seminars, workshops) and understand that all data will be presented anonymously.	Yes ☐	No ☐
I agree that data will only be used for this project (An investigation of secondary science teacher perceptions of the development of cultural capital and science identity in students following a linear science curriculum), although the data may also be audited for quality control purposes.	Yes ☐	No ☐
I agree to complete a questionnaire, a weekly diary entry over 5 weeks and to participate in an interview.	Yes ☐	No ☐
I agree to allow the interview to be audio recorded	Yes ☐	No ☐

All data will be stored safely on a password-protected computer (electronic data) or locked away securely (hard copies of data) for 10 years before being destroyed.	Yes ☐	No ☐
I understand that I can withdraw my data from the project up to December 31st 2022, before the data is aggregated in the analysis, without having to give an explanation.	Yes ☐	No ☐
I hereby give consent to take part in this study	Yes ☐	No ☐

_____	_____	_____
Name Participant (print)	Date	Signature
_____	_____	_____
Name Researcher (print)	Date	Signature

RESEARCH PROJECT CONSENT FORM

Title of Project: An investigation of secondary science teacher perceptions of the development of cultural capital and science identity in students following a linear science curriculum.

Researcher: Claire Copeland

I have read and understood the information sheet. (v.3)	Yes	☐	No	☐
I have been given the opportunity to ask questions, and I have had any questions answered satisfactorily.	Yes	☐	No	☐
I understand that my participation in this study is entirely voluntary and that I can withdraw at any time without having to give an explanation, without this in any way affecting my treatment now or in the future.	Yes	☐	No	☐
I consent that the data collected could be used for publication in academic journals or could be presented in academic forums (conferences, seminars, workshops) and understand that all data will be presented anonymously.	Yes	☐	No	☐
I agree that data will only be used for this project (An investigation of secondary science teacher perceptions of the development of cultural capital and science identity in students following a linear science curriculum), although the data may also be audited for quality control purposes.	Yes	☐	No	☐
I agree to complete a questionnaire, a weekly diary entry over 5 weeks and to participate in an interview.	Yes	☐	No	☐

I agree to allow the interview to be audio-recorded	Yes	☐	No	☐
I agree to participate in a follow-up interview	Yes	☐	No	☐
I agree to participate in a focus group interview	Yes	☐	No	☐
All data will be stored safely on a password-protected computer (electronic data) or locked away securely (hard copies of data) for 10 years before being destroyed.	Yes	☐	No	☐
I understand that I can withdraw my data from the project up to December 31st 2022, before the data is aggregated in the analysis, without having to give an explanation.	Yes	☐	No	☐
I hereby give consent to take part in this study	Yes	☐	No	☐

_____	_____	_____
Name Participant (print)	Date	Signature
_____	_____	_____
Name Researcher (print)	Date	Signature

Appendix 8: Questionnaire

A questionnaire about science identity and cultural capital.

This study is being undertaken as partial fulfilment for a Doctorate in Education.

Title of project: An investigation of secondary science teacher perceptions of the development of cultural capital and science identity in students following a linear science curriculum.

Researcher: Claire Copeland

Since the implementation of the Education Reform Act (1988), there have been many revisions to the curriculum, resulting in a decrease in content and unexpectedly leading to 'teaching to the test'. Following the removal of the KS3 Science Standardised Assessment Tests (SATs) the importance of science, as a core subject, has arguably been regarded as being less important. It has been well documented that science is a conceptually difficult subject, and less able students can perceive themselves as being less scientifically able.

In 2019, OFSTED inspection criteria changed and focused on the quality of the curriculum being offered to students. As a response to this, the research school designed, implemented, and began the delivery of a linear 5-year science curriculum to students. This study aims to explore the experiences of science teachers delivering the Linear Curriculum and to investigate the perceptions of teachers regarding those students being taught through the Linear Curriculum model.

This questionnaire will take no longer than 30 minutes to complete.

Please complete all questions as indicated.

Section 1 – Demographics

Please provide your name here:

_____

Your name is required so that the researcher can follow up on any comments you make here in the interview. Your name will not be used in the thesis, or any writing associated with this research.

Please tick as many boxes as apply.

1. Please indicate your age:
- ☐ 21-30
- ☐ 31-40
- ☐ 41-50
- ☐ 51-60
- ☐ 60+

2. Please indicate your gender:
- ☐ Male
- ☐ Female
- ☐ Prefer not to say

3. How long have you been teaching:
- ☐ 0-5 years
- ☐ 6-10 years
- ☐ 11+ years

4. What is your degree in:
- ☐ Biology
- ☐ Chemistry
- ☐ Physics
- ☐ Other (Please state below)

_____

5. Do you have a higher degree? Please state here the qualification and what the subject is:

_____

6. Have you completed any professional qualifications during your teaching career? Please state below:

_____

7. Are you currently studying for either a higher degree or a professional qualification? Please state below:

_____

8. What subjects do you predominantly teach:

- ☐ Biology
- ☐ Chemistry
- ☐ Physics

9. Do you have a Leadership role or hold a Teaching and Learning Responsibility (TLR):

☐ Yes (Please state what your TLR is for/your leadership responsibility)

_____

☐ No

10. Have you completed any CPD on curriculum development, cultural capital, or science identity?

☐ Yes (Please state what CPD you have completed, including the title and duration of the training)

_____

☐ No

Section 2 – Your thoughts about the 5-year science curriculum.

Read each sentence below and then tick the corresponding box to indicate the extent to which you agree with each sentence. There are no right or wrong answers.

	1 Agree	2 Neither agree nor disagree	3 Disagree	4 Not applicable
1. I know and understand the rationale behind designing a 5-year curriculum				
2. I was given the opportunity to have input into the design of the science 5-year curriculum				
3. The curriculum has been designed appropriately to help students build confidence in science.				
4. I expect that there may be some issues when teaching the 5-year curriculum for the first time (e.g., content missed or in the wrong place)				
5. I believe that the 5-year curriculum is designed to build on prior knowledge				
6. I think that the 5-year curriculum is challenging for all students.				
7. I think that the 5-year curriculum will build engagement in students				

8. I worry that students will forget content taught in the earlier years				
9. I cannot see how this 5-year curriculum model is any different to previous models I have taught				
10. I think that the 5-year curriculum model is a better model than having separate KS3 and KS4 plans				
11. I think that the 5-year curriculum model will build better scientists				
12. I think that the 5-year curriculum model will improve grades for all students				
13. I think that the 5-year curriculum model will improve science identity in all students				
14. I think that the 5-year curriculum model will provide cultural capital for all students				
15. I think that the 5-year curriculum model sets the foundations and then gradually builds difficulty				
16. I think that the 5-year curriculum model allows mastery of the content for all students				
17. I think there are more positives than negatives with the 5-year curriculum model				

18. I think that the 5-year curriculum model is suitable for all students				

Section 2 continues on the next page

If you have any other thoughts, ideas, or questions that you think are important regarding the 5-year science curriculum, please comment here:

Section 3 – Science identity. This section is about your understanding of what science identity is.

Read each sentence below and then tick the corresponding box to indicate the extent to which you agree with each sentence. There are no right or wrong answers.

Someone with a high science identity would:	1 Agree	2 Neither agree nor disagree	3 Disagree	4 Not applicable
1. Have a science qualification				
2. Talk about science with friends and family				
3. Think that science is important and interesting				
4. Read scientific articles in books and magazines				
5. Visit zoos, museums, and other science-centred organisations often				

6. Do you think that any of the points in Section 3, questions 1-5, are more important than others? **Yes / No** (*Please delete as appropriate*)

7. If Yes, using the table below, please rank the points in order of importance, from the **most** to the **least** important. Number **1** being the **most important** and number **5** being the **least important**.

	Have a science qualification	Talk about science with friends and family	Think that science is important and interesting	Read scientific articles in books and magazines	Visit zoos, museums, and other science-centred organisations often
Rank					

8. Are there any other points, linked specifically to science identity, that you think should be added to the above list? Please specify below and explain.

_____

_____

_____

_____

_____

_____

_____

Section 4 – Cultural Capital

In the most recent OFSTED inspection framework (2019), OFSTED explain their inspection criteria in terms of a curriculum design that provides 'cultural capital' to enable all learners to succeed in life. They have further defined this as 'the essential knowledge ... we want all children to have' and describe it as a 'golden thread, woven through everything you do to teach children well.'

Cultural capital can be defined as the accumulation of knowledge, behaviours, and skills that a student can draw upon. Within the school context, capital can be gained through enhanced knowledge and a gain in qualifications.

The next set of questions is concerned with the cultural capital of the students you teach. Please focus on those students who you think have **high cultural capital.**

Read each sentence below and then tick the corresponding box to indicate the extent to which you agree with each sentence. There are no right or wrong answers.

A student with a high cultural capital will …..	1 Agree	2 Neither agree nor disagree	3 Disagree	4 Not applicable
The student:				
1. … think that it is useful to know about science in their daily life				
2. …consider themselves as a science person				
3. ... know a lot about science				
4. … talk about science with a range of people, including				

parents, siblings, friends, and teachers				
5. … think that knowing someone who works as a scientist or is in a job that uses science is useful.				
School-related:				
6. … think that it is important to study science even if they don't want a science job in the future.				
7. … think that a science qualification can help to get many different types of job.				
8. … think that they learn lots of interesting things in science lessons				
9. … be confident in giving answers in science lessons				
10. … attend an after-school science club at least once a month				
Home related:				
11. … have parent/s who think that science is interesting				
12. … have parent/s who think that science is an important subject in the curriculum				

13. … have parent/s who know a lot about science				
14. … have parent/s who have discussed how science is useful for the future				
Hobby related:				
15. … have lots of books (more than 100) in their home.				
16. … watch science TV programmes (e.g., nature programmes, science documentaries) and/or TV programmes with some science in them (e.g., CSI, The Big Bang Theory)				
17. … read books or magazines about science				
18. … go online to find out about science (e.g., YouTube, science websites, play science games)				
19. … go to a museum at least once a month				
20. … go to science centre, science museum, Planetarium, zoo, or aquarium at least once a month				

21. … do experiments or use science kits (e.g., growing crystals, chemistry set, microscope) at least once a month				
22. … nature walk or similar (e.g., city farm, botanic garden, wildlife site) at least once a month				
23. … programme computers (e.g., writing apps, building websites) at least once a month				

24. Using the table below please rank the sections (Student / School / Home / Hobby) in order of importance, from the **most** to the **least** important. Number **1** being the **most important** and number **4** being the **least important** in judging a student's cultural capital in science:

	1 Most important	2	3	4 Least important
Section:				

25. Do you think that as a teacher you can improve a student's cultural capital? Please **tick** the appropriate box and **explain** your reasoning.

Yes, I think I can improve a student's cultural capital ☐

No, I don't think I can improve a student's cultural capital ☐

_____

_____

_____

_____

_____

Thank you for completing this questionnaire.

Appendix 9: Diary Entries

Week 1-4

Please keep a diary entry once a week, this may be handwritten or typed.

In this entry please be honest and reflect on your experiences over the previous week.

Please provide your name here:

_____

Your name is required so that the researcher can follow up on any comments you make here in the interview. Your name will not be used in the thesis, or any writing associated with this research.

Please make it clear in your entry which class/year group you are writing about

Possible things to discuss:

- Was the content you taught at the correct level of challenge?
- Were the topics you taught in the correct order (prior and future knowledge)?
- Were the students engaged?
- Can you identify any moments or incidences when students showed a change in their science identity? Please provide examples.
- Can you identify any moments or incidences when students showed a change in their cultural capital? Please provide examples.
- Did you adapt/modify your teaching?
- Did you adapt/modify the content taught?
- How much autonomy have you been afforded whilst teaching science this week?

Where possible please provide specific examples and anecdotes from your week.

Week 5

This is your final diary entry.

Please provide your name here:

_____

Your name is required so that the researcher can follow up on any comments you make here in the interview. Your name will not be used in the thesis, or any writing associated with this research.

Please make it clear in your entry which class/year group you are writing about

- Looking back over the last half term, have your reflections changed?
- Do you think there was any change in your students' science identity over the half term?
    - Can you provide an example, either showing some or showing no change.
- Do you think there was any change in your students' cultural capital over the half term?
    - Can you provide an example, either showing some or showing no change.
- Do you think there was any change in your students' engagement with the lesson?
- Were there any changes in your autonomy in the classroom? How did this impact your teaching?
- Having taught the Linear Curriculum for the half term, have your perceptions of it changed? Can you describe this and provide examples of incidences that have affected your perceptions?
- While reflecting over this last half term, do you think the curriculum does what it set out to do? Would you change anything? Please explain.

Appendix 10: Semi-Structured Individual Interview

This is an individual interview to clarify comments made in either your questionnaire at the start of this research or comments made in your diary entries.

1) What did you do before becoming a teacher?
2) What do you enjoy about being a science teacher?
3) What do you find challenging about being a science teacher?

Questionnaire

4) What do you understand by the term science identity?
5) What do you understand by the term cultural capital?
6) Can you explain how the curriculum was planned?
7) Do you think this could be improved?
8) Do you think the Linear Curriculum can build science identity and cultural capital in your students?

Diary entries

9) Did your reflections change over the half term?
10) Was there anything that influenced these changes?
11) Can you describe any particular incidents that affected your perceptions of science identity or cultural capital in your students?
12) Can you describe any particular incidents that affected your perceptions of how the Linear Curriculum worked?

Appendix 11: Follow-up Interview

This is an individual interview to clarify and discuss points made in your previous interview.

In this interview I would like to discuss the pen portrait that I have compiled using all the information you have provided in the questionnaire, your diary entries, and data from our previous interview.

In this interview the following points will be examined:

1) To what extent is this an accurate reflection of you, your background, and your teaching role?
2) To what extent is this an accurate reflection of your perceptions about the Linear Curriculum?
3) To what extent is this an accurate reflection of your perceptions about how science identity manifests in your students?
4) To what extent is this an accurate reflection of your perceptions about how cultural capital manifests in your students?
5) Is there anything else you wish to add which you think might be useful or important for the research but has not been captured in this pen portrait?

Appendix 12: Ethical Approval

Institute of Education

ETHICAL APPROVAL FEEDBACK

Researcher name:	Claire Copeland
Title of Study:	SU_21_210 An investigation of secondary science teacher perceptions of the development of cultural capital and science identity in students following a linear science curriculum.
Status of approval:	Approved

Thank you for addressing the committee's comments. Your research proposal has now been approved by the Ethics Panel and you may commence the implementation phase of your study. You should note that any divergence from the approved procedures and research method will invalidate any insurance and liability cover from the University. You should, therefore, notify the Panel of any significant divergence from this approved proposal.

You should arrange to meet with your supervisor for support during the process of completing your study and writing your dissertation.

When your study is complete, please send the ethics committee an end of study report. A template can be found on the ethics BlackBoard site.

Signed: **Date: 17th August 2022**

Ethics Co-ordinator
Institute of Education

Principal:

Our Ref:01A/CCpermission

24th March 2022

Dear Staffordshire University,

I confirm that permission is given for Claire Copeland to undertake research relating to her doctoral study at with staff members from the Science Department. I am happy for Claire to collect data from staff members via a questionnaire, diary entries and interviews during the period September 2022 and March 2023.

Yours faithfully,

Principal

If you require this information in a different format, please contact the school.

Institute of Education

ETHICAL APPROVAL FEEDBACK

Researcher name:	Claire Copeland
Title of Study:	**SU_22_270 (Amendment to SU_21_210)** An investigation of secondary science teacher perceptions of the development of cultural capital and science identity in students following a linear science curriculum.
Status of approval:	Amendment Approved

Thank you for your correspondence requesting approval of a minor amendment to application SU_21_210.

Whilst the supplementary data collection questions on the draft data collection instruments are acceptable, it is noted that the final wording of these questions is subject to the analysis of findings from earlier data collection methods. In the event that the analysis of these findings should lead to changes being made to the data collection questions that changed either the nature and scope of the project or the classes of participants involved, you would need to reapply for ethical approval.

Your amended application is approved. We wish you well with your research.

Action now needed:

Your amendment has now been approved by the Ethics Panel.

You should note that any divergence from the approved procedures and research method will invalidate any insurance and liability cover from the University. You should, therefore, notify the Panel in writing of any significant divergence from this approved proposal. This approval is only valid for as long as you are registered as a student at the University.

You should arrange to meet with your supervisor for support during the process of completing your study and writing your dissertation.

When your study is complete, please send the ethics committee an end of study report. A template can be found on the ethics BlackBoard site

Signed: **Date: 16/03/2023**

Chair of the Institute of Education Ethics Panel

Principal:

Our Ref:01B/CCpermission

13th March 2023

Dear Staffordshire University,

I confirm that permission is given for Claire Copeland to undertake research relating to her doctoral study at with staff members from the Science Department. I am happy to extend the deadline for Claire to collect data from staff members via a questionnaire, diary entries and interviews until the end of July 2023.

Yours faithfully,

Principal

If you require this information in a different format, please contact the school.

Appendix 13: Focus Group Interview

This is a focus group interview to discuss how the 5-year Linear Curriculum was developed and how you perceive it is working now.

Curriculum

1) Can you tell me how the 5-year curriculum is planned and share your views on this?
2) How has the curriculum developed since its first implementation?
3) Can you tell me what the strengths of the Linear Curriculum are?
4) Can you tell me what the limitations of the Linear Curriculum are?
5) How do you feel about being given the opportunity to develop your own curriculum?

Science identity

6) Can you tell me what science identity means to you?
7) What do you see in students who have this notion of science identity?
8) Do you think science identity can waiver? If so how, in what ways and what are the implications?
9) To what extent do you think the Linear Curriculum develops science identity?

Cultural capital

10) Can you tell me what cultural capital means to you?
11) What do you see in students who have this notion of cultural capital?
12) To what extent do you think the Linear Curriculum can develop a student's cultural capital?
13) Can science-linked cultural capital waiver? If so how, in what ways and what are the implications?

Appendix 14: Complete Pen Portraits

Emma

Emma has taught secondary education for her whole working life. She is an experienced, energetic, and passionate teacher, and throughout her long career, she has achieved qualifications, both academic and vocational, through CPD to improve her understanding of teaching and learning and her leadership skills. As a professional, she sees CPD as an essential feature of her teaching career, keeping abreast of the latest research. As such, Emma reads educational texts in her own time and attends the school Book Club to share ideas from chosen educational texts. She sees herself as a reflective and adaptive teacher and has the confidence to trial systems she has read about to help improve her teaching skills.

Having not achieved the 11-plus examination, Emma completed her education at her local comprehensive school rather than the grammar school she had been expected to attend by her parents. The support she received from teachers during her journey is arguably the driver of her enthusiasm to help students make their best progress. Emma enjoyed subjects such as science and art and disliked geography particularly, and she put this down to feeling 'unsafe' in the classroom as she perceived the teacher could not handle the misbehaviour of some students, and as such, she did not feel affection for the subject or that she belonged in the classroom. She described her science and art teachers as 'amazing' and supportive and believes she developed science and art identities in these subjects, in part because of the relationship she had with these teachers. Emma now sees herself as a scientist and believes she has a strong science identity, which she wants to share with her students in the same way her teachers shared their identity and love for their subject with her.

Within her classroom, Emma believes that modelling difficult-to-see or understand concepts is an important aspect of making science 'real' for students. Modelling may be through the teacher or with hands-on experience through practical lessons. She thinks that when students are completing practical work and wearing safety equipment, such as goggles, students see themselves as 'scientists' and this is important in developing their science identity.

Emma was involved in the initial design and implementation of the Linear Curriculum and believes the inclusion of the content required to achieve the Triple Award in science is a great contribution to providing students with opportunities to develop cultural capital in science. Emma believes the inclusion of Triple content throughout the curriculum prevents students from 'ceiling' themselves and labelling themselves as being 'only a foundation student' compared to the perceived 'brighter' Triple student. She is a strong advocate for equality for all students, no matter their background or prior experiences, and believes school is a place that can make a difference in the life of a child. Whilst recognising homelife is important in the development of cultural capital in a student, she recognised there are limitations to what parents can offer and their level of support.

Emma sees the Linear Curriculum in a positive light and is enthusiastic about how it provides challenges and opportunities for all, and in the way, it builds from simpler basic knowledge in Y7 to more difficult concepts in Y11, rather than repeating topics from KS3, again in KS4. The clear pathway provided by the Linear Curriculum and its use of themes is also seen as useful for students to see how lessons fit within the whole scheme. However, she recognises the curriculum is still developing and is conscious of topics that are still not in the right hierarchical place within the curriculum in terms of their difficulty. Emma considers the Linear Curriculum as a vital factor in developing science identities but recognises other factors that can influence this, including the teacher's own science identities and values, the quality of the teaching, the quality of the resources, and the leadership within the department and the school.

On a more negative note, Emma is concerned that the curriculum content is overwhelming for some students. While thinking that all students should have access to the Linear Curriculum and the Triple content, she also disputes its suitability for all students, particularly lower-ability students. Emma is aware of the constant tussle she faces between using the Linear Curriculum to develop science identities and cultural capital in her students and 'teaching to the test' to help her students achieve the grades they need for their next stage of education. In terms of science identity, Emma believes that a qualification is not a pre-requisite and an interest in the subject is enough to develop that identity, so by teaching all students the Triple content and

giving all students access to everything, this in itself is an enabler in developing science identity in students.

Despite the restrictiveness of the curriculum set by the National Curriculum, Emma does not discuss this and enjoys the autonomy she has in the classroom. She perceives the 'trust' of both her colleagues within the department and the Senior Leaders in the school to complete her job in the ways she sees fit, of which she is proud.

Jim

Jim worked in industry before entering the teaching profession. He is an experienced and reflective teacher and having achieved a vocational qualification in middle leadership, he moved into a middle leader role some years ago. He is considered in all his responses and enjoys the challenges involved in teaching. He is proactive in improving his lessons and continually works to improve his teaching and the learning opportunities for his students. Throughout this research and data collection, Jim described how he researched topics to help improve his understanding of the terms used and then examined how he approached his teaching.

Jim believes his science identity evolved during his secondary education, where he enjoyed his science lessons. Jim recalled success in his science lessons, which he now believes was more important in developing the origins of his identity and future study. Jim thinks that science identity is part of a person's personality and their 'approach' to life. He believes that someone with a high science identity will have a logical, unemotional, and structured approach to problems. Although he does not think you have to have a qualification to have a science identity, he links the traits of science identity to the skills a scientist would have, including collecting evidence, researching, and evaluating. Jim is very focused on the skills required to be a good scientist and persists with this theme when he describes how the curriculum could be improved. However, he has reservations about the usefulness of practical lessons in developing those skills. Jim believes the relationship between teacher and student is important in developing science identity and furthers this when he describes positive interactions that can change the mindset of students into believing they can succeed in science.

Jim understands the experiences people have, the impact on their cultural capital, and how this manifest throughout their lives. He believes it is important in the choices students make, even down to the quality of their diet. He thinks that cultural capital encompasses aspects of all experiences, including those in the arts as well as science, and as such recognises that science is a building block in providing students with experiences to enhance their cultural capital. Jim thinks teaching all the students the Triple Content, never mind their background, home life, and prior attainment, provides them all with the same opportunities to learn and develop cultural capital in science, which he perceives as being important in making all students equal and enhancing their opportunity to improve their cultural capital. From his experience as a parent, Jim thinks that home life helps to develop students' thirst for learning and their aspirations, and the role of the school is to facilitate this.

Although Jim recognises the difference between this curriculum and other models, he shares concerns over topics being taught in the wrong place due to their challenging nature. However, he is less concerned about this because the department has already recognised such issues and is remedying this through either reorganisation of the curriculum or improvements made to the shared resources, ensuring teaching links to prior required knowledge, which is the addition he thinks will help further improve the curriculum model. Although he has some reservations about the suitability of the curriculum model for all students, he recognises that the issues surrounding this set of students he was referring to are out of his control and so are not related to the model *per se*.

Jim described the curriculum model as being 'challenging' and 'high quality' and believes this will potentially positively impact science identity and cultural capital in his students. He recognises that some students already have a science identity, and these students are already motivated to learn more and engage more; however, others have very little or no science identity, and this is where the challenge lies. Jim links this to the skills he previously described as being important in science identity and thinks the next stage of curriculum development should be to include these explicitly to ensure students have the skills, they require to be successful. This will then potentially help them to achieve, which Jim thinks may help increase science identity in all students.

Jim thought the process of reflection he participated in over the term was useful in that it allowed him to consider the actual curriculum and its impact and steered him away from the more insular reflection of his lessons. He thought that what was being taught was probably more important than how it was taught, given that other colleagues were equally experienced. He explained how he thought the curriculum was the driver within the classroom and ensured all students had access to the same experiences in terms of topics taught and the potential to increase cultural capital. Jim acknowledged the teacher within the classroom was also important and linked their role to the development of science identity.

In his teaching, Jim described how providing an overview of a new topic and showing how it fits into the lives of students is paramount to the student's understanding. He thinks this is important in keeping students focused and engaged, helping them to understand the importance and where each topic fits into the whole. He further emphasises the importance of prior knowledge and revisiting it so that all students have the same starting point and can then further build on their knowledge. Jim thinks this is important because he perceives a lack of prior or background knowledge as a barrier to students forming a science identity and ultimately achieving in science.

Jim likes to have consistency in his lessons and, as such, likes the constraints put on him by whole school initiatives, such as recall recaps at the start of lessons. He thinks the curriculum model offers a balance of being told what to teach and when, whilst giving him the autonomy required to teach in his way and being able to adapt his teaching for different classes.

Laura

Laura is an experienced teacher who came straight into teaching after graduating with a science degree. She has completed a vocational qualification and currently works as a middle leader in the school. Despite considering herself a 'nerd,' a term she uses interchangeably and meaning possessing a science identity, she does not consider herself a scientist because she perceives a scientist practises science rather than just teaching science. Laura became interested in science from an early age when her parents bought her encyclopaedias to read when she showed no interest in reading storybooks.

Laura considers science identity to encompass a wide range of actions with the focus of enjoying science and thinking science is important in the world around us. She thinks it is important for students to see the relevance of topics and for them to understand the importance of these in their own lives. Alongside this, Laura believes self-recognition of success in 'knowing' some science facts can impact students' science identity. However, she believes enjoyment alone cannot impact science identity when students are achieving poor grades in assessments. Laura touches on the fact that she believes science identity may be 'fluid' and can come and go depending on whether you are engaging in any science. She considers cultural capital to include knowledge gained whilst studying alongside experiences gained through everyday life. Laura strongly believes that a stable home and time spent as a family unit are important in developing a child and increasing their cultural capital. Whilst she acknowledged schools can have an impact, she recognises time is a barrier in school.

Laura 'loves' how the Linear Curriculum model breaks down difficult concepts into the basics and then develops understanding through the rest of the curriculum. She sees this as important to prevent students from being overwhelmed and then disengaging with learning. She also identifies specific topics that are only introduced at a later stage and describes how she feels these are 'blocked' rather than linear, although she is unclear how these topics could be introduced any earlier due to their conceptual difficulty. Laura thinks the gradual increase in difficulty through the curriculum helps to build science identity and cultural capital in students and helps to build resilience in her students. She furthers this by describing the use of well-structured resources that support the students while recognising that poor-quality resources may hinder student progress.

To improve the curriculum, Laura expressed concerns about students recalling knowledge from previous years and described how the inclusion of the knowledge required at the start of a new topic would improve the ability of students to further their knowledge. She acknowledged that this is an area the department has already identified and is working to improve. She also described how a lack of time prevents students from developing some of the important skills required when investigating, which then impacts the level of their science identity.

Laura distinguishes between teaching content to enable students to pass an examination and teaching for learning, which is where she perceives science identity is gained. She also described how she thinks the relationships within the classroom are important, as engagement can also impact knowledge and science identity gained. Laura has found that having the opportunity, through this research, to reflect on her teaching has allowed her to think more carefully about how she builds knowledge in her students and considers her teaching has improved.

Max

Max came straight into teaching after graduating with a Master of Biology degree and following the successful completion of a postgraduate teacher training course. During the interviews, Max pauses and thinks before he presents his answers, and although his relatively short teaching experience is sometimes evident, he appears conversant with teaching and learning strategies. Max is very passionate about teaching and passing on his love of learning to his students.

Max recalls always enjoying science at school but cannot pinpoint a single point at which he decided he wanted to continue down that route. Although neither of his parents was in a science job or were particularly science-minded, they supported Max in his interests by buying him science-based books. Max sees himself as a scientist, based on his academic record, having studied Biology, Chemistry and Physics at an advanced level, and having then progressed to university and studied Biology. He sees his research activities working in laboratories as an important aspect of his own science identity.

Within his classroom, Max wants to inspire his students to follow in his footsteps and is considered in his approach to helping students understand and build their scientific knowledge, especially their science identity. However, he also recognises that a qualification is not the only way to develop this. He understands that students and groups of students are unique and require different strategies to support them. Max places more emphasis on the role of school rather than home in developing a love of science in the student, as he recognises, in a similar fashion to his background, that not all parents have that shared interest in science. He believes that a good relationship between the student and the teacher is important in helping the student feel they

belong and in helping them to want to learn more, as a prerequisite for developing a deeper interest in science and building their cultural capital.

Max was not involved in the initial design and implementation of the Linear Curriculum, but he considers himself to have a good understanding of the principles on which it was designed and recognises it as different and 'better' than the curriculum plans he has used before. He enjoys teaching using the Linear Curriculum model because it offers him the flexibility of adding his spin on lessons, but he also enjoys the structure offered in how topics are developed. Max does not currently teach across the whole curriculum and is not able to comment on the suitability and flow of the curriculum from Y7 through to Y11. Although he considered himself to not have enough experience to comment on areas to improve the curriculum, he identified points that highlighted positive aspects of the curriculum and evidenced it with examples in the classroom of where the curriculum did as it was intended to do. Max thinks it is important to ensure the curriculum is of the correct level of challenge so that students can complete work, rather than being unable to do tasks and then believing they are 'no good at science.'

Max thinks it is important to make subject content relatable to students' lives, as he recognises students struggle with science because of its challenging topics and the breadth of content. Consequently, Max focuses on the need for engagement throughout lessons to make sure students keep up with new content, as he is conscious of students tuning in halfway through the lesson, making understanding more difficult. He discussed the need to bring subjects alive through modelling to keep students focused and help with their understanding. To further this, Max discussed the importance of practical sessions within his teaching and sees these as opportunities to show students how things work.

Max believes teaching can both build and influence students' cultural capital, but he is less clear about how this can be measured. He further suggests that the enjoyment of a particular lesson or a lesson given by a particular teacher may influence students' science identity and cultural capital, and both are important factors in developing these in his students.

Robert

Robert worked for a few years as an unskilled labourer, followed by a year as an accountant before entering the teaching profession. He is an experienced and confident teacher and enjoys his time in lessons, building relationships with his students and helping them to make progress whilst enjoying science. He achieved a vocational qualification during his time working in middle leadership and reflected on how he enjoyed his earlier middle leader role and is now more focused on what happens inside his classroom.

Robert explained how he always had an interest in science and enjoyed studying it whilst at school, which combined with experiencing success, led to him studying all three subjects to the Ordinary Level Qualification (O-level) standard. He further described this as a conscious decision because he perceived there to be greater career opportunities for those with a science background. Although he recognised his enjoyment of the subject area to be a bonus. Robert's enjoyment of science extended into his home life, where he recalls watching nature programmes and subscribing to 'New Scientist' magazine, although again he sees he has come 'full circle' and now only concerns himself with topics that are connected to topics he is currently teaching.

Robert considers himself a scientist and describes this in terms of the methodology he uses or his approach to doing things. Before participating in this research, he was unsure what science identity was but now links this to his idea of methodologies and making links and identifying patterns. He perceives those with a science identity would use a methodology that lays the foundations on which to develop the more difficult concepts. He further described how a student with a science identity will think in a certain way and ask questions, which often pre-empt what the teacher is going to discuss. Robert makes a distinction between being good at science and being a good scientist and clarifies that a good scientist is the one with a science identity and can follow and develop systems to develop their own methodologies. Although Robert linked his own science identity to the enjoyment of the subject, he does not think enjoyment is an essential criterion for a science identity, although he recognises it helps. Robert was more familiar with the term cultural capital and used the definition he had been given in previous school training sessions. He defined it as the extra

content shared with students beyond the schemes of work and which helps students to function better in society, giving them an advantage either socially, academically, or professionally. He furthers this by linking this to real-life uses of science and identifies this as a difficult point to add to a curriculum since it is sometimes time-sensitive (what is currently happening in the world) and dependent on the teacher in front of the class and their personal life experiences, which are sometimes constrained by age.

Robert was very proud of the work he and his colleagues had done on developing the curriculum and identified the process as having a cooperative approach. Despite there being a few constraints, he saw it as a team approach where all members of the department were involved throughout the process and were trusted to complete the task. He furthers this by describing how his autonomy has continued to date and how he values the trust provided to him and his colleagues in ensuring the curriculum works and is suitable for the students. Robert reflected on the time spent in 'lockdown' during the COVID pandemic in the spring term of 2020 as being positive in terms of allowing staff the time to reflect and create booklet resources to match the curriculum. Despite being positive about the curriculum, Robert recognises there are points of the curriculum that need further development, although he notes that these points have already been identified and actioned within the working department.

Robert believes he can build science identity and cultural capital in his students but has reservations about how cultural capital development could be measured without specifically assessing for it. However, he identifies 'lightbulb' moments in his students as a point at which they have understood some aspect of science and links these to the development of science identity. Robert considered himself to not be particularly reflective on his teaching practice until he participated in this research. He now perceives that he has changed how he plans lessons by carefully considering the opportunities he provides for his students to work like scientists and to develop their science identities.

Appendix 15: Examples of Initial Open Coding, NVivo12 Nodes, Descriptions and Their Potential Relationship With the Research Questions

Quotes from data	Researcher Interpretations and Nodes
Themes: **3) Relationships between the Linear Curriculum, the teacher, and the students.** **4) Impact of curriculum development on the teacher.**	
Emma: Every student, no matter from what background you are from, should have the **same entitlement** and the same access to the curriculum . . . every student has access to the same entitlement and the same access. (SSI)	- equal opportunities should exist for all students – **Social injustice** - giving all students equal opportunities provides access to cultural capital – **Increasing cultural capital**
Jim: The simplest idea for me is that they all get the **same experiences** regardless of background, school, where they live, and give them the best experiences regardless of context. (SSI)	- not all students have the same experiences outside of school, so by providing equal opportunities in school, all students are equal – **Social injustice, Increasing cultural capital, Home/parents**
Laura: For me, cultural capital just means rather than just learning the curriculum, that you are **learning a wider, more broad education**, on the wider world, rather than just "this is the National Curriculum" and learning that. (SSI)	- the National Curriculum provides an education for all, but teaching beyond that or content not within it will give the students extra knowledge, which can be defined as cultural capital – **Cultural capital definition, Enriching the Curriculum**

Quotes from data	Researcher Interpretations and Nodes
Themes: **1) Participants' perceptions of the Linear Curriculum.** **3) Relationships between the Linear Curriculum, the teacher, and the student**	
Max: I think it's about instilling, relating things to what they might have seen in **real life**. . . it's about thinking about science in their daily life. I've had some students that will ask me questions about things that they've perhaps seen on the news, things they might have even seen just on the Internet. I had someone ask me the other day why do water bottles have an expiration date. It **wasn't related to the lesson**, but I thought it was quite interesting. I told them it's due to the plastic bottle, it's interesting but again, I suppose it's **being curious** and finding out things, relating them to real-life scenarios. (SSI)	- in the context of the text, Max is describing how teaching beyond the curriculum provides students with something 'extra' which he described as cultural capital – **Cultural capital definition, Real life, Enriching the curriculum**

Quotes from data	Researcher Interpretations and Nodes
Themes: **1) Participants' perceptions of the Linear Curriculum.** **3) Relationships between the Linear Curriculum, the teacher, and the student**	
Robert: I **didn't see it as they all got the same**, but by necessity, those children disadvantaged by background and with parents who didn't get them to read and [students who] don't have access to books, **we really have to do more** for them if they are going to leave with enough. (FG)	- there is recognition here that not all students are equal, and this begins in the home. Although Robert identifies activities such as lack of books and reading at home, appearing to have some understanding of how Bourdieu used the term cultural capital, his explanation of how schools can help appears to indicate schools providing a service or object to students to help with the 'levelling-up' process – **Cultural capital definition, Social injustice, Enriching the Curriculum, Home/Parents, Real life**

Research Question	Node	Description
Theme 1: Participants' perceptions of the Linear Curriculum		
RQ1	Bigger picture	Any reference to how content fits into topics or contexts
RQ1	Challenge	Any reference to the teaching order and difficulty of content
RQ1	Suitability	Any reference to the suitability of content and curriculum to students
RQ1	Developing the curriculum	Any reference to how the curriculum was developed, including what was included/excluded, sequence, changes
RQ1	Modelling	Any reference to techniques used to moderate issues (positives/negatives) in the curriculum model
RQ1	Prior knowledge	Any reference to how prior knowledge was used in developing the Linear Curriculum
RQ1	Resources	Any reference to how teachers used the curriculum model
RQ1	Sequence	Any reference to the sequencing of concepts and topics
RQ1/RQ3	Overwhelming	Any reference to how the science curriculum is perceived by teachers/students
RQ1/RQ2	Difficulty	Any reference to how teachers/students consider science compared to other school subjects
RQ1/RQ2/RQ3	Methodology	Any reference to skills perceived to be important in teaching and learning science and behaving as a scientist

Research Question	Node	Description
RQ1/RQ3	Real life	Any reference to the importance of real-life examples in teaching and the curriculum
RQ1/RQ3	Enrichment	Any reference to perceptions of enrichment and their impact on the curriculum model
RQ1/RQ3	Science identity	Any reference to aspects of science identity (see later)
RQ1/RQ4	Social mobility	Any reference to the school situation and low socioeconomic status
Themes: **2) Teachers' impact on the development of the Linear Curriculum** **3) Relationships between the Linear Curriculum, the teacher, and the student**		
RQ2/RQ3	Science identity and being a scientist	Any reference to attributes seen in themselves and students, related to perceptions of science identity
RQ2/RQ3	Failure	Any reference to not being successful
RQ2/RQ3	Overwhelmed	Any reference to the diversity of the content and the volume of work and content of the curriculum
RQ2/RQ3	Qualification	Any reference to recognisable qualifications
RQ2/RQ3	Enjoyment	Any reference to positive feelings about science or the curriculum
RQ2/RQ3	Interest	Any reference to points of interest in science in the world or school science
RQ2/RQ4	Teachers as students	Any reference to teachers learning or studying
RQ2/RQ4	Teacher-student relationships	Any reference to relationships between teachers and students in school and the classroom

Research Question	Node	Description
RQ2/RQ4	Professional identity	Any reference to teachers talking about how they perceive themselves or how others see them
RQ2/RQ4	Teacher demographics	Any reference to the personal background of teachers
RQ2/RQ4	Social injustice	Any reference to concerns about the fairness of education
RQ2/RQ4	Participant becomes a researcher	Any reference to the participant studying and researching aspects related to this research
RQ2/RQ4	Reflexivity	Any reference to teachers reflecting on their role/teaching etc and points demonstrating reflexivity
Theme 3: Relationships between the Linear Curriculum, the teacher, and the student		
RQ3	Different identities	Any reference to how students and teachers see themselves
RQ3	Fluid science identity	Any reference to identities changing
RQ3	Increasing science identity	Any reference to activities/content changing levels of science identity
RQ3	Teaching experience	Any reference to aspects of personal teaching experiences
RQ3	Mindset	Any reference to how students/teachers think and manage change
RQ3	Definition	Any reference to a definition of science identity
RQ3	Barriers	Any reference to points considered to reduce or prevent learning
RQ3	Knowledge	Any reference to the knowledge required or included in the curriculum

Research Question	Node	Description
RQ3	Motivation	Any reference to things that motivate students in science learning
RQ3	Resilience	Any reference to how students manage learning in science education
RQ3	Student *habitus*	Any reference to student *habitus*
RQ3	Making links	Any reference to the importance of linking topics in learning science concepts and improving knowledge
Theme 3: Relationships between the Linear Curriculum, the teacher, and the student		
RQ3	Teacher relationships	Any reference to the impact teachers may have on the capital gain in students
RQ3	Definition	Any reference to a description of what cultural capital is
RQ3	Increasing cultural capital	Any reference to perceptions of how cultural capital can be changed
RQ3	School facilities	Any reference to how school systems may impact cultural capital in students
RQ3	Symbolic violence	Any reference to harm perceived in science education
RQ3	Home/parents	Any reference to how homelife affects cultural capital in students
Theme 4: Impact of curriculum development on the teacher (Teacher Agency)		
RQ4	Curriculum concerns	Any reference to teacher comments about concerns of the curriculum model
RQ4	Curriculum positives	Any references to aspects perceived by teachers to have a positive impact
RQ4	Proactive teamwork	Any reference to how the group of teachers work together
RQ4	Pedagogy	Any reference to how teachers interact with students in the classroom

Research Question	Node	Description
RQ4	Routines	Any reference to routines in teaching and how these impact students
RQ4	Teacher agency	Any reference to teacher agency
Theme 4: Impact of curriculum development on the teacher (Teacher *Habitus*)		
RQ4	External pressures	Any reference to aspects of the teaching role that teachers perceive causes pressure/stress
RQ4	Inner quarrels	Any reference to teachers concerned about doing things they morally did not agree with
RQ4	Teacher *habitus*	Any reference to teacher *habitus*
Theme 4: Impact of curriculum development on the teacher (Teacher Professionalism)		
RQ4	Teaching to the test	Any reference to teaching to the test rather than teaching science
RQ4	Autonomy	Any reference to teachers' autonomy, increased or decreased
RQ4	Enjoy the job	Any reference to aspects of their role teachers enjoy
RQ4	Professionalism	Any reference to teachers' professional role