

Connecting the Echo Dots:
An Exploratory Ethnographic Study
of ‘Alexa’ in the Classroom

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Abstract

Educational research literature regarding epistemic curiosity and voice technology could not be found to answer a burning question of, ‘Why aren’t my students curious?’. The aim of the study was therefore to critically analyse teachers pedagogical approaches and how voice technology was used by students as a more knowledgeable other and the extent to which it affected students’ epistemic curiosity.

Using an exploratory ethnographic approach, Amazon’s Echo Dot voice technology was studied in lessons at Hillview School. Data was collected through participant observation, informal interviews and recordings of students’ interactions with ‘Alexa’.

Students asked questions to Alexa in large numbers. Alexa was asked 87 questions during two lessons suggesting that Alexa was a digital more knowledgeable other.

Types of questions asked to Alexa, such as ‘Can fish see water?’, were epistemic questions and suggestive of epistemic curiosity. Teachers used the Echo Dots infrequently and in a limited number of ways. Teachers relied upon a pedagogical approach and talk oriented around performance which overlooked students’ learning talk. The answer to why students might not be curious was not found. However, evidence to understand how and why they might appear not curious was revealed.

The study makes contributions to knowledge through the novel use of the Echo Dots to collect data and through a new data visualisation technique called ‘heatmaps’. The study contributes to knowledge by proposing three tentative notions that emerged inductively from the research: ‘performance-oriented talk’, ‘metricalisation’ and ‘regulativity’. The study aims to make a further contribution to knowledge by suggesting evidence of a ‘pedagogy of performance’. The study recommends ‘learning-oriented talk’ and development of Alexa ‘Skills’ as a way to disrupt the pedagogy of performance and as an area for further research.

Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of the University of Gloucestershire and is original except where indicated by specific reference in the text. No part of the thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas.

Any views expressed in the thesis are those of the author and in no way represent those of the University.

Signed:

Date: 26th March 2021

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Dedications

It is hard to put into words just how important the help and support of others is, especially when it has helped you complete a five-year journey. Support was often given without knowing how much it counted. Asking how it was going or telling me to keep going made the difference.

For Joe.

For Will.

For Julia.

For Pam & Malcolm.

For Daisy. *You always say we should never stop being curious, to always open any curiosity door we find. Why are you keeping this curiosity door locked?'*

'The Bathtub' (2016) *Stranger Things*, Chapter 7, Netflix, Accessed: 28th January 2021.

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From my time spent with the teachers at Hillview School I now know that teachers work really hard and that work in schools is really complex and hard – there was no easy work and no easy days. I left Hillview School with the overriding feeling that the ‘machine’ of the education system is fuelled by the goodwill of teachers. I too drew from this goodwill but hope that I gave something back.

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Table of Contents

Chapter 1: Introduction.....	1
1.1 Context and Background Information	1
1.2 The Scope of the Study.....	4
1.2.1 My Background	4
1.2.2 An Unanswerable Burning Question.....	6
1.2.3 Positionality	6
1.3 Theorising A Digital More Knowledgeable Other	8
1.4 The Aim of the Research	11
1.5 The Three Research Objectives.....	11
1.6 Thesis Structure	12
1.6.1 The Chapters.....	12
Chapter 2: Critical Review of Selected Literature.....	14
2.1 Part One: Voice Technology	15
2.1.1 What is Voice Technology?	15
2.2 Themes Within the Voice Technology Literature	16
2.2.1 Voice Technology ‘Use Cases’	16
2.2.2 Interactions with Voice Technology.....	17
2.2.3 Voice Technology: Testing, Trialling and Studying at Scale.....	17
2.2.4 Technical Set-up and Deployment of Voice Technology	18
2.3 Voice Technology in Education	18
2.3.1 Voice Technology in Classrooms.....	18
2.3.2 Pedagogical Approaches to Voice Technology.....	19
2.4 Voice Technology Literature: Summary	19
2.5 Part Two: Epistemic Curiosity	20
2.5.1 A Definition and Overview of Curiosity	20
2.5.2 Separating Epistemic Curiosity from Curiosity.....	21
2.5.3 A Lack of Students’ Questions in the Classroom.....	24

2.5.4 Questions for Reasons Other Than Curiosity	25
2.6 Epistemic Curiosity and Education	28
2.6.1 Further Perspectives of Curiosity	28
2.6.2 The ‘Zone of Curiosity’ Concept.....	29
2.6.3 A Cognitive Process Theory of Curiosity.....	30
2.6.4 Developing an Understanding of Epistemic Curiosity	31
2.6.5 Problems Measuring Curiosity	32
2.7 Epistemic Curiosity: Summary.....	34
2.8 Part Three: Social Interactions Involving Technology.....	35
2.8.1 Technology Acceptance Models	35
2.8.2 Affordance	36
2.8.3 Talk and Technology	37
2.8.4 Vygotsky: A Theory for Learning.....	39
2.9 Conclusion to the Chapter	40
Chapter 3: Methodology	42
3.1 Context for the Research Study	43
3.1.1 Guiding Principles of the Research Methodology.....	43
3.1.2 Ethical Responsibilities	44
3.1.3 The Research Design Rationale.....	50
3.1.4 Why Ethnography?	51
3.2 Methodological Approach	52
3.2.1 Aspiring for Ethnographic Validity.....	53
3.2.2 Consideration of a Range of Data Collection Tools.....	56
3.3 The Selected Methods of Data Collection.....	59
3.3.1 The Echo Dots	59
3.3.2 Transcripts from the Echo Dots.....	63
3.3.3 Participant Observation	64
3.3.4 Fieldnotes.....	65
3.3.5 Informal Interviews During Fieldwork.....	66

3.3.6 Use of Email	68
3.4 Fieldwork During the ‘Case’ Study	68
3.4.1 September 2017 to December 2017 (3 Months).....	69
3.4.2 January 2018 to March 2019 (15 Months)	70
3.4.3 July 2019 to December 2019 (4 Months)	70
3.4.4 January 2020 to March 2020 (3 Months)	70
3.5 Organising and Structuring the Data	71
3.5.1 Thematic Analysis of the Data	72
3.6 Conclusion to the Chapter	81
Chapter 4: Interpretations of the Data	83
4.1 Introduction	84
4.2 Part One: Themes from the Classroom.....	85
4.2.1 Organisation of the Classrooms.....	85
4.2.2 The Use of Worksheets in Lessons.....	87
4.2.3 Instruction from The Front	88
4.2.4 Teachers’ Positions and Talk During Lessons	92
4.2.5 Visualisation of Types of Students’ Talk	94
4.2.6 Visualisation of Teacher’s Talk During Lessons	99
4.2.7 Performance-Oriented Talk in Lessons	102
4.3 Part Two: Themes from the Echo Dots and the Classroom	104
4.3.1 Patterns of Use and Pedagogical Approaches of Teachers.....	105
4.3.2 Students’ Use of Alexa as a Source of Information	106
4.3.3 Ways the Echo Dots Were Deployed in Lessons	109
4.3.4 The Way of Teaching and Learning	112
4.3.5 Types of More Knowledgeable Other	114
4.4 Part Three: Themes from the Echo Dot Transcripts.....	118
4.4.1 Prompted and Unprompted Questions.....	118
4.4.2 Students’ Questions	119
4.4.3 Students’ Epistemic Questions and Epistemic Curiosity	122

4.4.4 Some Problems and Barriers Using the Echo Dots	125
4.4.5 Alexa as a Digital More Knowledgeable Other.....	128
4.4.6 Alexa’s Knowledge	131
4.5 Conclusion.....	134
Chapter 5: Discussion.....	135
5.1 Part One: The Research Objectives	135
5.1.1 RO1: Discussion of the Pedagogical Approaches of Teachers	136
5.1.2 RO2: Discussion of Voice Technology as a Student’s Digital More Knowledgeable Other in Lessons	149
5.1.3 RO3: Discussion of the Impact that Voice Technology Has on Students’ Epistemic Curiosity	162
5.2 Summary of RO1, RO2 and RO3	169
5.3 Part Two: The Research Aim	171
5.3.1 A Pedagogy of Performance.....	171
5.3.2 Talking and Questioning for More Knowledge.....	173
5.3.3 Disconnects Between Pedagogy and Students’ Needs and Talk.....	180
Chapter 6: Conclusion and Recommendations.....	187
6.1 Revisiting the Purpose of the Study	187
6.2 The Restrictive Impact of a Pedagogical Approach	187
6.3 Limitations.....	190
6.4 Implications of the Study.....	194
6.4.1 Recommendations for Further Research	195
6.4.2 Summary of Findings	199
6.4.3 Further Questions	200
6.5 Contribution to Knowledge	202
6.5.1 Curiosity Understood as a Signal/Problem (CUSP Model).....	204
6.5.2 Five Stage ‘PITEC’ Model for Voice Technology Adoption.....	207
Bibliography	210
Appendices	246

List of Figures

Figure 1: Zone of Curiosity (Derived from Day, 1982, p.20, Fig.1).....	30
Figure 2: Technical set-up: Version 1.	60
Figure 3: Final technical set-up of the voice technology used in classrooms.	62
Figure 4: Data per device with time of recording.....	76
Figure 5 Long List of initial Themes.....	77
Figure 6: Example visualisation of talk between two students as used in heatmaps.....	80
Figure 7: Heatmap from a lesson.....	81
Figure 8: Heatmap legend.....	84
Figure 9: Arrangement of a classroom at Hillview School	85
Figure 10: Seating arrangement and potential interactions	86
Figure 11: A ‘lab’ style classroom	87
Figure 12: Heatmap - Teacher position and density of talk in each position	90
Figure 13: Six of the positions of the teacher to monitor students.....	90
Figure 14: Heatmap of a lesson showing teacher talk and student groups.....	92
Figure 15: Students that did not interact with the teacher (F10, F11, M9, F12)	93
Figure 16: Students that remained silent (M10, F10, F11, F9, F12)	93
Figure 17: The lesson with James (M2)	95
Figure 18: The lesson with Otis and Surim.....	96
Figure 19: Position ‘a’ - Single instance of talk between M3 and M20.....	98
Figure 20: Position ‘b’ - Single instance of talk between F2 and Mb	98
Figure 21: Silent students and students who talked.....	100
Figure 22: Students talk and students the teacher talked to.....	101
Figure 23: Groups using Echo Dots called, Echo, Computer, Alexa and Amazon.....	111
Figure 24: The tentative notions forming a pedagogy of performance	185
Figure 25: Visualisation of a pedagogy of performance	185
Figure 26: Curiosity Understood as a Signal/Problem (CUSP) Model	206

List of Tables

Table 1: The process for a thematic analysis of the raw data.....	74
Table 2: The lexicon of ‘performance-oriented talk’ (in no particular order).....	103
Table 3: Question word length asked to Alexa (unedited)	130
Table 4: Interactions with different Echo Dots	132
Table 5: Five Stage ‘PITEC’ Model for Voice Technology Adoption	209

Glossary of Terms Used

A Level

An external examination usually taken by students in Year 12 or 13.

Alexa

Amazon's computer software that processes human speech, for example, on the Echo Dot.

Amazon Web Services (AWS)

A subsidiary of Amazon concerned with cloud computing technologies.

Artificial Intelligence (AI)

A term used to describe computer hardware and/or software that is designed to replicate the way in which humans think and act.

Booster

A lesson, tutorial or practical outside of timetabled lessons that aims to provide students with the skills to improve their examination performance or coursework.

Coursework

Work produced independently by students during dedicated time usually during lessons supervised by the teacher. Continually assessed as part of either GCSE or A Level.

Digital Technology

Computer or electronic hardware and/or software or devices.

Enterprise Network

A Wi-Fi protected access (WPA) or wireless network security for a corporate computer network.

General Certificate of Secondary Education (GCSE)

An external examination taken normally at the end of a two-year period, usually at the end of year 11

Human Computer Interaction (HCI)

A term used to describe the ways in which humans act and behave when using computer hardware and/or software.

Internet of Things (IOT)

A term used to describe computer hardware and/or software that has internet connectivity and which 'communicates' with the 'cloud' to perform tasks.

Intervention Group

Students identified as 'underperforming' and are the focus of specific teaching activities that aim to raise their forecast examination or coursework grades or levels.

Key Stage

A phase of education in school. e.g. Year 7, 8 and 9 are commonly called Key Stage 3. Year 10 and 11 are Key Stage 4 and Year 12 and 13 are Key Stage 5.

Machine Learning (ML)

Computer software that is able to 'learn' without being given explicit instructions by analysing patterns in data it has access to.

National Curriculum

A series of POS that outlines the content and standard of study for students.

National Cyber Security Centre (NCSC)

Government organisation established to protect the United Kingdom's critical services from cyber-attacks.

Natural Language Processing (NLP)

Computer systems that process and analyse natural language datasets.

Pedagogy

The method and practice of teaching that involves both the theory and application of education strategies and techniques.

Programme of Study (POS)

An outline of the content of each subject taught in a school

Senior Management Team (SMT)

A group of senior teachers including a 'headteacher', who are responsible for the school.

Skills

Software written to run on Echo Dot devices. 'Apps' able to perform specific tasks.

Use Case

An example of where, how and what a computer hardware and/or software was used for by a user.

User Experience (UX)

The way a user of a computer hardware and/or software interacts with the system.

User Interface (UI)

Menus, icons or text lists that a user interacts with to use the computer hardware and/or software.

Voice Technology

Computer hardware and/or software that through speech can process human speech.

Voice Use Interface (VUI)

Use of speech to control or instruct a computer hardware and/or software to perform requests.

Web 2.0

Website technology accessed through the internet, e.g. social media applications.

Zone of Proximal Development

A conceptual 'space' where a learner might progress to with help from more knowledgeable others.

Chapter 1: Introduction

1.1 Context and Background Information

The study aimed to contribute to the knowledge of an area created where pedagogy, voice technology and epistemic curiosity converged and that was shown by a critical review of available literature to be limited.

Amazon's 'Echo Dot' is an artificially intelligent (AI) digital voice technology that processes human speech using software referred to as 'Alexa', known as the voice of the Echo Dot. A 'more knowledgeable other' (Vygotsky, 1978) is someone who is considered more capable or skilled who is then able to develop the skill or knowledge of a less capable or skilled person, usually through social interaction (Daniels, 2008) and cultural mediation (Moll, 2014). Epistemic curiosity is a type of curiosity defined by Berlyne (1954, p.180) as a desire to know and 'whose main fruits are knowledge'.

The aim of my research was to investigate pedagogical approaches and how the Echo Dots were used in terms of a more knowledgeable other, a concept which is an integral part of Vygotsky's theory of the 'Zone of Proximal Development' (Vygotsky, 1978, p.86) and to analyse the extent to which students' 'epistemic curiosity' (Berlyne, 1954) was affected when the Echo Dots were used.

The study took place in a secondary school that is referred to throughout by the fictional name of 'Hillview School'. Names of other schools and teachers used within this thesis are fictional and any similarity to actual places or persons is coincidental. I conducted an exploratory ethnographic study at Hillview School that covered one academic year that involved fieldwork of data collection via participant observation and informal interviews. Data was also collected via Amazon's Echo Dots when they were used in lessons by students and teachers which, at the time in 2017 and 2018, was not a method of data collection evident in the literature.

The initial literature review at the start of this study established that there was limited literature that involved recent voice technology such as the Echo Dot and epistemic curiosity. It was apparent that research into the use of a voice technology such as the Echo Dot as a method of data collection had not been explored extensively in the

classroom. As a teacher and researcher I also became aware at the time that there appeared to be no educational research that had investigated voice technology along with epistemic curiosity. The educational research study was therefore an exploratory ethnographic study that included a novel method of data collection to investigate an area that was under explored. The final research design led to the development of a way of presenting the data that I have defined as ‘heatmap’ diagrams. Heatmaps visualised talk that took place by showing the instances of talk by specific individuals and where it occurred in the classrooms of Hillview School. Further information and additional examples to explain how they were developed are shown, in Appendix 8.

Between 2017 and 2018, through a review of selected voice technology and epistemic curiosity literature, I established that voice technology and epistemic curiosity were under-researched in secondary schools and that an opportunity existed to explore these in terms of Vygotsky’s (1978) ‘more knowledgeable other’. Other limitations were apparent from emerging voice technology literature, for example, a lack of research of voice technology in classrooms over the longer term and about everyday teaching and learning. The literature also showed that experiments had been carried out with voice technology often using small sample groups as with Underwood (2017) and, with a more recent research study that was found, in non-naturalistic environments as with Winkler et al. (2019). Research including that by Underwood (2017), Davie and Hilber (2018) and Hales et al. (2019) had also used participant groups of either very young children or older students and neglected secondary school students. Studies of everyday teaching and learning with voice technology was scant and that which was carried out over the longer term was an area that had also been neglected.

The literature showed that ‘epistemic curiosity’ (Berlyne, 1954) was not part of pedagogy and practice in schools and that this was educationally problematic as Engel (2009, 2011) has outlined. This was because epistemic curiosity is regarded as important to education as Schmitt and Lahroodi (2008) have explained. The literature demonstrated that Vygotsky’s (1978) concept of a more knowledgeable other had potential as an analytic tool for educational research (Zaretskii, 2009) and could potentially be used to analyse teaching and learning that took place with digital voice technologies, such as the Echo Dot, in the classroom. Despite the limitations of the more knowledgeable other, expressed by Daniels (2008), it was shown by Cicconi (2013) that it could be possible to conceptualise Vygotsky’s (1978) more knowledgeable other as a *digital* more knowledgeable other. A timely opportunity

emerged to study the Echo Dots in the classroom in terms of students' 'epistemic curiosity' (Berlyne, 1954) and the 'more knowledgeable other' (Vygotsky, 1978) and investigate an area that remained under explored in the literature at the time of writing.

The research study therefore contributes to knowledge of the pedagogical approaches of using Echo Dots in classrooms, contributes methodologically through the use of the Echo Dots as a data collection tool and also by way of 'heatmaps' to visualise talk in the classroom. The study involved two groups of participants, teachers and students, and an extended period of fieldwork across two years as a participant observer. I used four methods of data collection and produced transcripts that were coded and analysed to produce initial themes that were then thematically analysed to generate the interpretations presented in Chapter 4. The study oriented around teachers' pedagogical approaches but used the concepts of a 'more knowledgeable other' (Vygotsky, 1978, 1987; Daniels, 2008; Moll, 2014) and 'epistemic curiosity' (Berlyne, 1954; Litman, 2005, 2008; Kashdan et al., 2018).

The research study made use of Amazon's Echo Dot smart speaker and these are referred to throughout this thesis as the 'Echo Dot' and 'Alexa' is used to refer to the software based 'voice' of the Echo Dot. The term voice technology is occasionally used generically to avoid using a specific name of a manufacturer or as a collective term to broadly refer to a group or collection of different devices that are similar to, and include, the Echo Dot. Voice technology is used in both singular and plural forms to refer to an individual voice technology or a collection of voice technology. As this thesis is positioned in an area of overlap between the fields of computing and education, a glossary of terms has been provided to explain terms used that might be unfamiliar to either field.

This research study is relevant to education because, as well as being timely due to the limited research that was available. AI digital technology in society and education is an emerging field and a contentious issue as Ertmer (1999, 2005), Selwyn (2016a, 2016b) and Selwyn et al. (2019) have outlined, and the debate is ongoing. Emerging technologies with AI such as voice technology now have technological ability and capacity to offer new possibilities and potential for schools and teaching and learning just as other, prior non-AI technology such as radio, television and the internet have in the past, as Cuban (1993) has outlined. The impact of AI technologies, because of their technical potential and what that might yield, is therefore yet to be fully explored in

schools. It seems plausible therefore that usage in classrooms might increase over time and research around AI educational technology used in school classrooms remains limited at the time of writing (see Selwyn et al., 2019; McStay, 2019). The research study, exploratory as has been outlined, therefore aims to contribute to the knowledge of AI educational technology, specifically voice technology, as it may be used in schools as they begin to adopt it or as teachers and educators begin to use it more extensively.

1.2 The Scope of the Study

This section provides the broader context within which the research study took place and as such presents the scope of the study.

The study took place within an educational setting that was part of a larger complex structural and organisational system of education that involved different groups of people, pedagogical beliefs and agendas. This system has been described by Ball (2007, 2016), Ertmer (1999, 2005) and Apple (1993, 1995, 2014). Although not directly part of the research objectives of this thesis, these factors are considered in this chapter in the following sections: My Background, An Unanswerable ‘Burning’ Question’ and Positionality.

1.2.1 My Background

This section provides a description of my professional and personal background in relation to the scope and context of this research study.

I am currently a teacher educator but I was a secondary school teacher of computer science for 15 years. I am a parent of three secondary school aged children and as a teacher and parent, I had become sceptical of England’s school system and perplexed by its focus on examinations and outcomes, or what Giroux (2012a, p.3) has described as ‘a mindless infatuation with metrics and modes of testing’. Through critical reflection on my own practice and rising scepticism that I failed to understand, I developed a pedagogical problem. My understanding of pedagogy was that it was the applied knowledge and understanding of theories on how people think and learn. Pedagogy then, by various forms of instructional techniques in the classroom through practice, informs and then enables people to think and learn. My understanding of pedagogy therefore was similar to Mortimore (1999, p.3) who has defined pedagogy as:

‘Any conscious activity by one person designed to enhance learning in another’.

I understood practice to be the application of theories or the physical acts of *doing* teaching and learning and which was an integral part of pedagogy. However, I felt that as a teacher my pedagogy and practice had become disconnected. My teaching felt absent of pedagogy and was just practice, a series of disjointed strategies or individual acts of instruction. I believed that my practice had become overly focused around the delivery of examination specifications. Over the longer term this pedagogical problem gave rise to a deeper and broader concern about the impact of my practice upon students. I had no answers at this point, just a growing concern and lack of understanding.

My eldest child Will, at the time of this research study, was in Year 13 and I was particularly concerned that when in Year 11 in the summer 2019 ‘GCSE’ series, for the nine subjects he studied, Will had twenty-seven individual examinations, the shortest of which was one hour and fifteen minutes long. An untenable 40 hours of assessment by written examination. This total excluded subject coursework already completed and 20 hours of unusable computer science project work¹ plus several speaking and listening assessments for English, French and Russian².

Throughout the two year period of GCSEs, Will took numerous trial exams and tests, attended after-school revision sessions and intervention groups and we received regular termly assessments indicating his lack of progress and notes and letters about low effort and various intervention groups, mentoring and ‘boosters’ he was required to attend. His data in the computer systems of the school indicated that he was an ‘underperformer’ and underperforming. Regardless of our communications with the school to express his and our desire for a less pressured approach to his improvement, letters continued to arrive. As a parent, it began to feel, as Kulz, (2017, p.7) has described, that there was an ‘A-C economy’ which focused upon measurable and quantifiable outcomes as highlighted by Giroux (2012a).

¹ GCSE students had to complete a 20 hour programming project during lesson time. However, no marks were awarded for the 2018 coursework and it did not contribute towards their final GCSE grade. The task would have made up 20% of the final GCSE grade.

² Throughout the year GCSE students complete a range of speaking and listening activities that contribute towards their final grade. These activities can occur over the two year GCSE period and often include practice sessions.

Children appeared to endure a significant workload and bear a burdensome responsibility and appeared to do so largely unquestioningly. I began to question this approach to education and worried whether it was directing effort, time and resources toward useful, purposeful and wholesome outcomes. Placing this possible approach to teaching and learning within a wider economic framework, Giroux (2012a, p.51) has gone further stating that students experience:

‘a stripped-down notion of schooling, making it more difficult for them not to just think critically but also to imagine a world beyond the gospel of competition and profit and the economic calculus of financial gain and loss’.

From the perspectives of both parent and teacher, it became gravely concerning because, from teaching in classrooms and from interactions with schools as a parent over 15 years, it seemed that children appeared to have been changed. As a parent and teacher my observation was that larger numbers of children were acquiescent and compliant to an education system focused on testing (Giroux, 2012a, 2012b) and did so unquestioningly. My lack of understanding remained, and concern continued as a burning question began to emerge, which is presented in the next section.

1.2.2 An Unanswerable Burning Question

The research aim and objectives are presented in more depth at the end of this chapter but to explain the reason for the research I will state the burning question that emerged from concerns about my own teaching practice and school experience of my son. The question emerged over time from critical reflection and as I began to reflect on secondary education and my own practice. The concern could not be resolved so I directed my attention towards my own classroom, problematising it to form the question, ‘Why aren’t my students curious?’. This question captured my concern, scepticism and lack of understanding and inherent in the question were my epistemological perspective and ontological position. These will be explained in the next section.

1.2.3 Positionality

It was important at the outset to state that as a teacher, I did not set out to harm colleagues or my profession. I was driven by critical reflection on my own pedagogy and practice which had led me to ask, ‘Why aren’t my students curious?’. If this thesis is interpreted as a criticism of teachers, I will have failed to describe effectively why they

do what they do. Perhaps then, instead of being interpreted as an indictment of teachers, this thesis should be first considered in terms of the broader system of education. With this in mind, a caveat: if it seems from this thesis that as teachers we behave as ‘engineers’ (Scardamalia, 2002, p.70) there are reasons for this.

In this section, to present my positionality in terms of my epistemological perspective and ontological position, I consider three features of reflexivity that Corlett and Mavin (2017, p.379) have described, which are: what constitutes reality and knowledge, what is the relationship with elements of the research study and what is perceived as worth studying and why. To achieve this, this section presents experiences from my childhood and professional background that have shaped my beliefs and values, epistemological perspective and ontological position.

A factory worker and cleaner, from prior generations of unskilled workers who were council house tenants, my parents were the first in the family history to both have jobs and take a mortgage for a house. From within our community almost all children went to the local comprehensive school but I travelled to a Grammar school a few miles away. From attending a Grammar school I learned that I was working class and not middle class like the majority of my peers. My experience of school and education in the 1980s are echoed in accounts of schools around this era by Hargreaves (1967), Lacey (1970), Willis (1977) and Ball (1981). My life was within two cultures, one outside and one inside of school and I observed how two different categories of people lived. I was at odds with the school and its culture and I left school with a few ‘O level’ qualifications and began working in unskilled jobs, changing regularly usually after being made redundant. I spent six years in several different jobs including two years without work, until I secured a temporary position where I worked voluntarily inputting data into a computer to try to learn new skills. This was my first semi-skilled experience and it presented new opportunities I was previously unaware of. The people I worked with spoke of concepts I was ignorant of such as qualifications they had gained, previous jobs and their professional skills. Through the questions I asked them I saw possibilities emerge and began to ask myself why these opportunities had not emerged for me. From this experience I enrolled in a degree in computing at university as a part-time, mature student because as a mature student many of the entry requirement barriers were removed. Afterwards, with a degree in computing, I went to work in an ‘IT job’.

Following a ten-year career in IT, at 33 years old I entered the teaching profession as an ‘ICT’ teacher with a ‘make-a-difference’ mindset. My career spanned 15 years during which I was a classroom teacher, Head of Department and Consultant and Advisor to Senior Management Teams (SMT) and completed a Masters in Educational Leadership. Technology played an integral role throughout my career being something I taught about and taught with. Beyond the role of classroom teacher, particularly in a Head of Department role, capturing, processing and analysing data became an essential skill that I felt at times to be as important as classroom teaching. I felt that there had been a change but was aware that I did not know exactly what it was or how it had affected me.

My school and early experience of work led me to believe that society had a structure of categories, some of which were inaccessible to certain types of people. This inaccessibility was not caused solely by ‘class’ or social position or education but often by a lack of knowledge of ‘how the other half lived’ and how society worked and was structured. Much of the information needed to access these different categories appeared to be implied or ‘between-the-lines’ and the unknowledgeable therefore remained ignorant or decided to choose to not know, as Hertwig and Engel (2016) outlined in their study. However, from my own education, I began to feel more alignment with Giroux (2012b, p.40) who argued that educators should:

‘focus their work on important social issues that connect what is learned in the classroom to the larger society and the lives of their students’.

Dissatisfied with my teaching, along with the desire for intellectual challenge and in possession of a burning question, I relinquished a full time salary and leadership role to become a PhD student driven by a desire to find out why my students did not appear to be curious.

1.3 Theorising A Digital More Knowledgeable Other

Vygotsky’s (1978) notion of the ‘more knowledgeable other’ was used by the study as a point of departure and ‘lens’ to begin to study social behaviours and actions at Hillview School when voice technology was used in lessons. This section provides an understanding of a more knowledgeable other and, in terms of the ‘talkative’ Echo Dots, outlines an interpretation of a more knowledgeable other. This section is provided because further in this thesis, Amazon’s ‘Alexa’ is presented as a *digital* more knowledgeable.

The notion of the more knowledgeable other (Vygotsky, 1978) is fundamentally concerned with verbal social interactions and thinking and learning and knowledge and as such was considered relevant to the research study. What is understood by Vygotsky's (1978) more knowledgeable other and a *digital* more knowledgeable other is important therefore at this point. The concept of the more knowledgeable other (Vygotsky, 1978) was a conceptual framework to start to look at the ways in which teaching and learning occurred at Hillview School and to interpret the social behaviours and interactions.

Vygotsky's (1978) notion of the more knowledgeable other, according to Daniels (2008), is not without its limitations and these include, where hints or guidance originate from, the role creativity plays and the outcomes of the process of development of new knowledge. Other authors (Liu and Matthews, 2005) have also criticised the lack of evidence to validate ideas in Vygotsky's educational theories. There remains, however, an opportunity to contribute to existing knowledge and explore the notion of a digital more knowledgeable other because of Vygotsky's social development theory and its emphasis upon speech and social interaction (Vygotsky, 1978, 1987). There is also a potential application of the notion of a more knowledgeable other within education as Zaretskii (2009) has posited and which Moll (2014, p.2) has described as a 'malleable concept and applicable to education'.

When considering a more knowledgeable other as someone or even some 'thing', such as a knowledgeable computer system that someone desiring of knowledge can interact with to aid their development, Umair-Uddin, Shakir and Zaheeruddin (2017) have outlined that online courses present opportunities for learners to connect with more knowledgeable others. Umair-Uddin, Shakir and Zaheeruddin (2017) and Cicconi (2013) have outlined that technology present opportunities to provide more knowledge socially. Technology of this type is therefore construed by Cicconi (2013) as a more knowledgeable other moving the emphasis from a more knowledgeable other being a teacher, adult or peer, towards a technology such as a Web 2.0 system or other digital technology with similar attributes. Understanding of a more knowledgeable other is moved conceptually towards potentially being a digital technology. Cicconi (2013) reduces Web 2.0 tools to sources of collaboration and interactivity and online digital locations for the acquisition of facts and information and thus overlooks opportunities for speech based social interaction, two way voice interactions, described in Vygotsky's

(1978, 1987) social development theory. In this respect, the potential for two way dialogue, discussion and talk is overlooked. However, Cicconi's (2013) study is a theoretical paper exploring the potential or what might be possible, or what is in reality, consideration of a type of potential human computer interaction (HCI) and its potential for creating new technological 'Zones of Proximal Development' (Vygotsky, 1978) and digital more knowledgeable others. In summary, the literature suggests that a more knowledgeable other need not be human but in fact may take the form of a digital technology that has human-like attributes such as speech. At the time of writing there is no literature evident which explores the use of a digital technology as a more knowledgeable other or what is referred to in this thesis as a *digital* more knowledgeable other.

As such, the Echo Dot voice technology presents an interesting opportunity for students to interact with a digital more knowledgeable other as they might in a classroom with either the teacher, a teacher's assistant or a peer. However, it should be acknowledged that the Echo Dot is *human-like* and has a rudimentary capability to talk in comparison to human talk. Talk, understood as the socially constructed way that knowledge is developed through social interactions with more knowledgeable others, therefore becomes a key tenet of learning and development. In this way, Alexa is unable to mediate learning and development in a Vygotskian sense and could instead be understood as a more *informative* other, a device able to provide knowledge that students required for their learning.

By being able to fulfil spoken requests from students for data, facts and information just as a teacher may, as a more informative other, it is suggested that the Echo Dots can perform a role when question-asking, information seeking or requests for data, facts and information occur and can do this in the role of a *digital* more knowledgeable other. Therefore, for the purpose of this thesis, Vygotsky's (1978) more knowledgeable other is reconceptualised and understood through Alexa to be a digital more knowledgeable or informative other able to fulfil requests for data, facts and information, that may support a less knowledgeable other with independent development in tasks or activities.

This thesis has one aim and three objectives that work towards greater understanding of the motivation for this research study, my burning question of 'Why aren't my students curious?'.

1.4 The Aim of the Research

I have briefly described how reflections upon my own teaching practice caused me to be concerned. Perplexed, I focused on ways in which this might change. As a computer science teacher I considered digital technology as I had used various computer hardware and software in my own teaching. There were several existing options, but I became intrigued by the potential of ‘smart speaker’ voice technology as a possible educational technology. I was familiar with a Google ‘Home Assistant’ and felt it might augment teaching and learning or become a teacher’s assistant because of the ability of the technology to use digitised speech and retrieve data, facts and information.

The idea for the research study became situated in the broad area where voice technology, curiosity and pedagogy converged. Following further preliminary reading and consideration and reflection on my burning question the aim of the research was finalised. The aim of the research was:

- **to investigate how voice technology was used and the extent to which it performed as a more knowledgeable other and affected students’ epistemic curiosity.**

1.5 The Three Research Objectives

In order to achieve the aim of the research study three research objectives (RO) were identified. They are presented and explained below.

- **To critically analyse the pedagogical approaches of teachers before and during the use of voice technology in lessons (RO1)**

This RO established how teaching occurred and how the Echo Dots were used in the classroom. It enabled me to study what type of interactions took place or what factors impacted upon voice technology used in lessons. This RO required me to be in the classroom in lessons so that I could observe students and teachers interacting with voice technology. This RO will be addressed in part one of Chapter 5, Discussion

- **To critically analyse voice technology as a student’s digital ‘more knowledgeable other’ in lessons (RO2).**

This RO provided an opportunity to explore a supposition that because voice technology can engage in speech it can provide data, facts, and information to

students so might potentially be regarded as a digital more knowledgeable other. It also allowed me to investigate teachers and students' talk in more depth. This RO will be addressed in part one of Chapter 5, Discussion

- **To critically evaluate the impact voice technology has on students' epistemic curiosity (RO3)**

This RO allowed me to investigate epistemic curiosity in lessons by enabling me to observe interactions such as students' questions and requests for information or conversations students have. This RO will be addressed in part one of Chapter 5, Discussion.

1.6 Thesis Structure

Having read ethnographic theses, educational research and ethnographic monographs I had planned to write using a narrative approach commonly found within the field (see Brodkey, 1987; Bönisch-Brednich, 2018). However, the research study became clearly partitioned as it progressed suggesting a structure by chapters. For example, there were distinct phases of fieldwork, methodology design and reviews of literature. There were also phases of data analysis, insights and interpretations and an analytic discussion. The phases lent themselves to a six-chapter structure or what Dunleavy (2003), Bell (2010), Thomson and Walker (2010) and Bottery and Wright (2019) describe as a traditional thesis structure.

1.6.1 The Chapters

This thesis is organised into the following six chapters:

- Chapter 1 - Introduction
- Chapter 2 - Critical Review of Selected Literature
- Chapter 3 - Methodology
- Chapter 4 - Interpretations of the Data
- Chapter 5 - Discussion
- Chapter 6 - Conclusion and Recommendations

Chapter 1, an introduction, provided the rationale for the research, my positionality and background and presented the research aim and research objectives along with a reconceptualisation of Vygotsky's (1978) more knowledgeable other as a potential digital more knowledgeable other.

Chapter 2, the critical review of literature, focuses on two areas pertinent to the aims and objectives of the study: digital voice technology and ‘epistemic curiosity’ (Berlyne, 1954). It demonstrates the small body of literature that is currently available and what is currently known about these areas. It also outlines limitations within this literature and identifies gaps and opportunities for further research.

In Chapter 3, the methodology chapter, the methods and research design are presented in terms of the aim of the research and the limitations and gaps that were exposed through a critical review of literature. The ethical issues that were addressed are presented in this chapter. The methodology chapter is organised chronologically showing how the initial phases, trials and a pilot led to the final research design. It also outlines what influenced the selection and choice of methods.

In Chapter 4, interpretations of the data are presented. Part one is concerned with data from observations of the classroom and the second part is concerned with data from Alexa and the use of Echo Dots in the classroom.

In Chapter 5, significant interpretations that emerged in Chapter 4 are presented and discussed as tentative notions. This chapter is structured into two parts: Part One, the research objectives and Part Two, the research aim.

In Chapter 6, a conclusion in relation to the aim of the research is presented. Recommendations are also presented which includes the implications of the study and further questions.

Chapter 2: Critical Review of Selected Literature

At the time of writing, in March 2021, it is evident that the adoption of voice technology has continued and additional voice technology literature has emerged. However, research of voice technology in education was limited to seventeen papers by the end of 2019 (Terzopoulos and Satratzemi, 2019) and for general voice technology literature, there were thirty-seven papers in 2020 (Terzopoulos and Satratzemi, 2020). This chapter reviews literature regarding voice technology and epistemic curiosity that was sourced between late 2017 and mid-2019 with a focus around research in education.

The critical review identifies the limitations and gaps in the research literature to identify the lacuna related to this thesis and present where this research study aims to make a contribution to knowledge.

This chapter is organised into three parts related to the aim of the research study. Part One is concerned with voice technology and Part Two is concerned with epistemic curiosity.

Part One about voice technology has two sections. The first section presents themes that emerged from the literature around voice technology. The second section presents limitations in the research around voice technology in education. The two sections jointly identify an area where this thesis aims to make a contribution to the knowledge of voice technology in education.

Part Two critically reviews literature regarding epistemic curiosity. There are two sections in Part Two. The first section decouples epistemic curiosity from the broader more complex construct of curiosity and presents what is known about a relationship between knowledge-forming questions and intellectual or epistemic curiosity. Later, the critical review forms a key part of a discussion in Chapter 5. The second section of part two critically reviews literature concerned with epistemic curiosity and education and uses research from the field of psychology to present definitions and an understanding of what epistemic curiosity is. It identifies that epistemic curiosity is currently under-researched in education, and this limitation is where this thesis aims to make a contribution to knowledge.

Part Three critically reviews literature regarding users' perceptions of technology, what is considered in this thesis as their attitude to technology, affordance, talk and Vygotsky's (1978) description of a more knowledgeable other.

2.1 Part One: Voice Technology

Part One explains what a voice technology is and defines the scope of what constitutes a voice technology in terms of this thesis. It presents themes that are present in the selected literature. In this way, this part clarifies the specific area of voice technology literature relevant to the research study and the limitations and gaps that currently exist in the literature for both voice technology and voice technology in education.

2.1.1 What is Voice Technology?

Digital technology dedicated to assisting people with their information requests, shopping and social and entertainment activities using only voice interaction has previously not been widely available and is referred to as a consumer level voice technology by Cohen, Giangola and Balogh (2004). Consumer level voice technology, such as Amazon's Echo Dot, which emerged around 2014, has become a new field for research and which is developing. However, in the literature available at the time of writing, there was an inconsistency in how this technology was referred to and different terms were used for similar technology or features of the technology which becomes problematic. The inconsistency is confusing because it creates ambiguity when analysing research studies. For example, Lopez, Quesada and Guerrero (2018) refer to 'natural user interfaces', and Hoy (2018), Mclean and Osei-Frimpong (2019), and Terzopoulos and Satratzemi (2019) refer to 'voice assistants' and Wagner and Schramm-Klein (2019) to 'digital voice assistants'. Austerjost et al. (2019) call them 'smart virtual assistants' and Winkler et al. (2019) 'smart personal assistants'. Reis et al. (2017), Lopez, Quesada and Guerrero (2018), Lopatovska et al. (2018) and Radford et al. (2019), refer to these devices as 'intelligent personal assistants' and Chung et al. (2017) call them 'intelligent virtual assistants', while Porcheron et al. (2018) and Reyes-Cruz, Fischer and Reeves (2019) mention 'voice user interfaces'. Other terms often used interchangeably are 'conversational agents', 'conversational user interfaces' or 'voice enabled speakers' (Sciuto et al., 2018) and 'smart speakers' (Lopez, Quesada and Guerrero, 2017; Radford et al., 2019). For the purpose of this thesis, voice technology is understood to be recent digital technology that has the ability to process human speech and fulfil spoken requests for facts and information or to assist users with social and entertainment activities. These are, for example, smart speaker type devices which

emerged for consumers from 2010 onwards such as the Amazon Echo Dot or the Google Home Assistant device.

2.2 Themes Within the Voice Technology Literature

This section provides a critical review of selected voice technology literature and identifies themes that emerged. The themes are used to identify the lacuna within the field of voice technology in education literature where this thesis aims to make a contribution to knowledge.

2.2.1 Voice Technology ‘Use Cases’

There is a theme regarding where voice technology is used by users and studied by researchers. For instance, Reis et al. (2017), Underwood (2017), Austerjost et al. (2018), Reyes-Cruz, Fischer and Reeves (2019), Terzopoulos (2019), Radford et al. (2019), Lopatovska et al. (2018) and Winkler et al. (2019) provide research into where devices are or might be used by people, referred to from here as a ‘use case’. Currently there is evidence of use cases in a public space of an academic institution (Lopatovska et al., 2018; Lopatovska and Oropeza, 2018), a science laboratory (Austerjost et al., 2018), potential use in library environments (Radford et al., 2019) and a classroom (Underwood, 2017; Hales et al., 2019). These limited number of use cases are outside of the home and provide two significant insights. Firstly, it is both possible and necessary to further investigate voice technology in areas wherever in future it might be encountered, for example, outside of the home. Secondly, the literature shows that the use cases are limited in scope because they occurred in a limited range of learning environments. As such, the theme of use case shows that many other use case scenarios are possible and could be investigated in the future, for example, in secondary schools. Use case scenarios evident in the literature also tended to be carried out under controlled conditions or with small groups of participants or over shorter spans of time. In the literature there are studies of voice technology in the home or an experimental location where a single device is set up to be studied. Currently in the literature, there can be found no literature that studied voice technology already operational, established or in use in a business or commercial organisation such as a factory, shop or secondary school and used by users in everyday situations that were not established for research purposes. There was no literature available that could be found regarding use of multiple or groups of Echo Dots.

2.2.2 Interactions with Voice Technology

There is literature from Austerjost et al. (2018), Taken Smith (2018), Lopatovska et al. (2018) and Burbach et al. (2019) that explored how users interact with voice technology and which investigated the reasons for user adoption, acclimating to devices, phrases or words spoken and analyses of frequency of use and consideration of placement of the devices in homes. In the literature there are research studies from Sciuto et al. (2018), Lopatovska et al. (2018), Siddike et al. (2018) and Mclean and Osei-Frimpong (2019) that investigated ‘conversational interactions’ and explored how people interacted or used voice-enabled technology. From the literature, there was scant research available that investigated school students use of voice technology.

Davis (1989) has provided the ‘Technology Acceptance Model’ (TAM) that evaluates the perceived usefulness and perceived ease of use of technology for a user and Venkatesh et al. (2003) have provided an extension of the TAM. Both models are useful frameworks for assessing user adoption and engagement with technology. These are a useful way to analyse how technology and people interact but both frameworks do not provide scope to evaluate factors such as natural language processing capacities, or voice interactions, and perceptions of users. The two TAM frameworks do not cater for technology with AI or that might raise privacy concerns and as such the two frameworks are limited when applied to voice technology. At the time of writing there was no literature that considered reasons why a school, teachers or students might or might not interact with voice technology.

2.2.3 Voice Technology: Testing, Trialling and Studying at Scale

In the literature, several studies used research environments that were arguably artificial as in the study by Winkler et al. (2019) that looked at how personal voice assistants could support group work. Reasons why a ‘real’ scenario may not be studied could be due to the logistics of accessing groups or technical problems of setting up and conducting the study or issues with children engaging with devices, as in the content analysis of user reviews by Radford et al. (2019). When using a new technology such as a voice technology, limitations may occur due to the small size of the sample participants, as in Underwood’s research (2017) or that they are studied over a short period or for one or two occasions, As such a limitation of the currently available research is that it is not ‘at scale’ and is not a real use case or performed over the longer term. It also does not provide evidence of the impact of extended or prolonged use of Echo Dots. Also, at the time of writing, it was also not possible to find literature that

studied how multiple voice assistants might be used in a ‘live’ environment over time. There appears to be a gap in the current literature for voice technology research over the longer term, which involves multiple devices, or is carried out in an organisation where users behaviours and interactions can be observed as part of everyday activity.

2.2.4 Technical Set-up and Deployment of Voice Technology

There was limited research available that described how voice technology is set up by researchers and it remains an under-represented area in the literature. This is especially evident when analysing the few studies that occurred outside of the home environment. The reason for this, and which appears to be a barrier to further research, is because, as Davie and Hilber (2018) have explained, voice technology devices need to authenticate using the internet and how they do this is problematic for most Wi-Fi networks outside of the home environment. This was discussed via email and solutions can be found and there are workarounds but these are cumbersome and technically problematic and have been explained as time consuming for organisations (Dash, 2019). A limitation of the literature is there is scant evidence that demonstrates or explains how to set up voice technology such as the Echo Dot outside of the home, for example, in a school.

At this point it has been shown that there is limited research literature regarding voice technology such as the Echo Dot. In particular, there is a lack of literature involving research over the longer term, including multiple or groups of Echo Dots or that involves larger participant groups, or which is conducted in locations outside of the home, for example, in schools. The next section therefore looks specifically at the currently available research literature regarding voice technology and education.

2.3 Voice Technology in Education

This section presents a critical review of selected voice technology literature concerned with education. It establishes the limitations and gaps that exist in the research of voice technology in education which was available at the time of writing. Currently these include studies by Dizon, (2017), Ellis (2017), Underwood (2017) and Hales et al. (2019).

2.3.1 Voice Technology in Classrooms

In one of the only research studies evident at the time of writing, Underwood (2017) used voice technology in the classroom with eleven students who had English as a

foreign language where Alexa, Siri and Google voice search were used. The voice assistant interactions were predominantly accessed via the teacher's mobile phone and not a dedicated smart speaker type voice technology device. As such, despite being what appears to be the first study in an educational setting 'in-the-wild', Underwood (2017) used the voice assistant software and not a voice technology hardware device such as an Echo Dot or Google Home Assistant. There was no evidence in the literature to ascertain how the technology in Underwood's (2017) study was set up in the classroom. Also, by using a mobile telephone, it would constitute research of a mobile telephone voice assistant rather than research of smart speaker voice technology device.

2.3.2 Pedagogical Approaches to Voice Technology

In Underwood's (2017) study, there was no explanation of the pedagogical approach taken and any influence of this. Although wider contextual influences such as school culture, school policies and educational policy might not be expected to be considered in such a small-scale study, along with the pedagogical approach, they may have had an impact on what occurred and why it occurred.

In relation to voice technology in the classroom, Ellis (2017) makes several suppositions about the different ways in which Alexa might be used in a classroom, and although some useful ideas are promoted, the website page does not offer technical guidance or provide research evidence from a study. As such academic literature regarding the actual application of voice technology in a classroom, with students or whole classes, as part of a pedagogical approach remains under explored. Educational research currently available has focused on second language skills in the classroom (Dizon, 2017; Underwood, 2017). The current research does not explore the role that might be played by Alexa or a smart speaker voice technology in the different subjects in schools, across the various year groups or in different 'Key Stages' such as examination phases at GCSE or A level or consider the pedagogical models by a variety of different teachers. Currently therefore, there is a limited number of studies and these are limited in their scope and range and as such, there is an area where this thesis aims to make a contribution to knowledge.

2.4 Voice Technology Literature: Summary

In summary, the selected literature regarding voice technology currently available indicated that there is scant research into voice technology especially within education. The existing literature is also limited because it does not include research of the smart

speaker type devices or these devices in real settings outside of the home environment. Although there is a small number of emerging studies of voice technology in education up to 2017, as has been discussed, there are further opportunities for research. For example, the use of voice technology in a secondary school or how they might be used pedagogically in both the short term in lessons or over time across a wide range of subjects and age ranges. So far, at the time of writing, voice technology literature has not proceeded beyond user-interactions in limited scenarios nor has it explored the effect or impact voice technology might have on learning, knowledge acquisition or pedagogical approaches. As such there is a gap in the existing literature where the research study of Amazon's Echo Dots in the secondary classroom can make a contribution to knowledge.

2.5 Part Two: Epistemic Curiosity

In Part Two, selected epistemic curiosity literature is critically reviewed to present limitations and gaps and identify where the research study aims to contribute to knowledge. Sections are dedicated to curiosity, questions and question-asking, which present the current knowledge, key arguments and perspectives in relation to epistemic curiosity. There are sections dedicated to the psychological perspectives of epistemic curiosity and these are presented in order to define and clarify what epistemic curiosity is and present the current knowledge. The sections also present the strengths and weaknesses of key arguments within this literature to identify limitations and the gap that exists in the literature regarding epistemic curiosity in education. As such the following sections identify a gap where this research study aims to make a contribution to knowledge.

2.5.1 A Definition and Overview of Curiosity

As a noun, curiosity means 'an eager desire to know, inquisitiveness' or alternatively 'strangeness'. As an adjective, curiosity means 'eager to learn, inquisitive or strange, surprising, odd' ('Curiosity', 1982). From the definitions, curiosity incorporates inquiry and uncertainty and involves knowing or wanting to know. These elements could reasonably be expected to be part of an education in a school. The understanding of curiosity as integral to learning is evident in the literature and as a concept that includes facets such as motivation, thinking and question-asking. As a psychological construct, curiosity is defined by Kashdan, Rose and Fincham (2004, p.291) as 'a positive emotional-motivational system associated with the recognition, pursuit and self-regulation of novel and challenging opportunities'. Curiosity appears to be linked to the

behaviour or action of inquiry or exploration. It is evident from the definitions and understandings of curiosity that the concept of curiosity has inherent features that make it a potential resource for educators. However, Arnone et al. (2011, p181) posit that despite being a powerful precursor of learning:

‘students may be curious, but the relevant resources may not be available to satisfy that curiosity’.

Herein lies the conundrum of curiosity: it is described as motivational, emotional and that it drives inquiry, behaviour and action to seek or find knowledge, but appears either hard to observe and identify or measure in schools because of a lack of relevant resources (Day, 1968; Arnone et al., 2011). Problems have also arisen when trying to empirically link curiosity with attainment and achievement (Engel, 2009, 2011) as has been done successfully with ability and effort (von Stumm, Hell and Charmorro-Premuzic, 2011). It appears that curiosity is hard to observe in classrooms but there is a dichotomy, because as Engel (2009) has revealed, curiosity *is* observable in the home.

Despite decades of research into curiosity (see Berlyne, 1954; Day, 1982; Beswick, 1971; Loewenstein, 1994; Litman, 2005, 2008; Engel, 2011; Kashdan et al., 2013), it remains a curious concept and, for particular types of curiosity, it remains an area where further educational research may contribute to knowledge. Post and Walma van der Molen (2017) have emphasised this by explaining that the literature does not agree on what causes children to be curious, that there have been many behavioural descriptions and instruments which have resulted in ‘a multitude of theories about the nature, determinants and behavioural characteristics of curiosity’ (Post and Walma van der Molen, 2018, p.3) and that this has created a digression from consensus.

2.5.2 Separating Epistemic Curiosity from Curiosity

Curiosity, as an area of research, has attracted much attention and notable authors who have written on the topic include Beswick (1971), Loewenstein (1994), Borowske, (2005), Litman (2005, 2008), Kashdan (2009), Smith (2011) and Kidd (2015) The most notable scholar of curiosity is Daniel Berlyne who, during the 1950s and 1960s, offered a perspective of curiosity that described it as having ‘two dimensions’ (Berlyne, 1954, p.182). Epistemic curiosity as first proposed by Berlyne (1954), in his classic research study of curiosity, explained that curiosity existed as different categories and types that existed on two dimensions: perceptual and epistemic and specific and diversive. Berlyne (1954) explained that epistemic curiosity applied mainly to humans and referred to

epistemic curiosity as being motivated to acquire knowledge. Berlyne (1954) defined diversive epistemic curiosity as exemplified by a need to know small and varied information from a broad source. Specific epistemic curiosity was defined as a search for information that would resolve a problem.

Berlyne's (1954) theory of curiosity proposed that epistemic curiosity, most relevant to humans, was formulated from a neurophysical perspective of curiosity, and was based on the notion that epistemic curiosity stems from arousal that leads to exploratory behaviour. Berlyne (1954, p.189) defines epistemic curiosity as 'a drive reducible by knowledge rehearsal'. He further described the principle feature of epistemic curiosity as:

'(1) An account of questions as thematic probes which evoke drive-producing meaning-responses and (2) the attribution to learned conflict of the curiosity aroused by strange, surprising or puzzling situations or questions'.

From Berlyne's (1954) descriptions, above, it can be seen that curiosity orients around knowledge gaps, arousal, conceptual conflict and a motivational drive or desire that results in some action or behaviour. Berlyne's (1954) perspective of curiosity has been interpreted as a motivational exploratory behaviour and his widely accepted concept of epistemic curiosity is understood to be a need or wish to learn or find new knowledge, remove knowledge gaps and solve conceptual problems (Loewenstein, 1994; Litman, 2005, 2008). Epistemic curiosity is considered to arise from gaps in knowledge (Litman, Hutchins and Russon, 2005) and is a drive or desire to know (Litman, 2005, 2008; Piotrowski, Litman and Valkenburg, 2014).

Koo and Choi (2010, p14) have described a form of curiosity in regard to education that is a drive which:

'motivates inquisitiveness, and experimentation and that [it] underlies intellectual development and scholarly achievement'.

As is evident from the literature (see von Stumm, Hell and Charmorro-Premuzic, 2011; Powell, Nettelbeck and Burns, 2015), research begins to connect epistemic curiosity with thinking, or intellectual thinking or scientific thinking (Jirout, 2012) and outlines that this type of curiosity offers educational potential and benefits as Arnone and Small, (1995) and Arnone et al. (2011) have outlined. Schmitt and Lahroodi (2008) have explained that curiosity is connected to inquiry and education and has emphasised its

significance and thus importance for education, educators and children because it is an integral part of learning and teaching. This is also illustrated by Post and Walma van der Molen (2018) who explain that despite wider acknowledgement that curiosity has potential to contribute positively towards pedagogy, epistemic curiosity, the search for information or knowledge, can be overlooked. There are reasons why this might be so, and Post and Walma van der Molen (2018) state teacher control, teaching style, and teaching approach that creates direct instruction by teachers that inhibits children from being curious and expressing curious questions. It is evident then that there are some external factors that affect curiosity, motivation and exploratory behaviours, such as seeking information and knowledge, some of which emanate from the teacher.

Discussing curiosity more broadly and the different types of curiosity in the literature, including epistemic curiosity, Reio (2009) highlights an ageist perspective that posits the notion that people become less curious as they get older. An ageist perspective is explored by Engel (2009, 2011) who posits that curiosity is not common in schools, and that as children grow older and move into education, their curiosity diminishes. Both Reio (2009) and Engel (2009) suggest that as children age, they lose their curiosity but importantly, Engel (2009) notes that it is perhaps not age but, in fact, school which has an effect on children's curiosity. When investigating an uncertainty preference in children, Jirout (2012, p156) however, found no correlation between curiosity and age and explained that:

‘curiosity assessed as uncertainty preference might be stable across time, and not something that generally increases with age’.

It is evident in the literature that curiosity remains a curious concept and has been investigated and interpreted differently leading to a variety of suppositions and notions of different types or reasons for it or not for it.

What emerges from the literature is a general acceptance that there is a type of curiosity, identified as epistemic curiosity (Berlyne, 1954), which is fundamentally concerned with knowledge acquisition, or as might be understood by educators, as teaching, thinking and learning or more generally, acquiring knowledge. Epistemic curiosity holds potential because it appears to be a valuable attribute of a student who wants to acquire knowledge, or as Berlyne,(1960, p.262) has defined it, to engage in ‘epistemic behaviour’. However, from the literature, there is little educational research that can be found which explores epistemic curiosity in the classroom or that explores its

importance to learning. This is an interesting area where further educational research may contribute to knowledge of the epistemic curiosity of students in schools.

2.5.3 A Lack of Students' Questions in the Classroom

Question-asking in the classroom has several identifiable issues outlined by Chinn and Osborne (2008) and which Dillon (2004, p.197) has summarised stating that:

‘those who ask questions in school - teachers, texts, tests - are not seeking knowledge; those who would seek knowledge - students - are not asking questions at all. Classrooms are full of questions but empty of inquiry’.

In the literature, Wragg (2001), Dillon (2004) and Ness (2015) state that in school classrooms, students do not appear to ask questions and suggest that they might therefore appear to be ‘un-curious’. But importantly, as Almeida (2010, p.307) states, ‘question-asking fosters discussion and debate’ and as Heritage (2002, p.1427) outlines, ‘a question is a form of social action’, emphasising the social element of question-asking, inquiry and curiosity making it possible to tentatively connect question-asking with curiosity. However, there are issues surrounding questioning in schools evident in the literature that appear unresolved by research, as Dillon (2004, p.7) has illustrated when emphasising the importance of students' questions:

‘Whose question? determines the issue of teaching and learning. Just as asking proceeds answering in the questioning process, so do student questions come before teacher questions in the learning process. For when students ask, learning follows in answer’.

In earlier literature, Dillon (1981) supports this but argues that questioning by the teacher foils discussion and that students more readily ask each other questions than the teacher (Dillon, 1983) and goes further by claiming that teachers' silence may in fact stimulate question-asking or discussion between students (Dillon, 1981) and that students need a classroom environment where they feel they can speak freely. Here, Dillon (1981, 1983) expounds the importance and role of the teacher in positively or negatively affecting students' questioning and inquiry or curiosity.

Bruner (1996) offers an alternative perspective on the role of the teacher and their impact upon students in terms of questioning and presents a type of pedagogy. Bruner (1996) has explained that often teachers are perceived as having all the facts and

information to be learned or remembered and that they control or as Wood and Wood (1988) state, govern what is to be learned, heard or viewed. Bruner (1996) explains further stating that in most instances in the classroom pedagogy requires nothing more than students having the abilities of remembering, recollection and recall rather than a deeper understanding of the 'How?' and 'Why?'. Bruner refers to this perspective of imitative learners and pedagogical model as a 'folk pedagogy' (Bruner 1996, p.55). It is evident from the literature that a pedagogical issue has arisen in schools with regard to question-asking or inquiry by students because as Dillon (2004, p.7) states:

‘classroom discourse normatively proceeds in ways that rule out student questions, while other powerful conditions and facts of life give students good reason not to ask’.

It is evident from the above literature that there are three issues emerging from the research regarding knowledge, question-asking or inquiry which can collectively be described as being curious. Firstly, the issue of pedagogy means that teachers are placed in a position that requires teaching and learning to be controlled, imparted and structured by them and that this results in teachers asking a lot of questions and students very few. Secondly, the issue of question-asking as inquiry means that the environment needs to be such that students feel able to speak freely and question-asking is also encouraged. Finally, the issue of the role of the teacher is such that little opportunity exists for the students to ask questions.

2.5.4 Questions for Reasons Other Than Curiosity

Emerging from the literature, as has been discussed, is a suggested relationship between questioning and curiosity but it appears tentative. However, Duffy (1974, p.55) offers a perspective that begins to connect questioning and curiosity and states that:

‘The expression of a question is not a necessary consequence of his being curious: Questions are but one possible symptom of curiosity and one means of attempting to satisfy it’.

Duffy (1974, p.34) describes various studies that looked at the measurement and analysis of question frequency, question type, questions by age, where questions occur and how questions are generated by exploratory behaviour but did not state that questions result from curiosity. In support of the notion that questions are an output or symptom of curiosity, Duffy (1974) described experiments that measured the number of questions and found that incongruity stimulates curiosity *and* question-asking, but the

total number of questions was low. Regardless of the quantity of questions, a relationship emerged between curiosity and question-asking which has also been supposed by Chinn and Osborne (2008). However, Robinson (1974, p.169) found that there was no definitive link and explains that questioning may be one of many ‘outputs’ of curiosity and states that:

‘Between curiosity and questioning the link was not so strong that either could be seen as necessary or sufficient conditions of the other. Curiosity can be manifested in activities other than questioning. Asking questions may serve functions other than that of attempting to satisfy curiosity’.

Robinson’s (1974, p.55) report does not produce a clear or definitive conclusion as to whether question-asking is a symptom of curiosity and states that:

‘the occurrence of a question does not enable us to infer that a state of curiosity exists... the expression of a question is not a necessary consequence of his being curious’.

However, Robinson (1974, p.54-55) has contradictorily stated that:

‘some questions are indicative of a state of curiosity and that a state of curiosity sometimes results in questions being asked’.

What can be deduced from the literature is that the relationship between question-asking and curiosity is unclear but nonetheless, Chinn and Osborne (2008) have explained that question-asking, as part of students’ learning, is important.

So far, for question-asking, research discussed has shown that numbers of questions asked by students generally can be generally low and this may account for some of the problems associated with question-asking and curiosity due to students’ questions being difficult to observe or study in the classroom. Literature from Wragg (2001) Dillon (2004) and Ness (2015) support that student question-asking is infrequent and shows that question-asking in classrooms is an area where additional educational research may contribute to the understanding of the relationship between question-asking and epistemic curiosity. This is addressed in Chapter 5, Discussion.

Studies from Wragg (2001), Dillon (2004) and Ness (2015) that have considered question-asking suggest problems for students such as finding the space or time within an often highly structured and planned lesson or possessing adequate question-asking

skills. There are therefore these and other context specific and inherent problems as Loewenstein (1994, p.94) explains, stating:

‘it implies that curiosity requires a pre-existing knowledge base. Simply encouraging students to ask questions - a technique often prescribed in the pedagogical literature - will not, in this view, go very far toward stimulating curiosity. To induce curiosity about a particular topic, it may be necessary to ‘prime the pump’ to stimulate information acquisition in the initial absence of curiosity’.

Loewenstein (1994), when describing the knowledge making process, acknowledges that curiosity will lead to questions, and makes one of the few concrete links currently found between student questions and curiosity. What this illustrates, is that curiosity and questioning are bound together and are located in the gap that is formed between knowing something and knowing that one does not know something. It can be seen that a little knowledge that leaves a student with a deficit, gap or incongruity may initiate or stimulate curiosity and result in question-asking.

Although not a study of classroom teaching and learning, Jirout (2011) undertook a study of a pre-school intervention with 97 children that investigated the relationship between curiosity and children’s question-asking ability. Jirout (2011, p.27) has explained that ‘there is little known about the relationship between curiosity and question-asking behaviour’ and that question-asking is a key facet of learning, that higher level questions develop at a later age in children and that questions take several forms. The study investigated two types of questions, namely, ‘understanding questions’ and ‘identification questions’ (Jirout, 2011, p.30) and found that:

‘high curious children ask more information seeking questions and are better at discriminating between helpful and not helpful questions’.

In the study Jirout (2011) describes an understanding question as being a type that is:

‘typically asked about a general area of knowledge and elicit[s] in-depth responses, or to fill in some missing information or resolve confusing situations’.

In the study, an identification question is described by Jirout (2011, p.27) as one that is:

‘feature-focused, addressing the goal of filling in a specific small gap in one’s knowledge and are the type typically addressed in the question-asking literature on young children’.

What can be seen from the study by Jirout (2011) is that a correlation is established between question-asking and curiosity, and that information seeking questions, or understanding questions as Jirout (2011) describes them, are asked in higher numbers by children who are more curious and that these types of questions are asked by children to get an in-depth response, to close a gap in their knowledge or to remove conceptual conflict caused by confusion. It is possible to conceive, according to Jirout (2011), that question-asking is an indication of curiosity or an action that stems from being curious, suggesting that curiosity and question-asking are connected, although this had not been fully explored.

In the following second and final section of Part Two the literature around epistemic curiosity in education is critically reviewed.

2.6 Epistemic Curiosity and Education

The following selected literature is concerned with epistemic curiosity and education and through a critical review, limitations and gaps are presented where this thesis aims to contribute to knowledge.

In the literature selected for review, and when analysing epistemic curiosity in regard to children and schools, or what can be considered relevant to educational research, there are research studies from the field of psychology that include important studies by Langevin (1971), Lowry and Johnson (1981), Boyle (1989), von Stumm, Hell and Charmorro-Premuzic (2011) and Jirout and Klahr (2012). There appeared to be limited educational research studies of epistemic curiosity and the most significant studies are by Day (1968, 1982), Chak (2007), Arnone et al. (2011) and Engel (2011). Other research literature regarding curiosity and education were of interest but considered less significant to the thesis, for example, studies by Vidler and Levine (1981) regarding magic and Keller (1987) regarding an instructional design model for motivation.

2.6.1 Further Perspectives of Curiosity

Chak (2007) investigated the conceptions and perceptions of parents and teachers regarding curiosity and found that curiosity was viewed positively but that teachers were more willing to encourage it than parents. In the study, Chak (2007) used a mixed

methods approach within which there was a category specifically related to ‘epistemic behaviour’ that Chak defined as question-asking and information seeking. An interesting result that emerged from Chak’s (2007) study is that participants felt that if curiosity was to decline with age then they felt that environmental factors rather than biological ones would cause this. It was perceived that factors such as school, academic pressures and curriculum might cause any age-related decline in curiosity rather than simply getting older.

Arnold and Small (1995) provide a theoretical paper that considers several perspectives on developing students’ curiosity and concludes that the ‘Attention, Relevance, Confidence, Satisfaction’ (ARCS) model developed by Keller (1987) might be used by educators to stimulate curiosity and identifies a need for a pedagogical framework that facilitates this type of instruction.

Engel (2011) has provided an interesting perspective that determined curiosity to be a social interaction between children and adults, whereby students ask questions to adults for information. Engel (2011) described a perspective of curiosity as a quest for information and knowledge that takes place between people and that adults occupy a pivotal position in fostering and developing children’s intrinsic curiosity in the classroom. What can be seen from the educational research around epistemic curiosity is that it is regarded as a key component of learning but that external factors can affect the degree or level of curiosity that children exhibit or use in classrooms.

2.6.2 The ‘Zone of Curiosity’ Concept

An alternative perspective of curiosity, that is infrequently considered, is presented by Day (1982) who has outlined a homeostatic perspective rather than a neurophysical or behavioural perspective of curiosity. Day’s (1982) theoretical paper presents curiosity as a form of arousal or alertness that is situated between anxiety on the one hand and relaxation on the other. Day (1982) provides the concept of a ‘tonus level’ (Day, 1982, p.20) which is explained as an ‘optimum position between two extremes of frenzy and coma’. Day’s (1982) theory further describes three zones, the zone of relaxation, the zone of curiosity and the zone of anxiety with the tonus level being a place within the zone of relaxation. It can be interpreted that if a student is positioned below the tonus level, they might appear unmotivated or disinterested or excited and interested if above it, as shown, below in Figure 1.

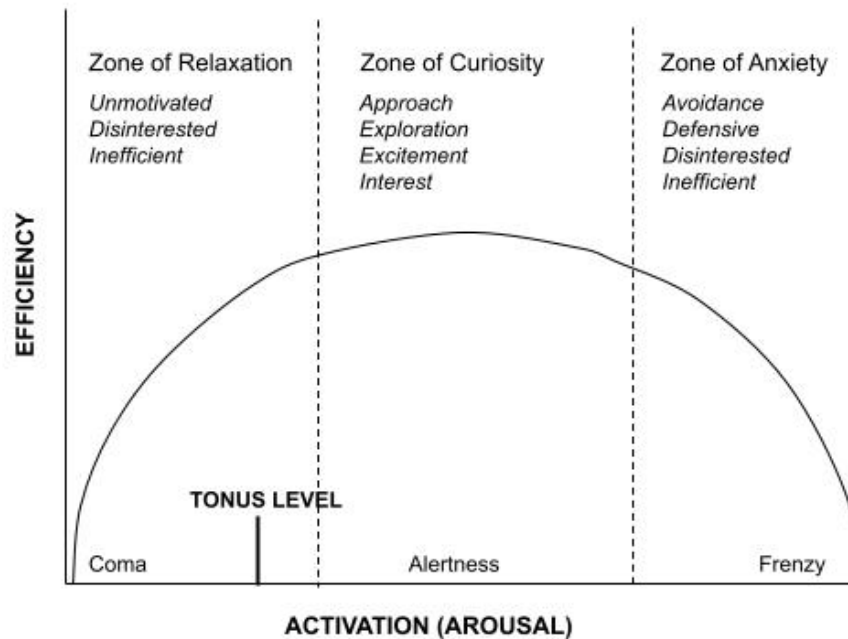


Figure 1: Zone of Curiosity (Derived from Day, 1982, p.20, Fig.1).

Day (1982) provides a perspective of curiosity that also illustrates the teacher's influence upon the state of activation of a student. As such, Day (1982) positions the teacher as an important influence upon a students' curiosity able to affect the students' interest and engagement in learning or inquiry. Day (1982) presents the concept of the zone of curiosity and the tonus level, alongside relaxation and anxiety and thus presents educators with the potential of being able to consider students' positions and aim to affect it so that they are within a zone of curiosity. The model presented by Day (1982) offers a homeostatic process perspective of curiosity.

The next sections present a critical review of the literature around epistemic curiosity from 1960 onwards. Psychological perspectives are presented in order to outline the knowledge within Psychology that is then used within educational research. It is important to understand the limitations and gaps that exist in this literature so that the lacuna can be identified where this thesis can aim to make a contribution to knowledge.

2.6.3 A Cognitive Process Theory of Curiosity

Beswick (2004) presented a perspective of curiosity that defined it as a process. In his research, that spans from 1960 to 2000, he argued that people process signals as part of the 'process of curiosity' and that the information in these signals are assimilated and accommodated as Piaget (1952, 1970) has described. In the theory by Beswick (2004) some signals were of higher value than others and that they were integral to the process

of curiosity which Beswick (2004) described as one of creating, maintaining and resolving conceptual conflicts. Beswick (1971) described how cues or signals such as a need, wish or desire were part of the process of curiosity that ended with either covert or overt responses. Beswick (1971) described overt responses as handling objects, asking questions, gestures or movements or other bodily actions or behaviours. Covert responses were described as surprise, arousal, interest, a need to know or similar feelings or thoughts. Beswick (1971, 2004) provided a theory of curiosity as a process that is to some degree an alternative perspective to those presented at the time. Of interest to educators and this thesis, Beswick (1971) argued that curiosity can be awoken by cues or signals, or in educational terms, activities, explanations, presentations, demonstrations or artefacts that a teacher might use as part of teaching and learning as a cue or signal. However, Beswick's (1971) theory assumed that signals or cues are integrated automatically into cognitive maps and that students, for example, were motivated to engage with the cues or signals. Beswick's (1971, 2004) process of curiosity also overlooks the degree or extent to which emotion is involved in the processing of cues and signals. As such these factors remain a limitation of Beswick's (1971) cognitive process of curiosity (Beswick, 1971, 2004, 2017).

2.6.4 Developing an Understanding of Epistemic Curiosity

In the literature there is a body of research around epistemic curiosity that is sometimes referred to as the epistemic behaviour (Berlyne, 1960) of children in schools. It is referred to by Reio (2009, p.3) as 'information-seeking or cognitive curiosity', that is, 'a behaviour or action that is performed with the goal or aim to gain or gather new information and knowledge'.

Langevin (1971) devised a study to test a hypothesis that curiosity is multifaceted and not a unitary construct. However, a notable finding relevant to this thesis was that teacher rating of curiosity, an exception to the other curiosity measures, was found to be more likely a measure of intelligence rather than curiosity. A limitation that, as previously identified, may also have influenced Mittman and Terrell's (1964) findings. Maw and Magoon (1971) performed an empirical investigation of the curiosity of elementary schoolchildren which at the time appeared to have been seldom done. In a later study, Maw and Maw (1975) provided another investigation of curiosity in young children in elementary school which looked specifically at the correlation between social adjustment and curiosity.

Coie (1974) provided a study which questioned the validity of teacher ratings of curiosity and concluded that teachers ratings of curiosity, because they tended to relate to the teachers knowledge of the child's intellectual ability and prior academic performances, should be treated with caution. However, Coie's (1974) study did not consider the child's confidence or social skills, or their motivation or security to ask questions or talk, and this appears to be a limitation of this study.

Kreitler, Zigler and Kreitler (1975) examined the nature of curiosity in children using different observable behaviours to determine if these were different types of curiosity. The study found evidence that supported the notion of five different types of curiosity: manipulatory curiosity, perceptual curiosity, conceptual curiosity, curiosity about the complex and adjustive curiosity. The study concluded that educators should focus on developing conceptual curiosity and curiosity about the complex as they can be overlooked. Lowry and Johnson (1981) provided an important study into how controversy affects epistemic curiosity and the achievement of students. They found that epistemic curiosity is mutable, and not only can it be increased by providing controversy, but that controversy then leads to 'higher achievement and more positive attitudes (Lowry and Johnson, 1981, p.31). When outlining the significance of controversy, Lowry and Johnson (1981) define controversy as a situation a person experiences when their:

'Ideas, information, conclusions, theories, or opinions are incompatible with those of another person, and the two seek to reach and agreement'.

In terms of the social interactions between people, Lowry and Johnson (1981) presented an alternative possible pedagogical approach that places talk, discussion and questioning at the centre of teaching and learning. The research was carried out with elementary age school children, and what is not considered is the effect or impact that the topics or subjects in the curriculum at a later stage of education might have. None the less, the study found that epistemic curiosity directly affected achievement in a positive way.

2.6.5 Problems Measuring Curiosity

Much of the research of curiosity in schools reviewed so far has focused on younger school children and Engelhard and Monsaas (1988) investigated whether curiosity changes across different school ages and studied school children from both elementary

and public schools. Engelhard and Monsaas (1988) found that curiosity decreased with age but showed that schooling itself might have an effect and also that the students' self-reporting of their curiosity might have also affected the results of the study. However, Engelhard and Monsaas (1988) have illustrated that curiosity is an important part of teaching and learning and that school and teachers are also influential.

Although not a study of epistemic curiosity, Henderson and Wilson (1991) in a study of intelligence and curiosity of preschool children, sought to establish a link between exploration and intelligence. Exploration was defined by Henderson and Wilson (1991) as a tendency to explore novelty in the environment. Although they found no correlation between intelligence and curiosity, they arguably looked for Berlyne's (1954) 'perceptual curiosity', the desire to seek new or novel stimulus.

Engel (2009) described a similar theme that has been evident and has emerged in research studies, namely that teachers play an important role in the development or suppression of curiosity in the classroom, particularly 'expressed curiosity'. Engel (2009) found that, in fact, curiosity was often restricted rather than being developed and identified that children often appeared to be engaged in learning but that this did not mean they were curious. Interestingly and of importance to this thesis, Engel (2009) identified that by changing to a pedagogical approach that encourages understanding, rather than worksheet completion, it would improve curiosity.

Von Stumm, Hell and Charmorro-Premuzic (2011) conducted an important research study on the key features of academic performance. In their meta-analysis of literature, von Stumm, Hell and Charmorro-Premuzic (2011, p.583) established that a 'hungry mind' or 'intellectual curiosity' is indeed a key facet of academic performance but also suggested that 'choice of subject, socio-economic status, learning style, and self-confidence, are likely to be influential, too' (von Stumm, Hell and Charmorro-Premuzic (2011, p.583). Von Stumm, Hell and Charmorro-Premuzic (2011) described intellectual curiosity as encapsulating epistemic curiosity and have emphasised the importance of epistemic curiosity within education.

Jirout (2011) has explained that training given to preschool children did not elicit any improvement in question-asking and that this may have been due to the very small amount of training given. A limitation of the study is that it involved a relatively small timeframe, a total of one hour of training and as is evident in other research studies,

involved only younger children. These factors belie some of the problems that are inherent when trying to assess the curiosity of children, particularly when they are in school.

In terms of research methods, Jirout and Klahr (2012) have explained that questionnaires are often used for adults and these are inappropriate for preschool children as they may be learning to read and write. Jirout and Klahr (2012) thus identified the problems of measuring the curiosity of children using tools designed for adults and described a new paradigm for measuring preschool childrens' exploratory curiosity. From this approach Jirout and Klahr (2012) posit five classes of definitions of childrens' curiosity to form an operationalized definition defined as 'uncertainty preference' (Jirout, 2012, p.156). In terms of epistemic curiosity or the desire to seek specific knowledge about a topic or subject, Jirout and Klahr (2012, p.156) proposed that 'scientific curiosity' or the desire to know more about the natural world is a more appropriate type of curiosity to attempt to measure in young children.

Piotrowski, Litman and Valkenburg (2014) provided a study to measure epistemic curiosity in young children in order to assess 'I- and D-type epistemic curiosity'. The study presented a perspective that different types of curiosity exist in children. The authors of the study aimed to develop a new measure of epistemic curiosity constructs in young children. A limitation of the research is that the sample of children is those aged only between 3-8 years of age meaning that assessment of I- and D-type epistemic curiosity in older children currently remains under explored. Additional research that investigates epistemic curiosity in children of the age range from 11-16 years old therefore stands to make a contribution to knowledge.

2.7 Epistemic Curiosity: Summary

The research literature currently available at the time of writing, relevant to education, is only able to explain what epistemic curiosity is and that it exists and to an extent, that it is potentially measurable. The literature currently does not investigate if a resource such as voice technology, could affect students' curiosity, students' information-seeking questions, or epistemic curiosity. What has also emerged from the literature reviewed so far regarding epistemic curiosity is that there appears to be little evidence surrounding students' question-asking, information-seeking questions and epistemic curiosity or the desire for knowledge or drive to know. This suggests that where pedagogical

approaches, students' question-asking and epistemic curiosity converge is an area where this study can make a contribution to knowledge.

2.8 Part Three: Social Interactions Involving Technology

2.8.1 Technology Acceptance Models

Perceived Usefulness (PU) and Perceived Ease of Use (EU) form two key features of Davis's (1989) 'Technology Acceptance Model' (TAM). PU can be understood, for an *individual* teacher whose main role is teaching, as a technology that they *think* enhances teaching. EU can be understood, for an individual teacher, as the degree to which a technology would be free from effort. In this way, PU and EU can be used to reveal a teacher's potential attitude to a technology.

Usability, or the ways and means a user uses a technology, or the elements of the technology that allow it to be used effectively and efficiently, seem significant in user adoption of technology. However, this has been argued to not be a key reason why technology is accepted by users (Dillon, 2001). The reason, as Dillon (2001) has explained, are the characteristics of potential users of technology, for example, cognitive style, personality traits or demographic variables. What can be seen is that the TAM is effective in identifying PU and EU as being able to identify elements of an individual user's *attitude* to a technology, but a broader understanding is required such as the *characteristics* of users.

Venkatesh and Davis (2000) have provided a theoretical extension to Davis' (1989) TAM, referred to as TAM2 which situates an individual user within a wider context. Within the proposed second model are features of social influence (SI) and cognitive instrumental processes (CIP). To a degree, these features were intended to capture a broader understanding of influences upon users that might affect their attitude to technology. However, TAM and TAM2 still do not connect elements such as PU, EU, SI and CIP to educational job performance priorities such as, for example, outputs of teaching and learning such as marks, scores and grades.

Venkatesh and Bala (2008) have provided a further extension of the TAM, referred as TAM3. Within TAM3, Venkatesh and Bala (2008) propose further elements related to PU such as perceived enjoyment and computer playfulness along with computer anxiety. From their model, Venkatesh and Bala (2008) have outlined that interventions

by organisations are required to minimise resistance and maximise utilisation and to increase adoption of technology.

What is revealed is a useful way through TAM and TAM2 of evaluating a teacher's attitude to a technology in terms of PU and EU. However, there is little evidence to evaluate a teacher's attitude to a technology in terms of the impact on 'performance', that is, examination results or outcomes. A second limitation is that both TAM and TAM2 do not provide practical guidance on how technology might be adopted by teachers in the form of approaches or methods. Both TAM and TAM2 describe that technology should be easy to use and be useful but offer no practical guidance on how to achieve this. What can also be seen across the TAM, TAM2 and TAM3 is a progression from user level to organisational level. TAM aims to describe reasons why an individual user may or may not adopt a technology, without giving broader contextual factors or considering, for teachers, performance priorities. TAM3 outlines interventions that an organisation might wish to consider, to increase adoption of technology, but again without considering organisational performance priorities that teachers in a school might have or that a school might have as an organisation.

What can be seen from the three TAMs is that there exists a gap for practical actionable guidance for a teacher in terms of technology adoption, specifically, in relation to this thesis, voice technology adoption, that might have positive effects on teachers' performance or associated pedagogical approach.

2.8.2 Affordance

Gibson (1979), drawing on gestalt psychology to consider both the physical and phenomenal values of objects, has explained that objects are not composed of their qualities but are instead perceived in terms of their 'affordances'. From Gibson (1979) it is possible to understand an affordance as being both the perception of and properties of an object. The concept of an affordance is taken from the ecological approach to visual perception of Gibson (1979) and deployed as a concept that can be used to analyse users and usage of educational technologies (Conole and Dyke, 2004; Hammond, 2010). It is possible therefore to deploy the concept of affordance into the 'ICT' domain.

Hammond (2010) explains affordance as the physical and symbolic properties of an object and uses the example of the multiple ways that a socially constructed understanding can be formed of a computer. As an example, in terms of the research

aim of the study, how a teacher might perceive an Echo Dot and a student might perceive an Echo Dot might be different in terms of affordance. In this way, from Gibson (1979) and Hammond (2010) an 'ICT' is able to be interpreted using affordance as a conceptual tool to analyse the interactions that occur between object and person.

Conole and Dyke (2004) have outlined a taxonomy of ICT affordances. In doing so they have described a practical way to analyse and evaluate educational technologies within educational organisations. Elements of the taxonomy potentially relevant to voice technology include selection of information, the way in which information and information society discourse is mediated by technology, and immediacy. A further element of the taxonomy that is considered relevant to the research aim and to the Echo Dots and Alexa is 'communication and collaboration'. Conole and Dyke (2004) consider social learning theories in this element of the taxonomy and direct their focus at a *macro-level* toward technology affordances that connect dispersed global communities. In doing so they leave an opportunity to focus at a *micro-level* towards affordances of individual teacher's classroom practice and the way in which Echo Dots might connect teacher-student and student-student as part of a pedagogical approach.

Through both Conole and Dyke (2004) and Hammond (2010), along with other research into affordances of ICT (see Churchill and Churchill, 2007; Anderson and Robey, 2013; Al-Maawali, 2020), it is evident that Gibson's (1979) perspective of objects as having affordance can be extended to include modern information technology and this might therefore include voice technology. However, currently at the time of writing, there exists no literature that looks specifically at the affordances of Amazon's Echo Dots and Alexa or voice technology in the classroom. This is an area therefore where a contribution to knowledge might be made.

2.8.3 Talk and Technology

Mercer and Dawes (2014) have argued that a pedagogical approach centred around talk is transformative and that there was a growing pedagogical interest amongst teachers in classroom talk. Howe et al (2019) have stated that classroom dialogue, particularly talk between teacher and student, such as discussion of competing viewpoints, thinking about thinking and participation in discussion, positively affected students' outcomes.

Hennessy (2005, 2007) has described the key role teachers play as mediators in facilitating learning in technology environments, especially collaborative work, but that

pedagogical approaches for learning in ICT environments are underdeveloped. Ertmer (2001, 2005) has identified reasons for this including the beliefs of teachers that negatively impact on use of technology for purposeful teaching and learning. Ertmer and Ottenbreit-Leftwich (2010) have argued that technology has not been used to support successful pedagogical approaches and have outlined other reasons for limited uptake of technology such as teachers' knowledge of exemplary practice and the impact of a school's culture. Through this literature it is possible to see that the technology *itself* does not foster pedagogical approaches that promote dialogic and talk-oriented teaching.

Hennessy, Ruthven and Brindley (2007) have synthesised pedagogical beliefs with 'affordances' (Gibson, 1979) of technology to conclude that teachers considered the 'value' that technology could add in relation to external influences such as examination requirements. However, the extent to which external influences directly affected what took place in the classroom in terms of teaching and learning remained under-explored and this was despite identifying that a 'pedagogical evolution' (Hennessy, Ruthven and Brindley, 2007) did not occur when technology was considered. Talk or dialogic teaching appears to be often overlooked given other educational priorities or educational technology innovations.

Wegerif (2004) has developed an important idea regarding technology and talk. Through a study involving children, Wegerif (2004) explored how educational software could support 'learning conversations' and found that learning occurred in the talk of children, learning gains could be made and a computer could produce effective learning conversations. The important idea that Wegerif (2004) developed was that technology such as a computer could be conceptualised as being both an *object* and to behave as if it were a *subject*, i.e. a person. This, as Wegerif (2004) explains, is an ontological problem, but what is not evident in Wegerif's study is the affordance that emerges from a technology when it is perceived as a person. What is not considered is if the technology has *human-like* interactive capacities such as digitised speech and is therefore not only thought of as human but sounds human. Wegerif (2004) concludes that a technology, such as a computer, is equipped to support dialogic teaching and learning but does not proceed further. What emerges from Wegerif's (2004) study is a limitation towards considering voice technology. Here, therefore, is the idea that a technology such as a voice technology and affordances of it as a more informative or knowledgeable other, provides an interesting area to explore in terms of dialogic

teaching and learning and the ability to support, promote or mediate learning conversations.

In summary, what is not apparent in the literature, at the time of writing, is research that explores how a technology, such as Amazon's Echo Dots, might be used to mediate a dialogic pedagogical approach between teacher and student that utilises epistemic curiosity to promote talk, discussion and epistemic question-asking. There is no literature available that explored voice technology and talk which looked specifically at the types of discourse and talk that occurred between student and student when this technology was deployed in classrooms.

2.8.4 Vygotsky: A Theory for Learning

Although Vygotsky's (1978) 'Zone of Proximal Development' (ZPD) is used by educators and education researchers to focus upon methods of instruction that support the progress of learners it is concerned with both instruction and assessment. Vygotsky (1978) was able to develop the notions of a potential or proximal development level and a supportive other by exploring, through the assessment of development and status of progress, how learners could make progress. Interpretations of Vygotsky's later work outline two accounts of the 'ZPD' (Daniels, 2008). The ZPD, as Vygotsky (1978) had first described it, contains the undefined concept of a knowledgeable other who, through a process of mediation, supports a learner.

Daniels (2008) has outlined that Vygotsky developed two possible understandings of 'mediation', one that explained it as stimulus-response and the other as concerning semiotics. However, speech can be understood as integral to both conceptualisations of mediation, along with other 'psychological tools' such as symbol systems, writing, diagrams, maps and conventional 'signs' (Daniels, 2008, p.7). These tools can also be considered 'artefacts' and which have affordances (Gibson, 1979) and are conceptual objects which are formed *in* and *of* the culture and society they belong to. In this way, for Vygotsky, speech as an artefact or psychological tool, presented a socially and culturally 'artefact-mediated formation of mind' (Daniels, 2008) using a more informative of knowledgeable other.

According to Lindblom and Ziemke's (2002) understanding of Vygotsky's (1978) cognitive development theory, the natural or lower mental functions such as memory or perception, are controlled by the stimuli in an environment. The cultural or higher mental functions occur from the transformation of lower mental functions. The

transformation occurs in a stimulus-response scenario whereby higher mental functions require a psychological tool, such as language, to be enacted and this then leads to thoughts. Lindblom and Ziemke (2002) outline that speech, in a Vygotskian sense, initiates social contact, social interaction, communication and, through internalisation of speech, can then be used to develop control or mastery of thinking. Here, through Lindblom and Ziemke's (2002) interpretation of Vygotsky's (1978) theory, it is possible to regard speech as integral to thinking. However, it has been argued by Van der Veer and van IJzendoorn (1985) that restricting Vygotsky's (1978) notion of social interaction to speech and the notion that development is only brought about by social interactions, it becomes a reductive interpretation. Nonetheless, the social and cultural nature of Vygotsky's (1978) conceptualisation of speech takes into account the active and social characteristics of teaching and learning. Thus it can be considered that Vygotsky's (1978) theory has elements inherent in it, that for educational research in schools, could be used as a conceptual tool to explore classroom social interactions including talk. Also, regardless of criticism of Vygotsky's (1978) 'social' constructivist philosophy (Hua Liu and Matthews, 2005), there remains little evidence to demonstrate that mediation of learning through and by a culture and a social setting does not involve other people or that these other people do not influence learning and development and that talk is a key facet. As such, although Vygotsky did not define what a more knowledgeable other was, it remains a concept integral in the concept of the 'Zone of Proximal Development' (Vygotsky, 1978), which outlines the importance of a more knowledgeable other or, a digital more informative other, and which therefore remains a part of learning or cognitive development.

What is apparent is that speech, when understood as the social process of talking, allows a stimulus to be transformed into a thought and that when talk occurs, mediation occurs between a less and more knowledgeable or supportive other. However, in the literature it was not possible to locate research that investigated the role a voice technology might play in the transformation process of stimuli to thought and the way in which such a device might mediate learning in a school. As such an opportunity exists to explore in what ways a device such as the Echo Dot and Alexa might be used as a digital more knowledgeable, supportive or informative other in the classroom.

2.9 Conclusion to the Chapter

There is a body of literature regarding epistemic curiosity but educational research is limited. There is also limited research of modern voice technology used in education. It

was not possible, at the time of writing, to identify literature concerned with both voice technology and epistemic curiosity. It was not possible to identify literature that investigated the relationship between students' question-asking to voice technology or the impact of voice technology upon students' epistemic curiosity or how voice technology was used pedagogically in a school.

The relatively small number of educational studies available at the time of writing do not research epistemic curiosity and pedagogical approaches in terms of voice technology, so are limited in what they can reveal about the educational use of a device such as Amazon's Echo Dot. As such research of the area where voice technology, epistemic curiosity and pedagogical approaches converge, conducted in a school, in classrooms, involving students and teachers in everyday lessons, stands to make a contribution to knowledge.

From the critical review of the available and selected literature regarding voice technology and epistemic curiosity and what is currently known, there is a gap where this study can make a contribution to knowledge. The research design for an educational research study of voice technology and the epistemic curiosity of students is presented in the next chapter.

Chapter 3: Methodology

The literature critically reviewed in Chapter 2 has demonstrated that, at the time of writing, no research could be found regarding the area where voice technology, epistemic curiosity and pedagogical approaches converged. The research design and methodology for an exploratory research study at Hillview School, informed by the critical review of the literature in Chapter 2, is presented in this chapter.

This chapter explains how the research design was developed by a process of initial discussion with schools, small investigative research pilots, testing of voice technology devices and trials of data collection methods.

This chapter explains the ‘How?’, ‘What?’, ‘Where?’ and ‘Why?’ of the research study and also deals with researcher’s presence as the ‘Who?’. This chapter is concerned less with outputs, or empirical instruments, or the products of a study but with the ‘process’ of researching (Cohen, Manion and Morrison, 2000, p.45). For Brewer (2000, p.2), this is a set of ‘technical rules’ for the procedures taken in the research study and the philosophical and theoretical framework that these fit within. This chapter therefore provides an account of the formal and informal process of the research design.

For qualitative research, Hedges (2017) explains that validity claims are often based around researcher integrity, objectivity and honesty, the depth of description and analysis and interpretation of the data and authenticity. There are also ethical decisions that need to be made and specific ethical issues related to ethnographic research and these will be discussed in this chapter.

The research objectives were:

- To critically analyse the pedagogical approaches of teachers before and during the use of voice technology in lessons.
- To critically analyse voice technology as a student’s digital ‘more knowledgeable other’ in lessons.
- To critically evaluate the impact voice technology has on students’ epistemic curiosity.

3.1 Context for the Research Study

Increasingly, some of the educational technology used in school can be digital, as Selwyn and Gorard (2002), Selwyn (2006) and Watters (2014) have explained. From visiting secondary schools and observing classrooms it was evident that teachers often utilised a range of digital technology for teaching and learning. However, in the classrooms observed in advance of the study during initial investigative research, no voice technology was observed being used. This indicates that there is an opportunity to investigate voice technology in classrooms as part of everyday lessons before it has been used or more widely adopted by schools.

3.1.1 Guiding Principles of the Research Methodology

I wanted to study the teachers and students who used voice technology in lessons. For Cresswell (2014) this is the teachers and students' social interactions and their shared patterns of behaviour, beliefs and language that are evident over time.

In order to provide insights into real events, my aim was to collect data directly from the secondary school classroom. I therefore aimed to avoid a staged environment and wanted the research setting to be as naturalistic as possible to avoid it being set up for the purposes of the research study as I had read had been done by others (see Druga et al. 2017; Porcheron et al., 2018; Blond, 2019). From the outset therefore, there were several factors to address in the preliminary stages of the initial research design.

As I progressed the research design and gained a deeper understanding of the details and stages of it, I developed an insistence that my research should be equitable (Cresswell, 2014). It needed to have formal ethical approval, but importantly, from my own personal values position, it should cause no harm and would not exploit or take advantage of others. Where possible, either through fieldwork or the results of the study, it would aim to give back as much, if not more, than might be taken. I remained a qualified teacher and teacher educator and was bound by standards of professional conduct and wanted to ensure that a professional integrity was maintained (Seale, 2012). In order to achieve this and to reduce my moral tension, I negotiated access to schools and teachers on the basis that I was available for them to use freely as a teacher or teacher's assistant. For the fieldwork, Hillview School used me as a teacher's assistant which I felt achieved an equitable balance.

The research design had several formal and informal principles that acted as guides to its methodological design (Cresswell, 2014). The formal principles were around the

ethics and morals, equity and integrity as has been briefly described. The informal principles were based on my prior professional role as a teacher and principles from my personal values. The formal ethical issues and considerations for the research study are discussed in the next section.

3.1.2 Ethical Responsibilities

This section outlines the ethical considerations that were identified in advance of the research study, and that arose as it progressed, and approaches taken to address them. In this section I will address the following ethical issues that were identified: principles and power, working with gatekeepers, consent and assent, potential implications and data from the Echo Dots.

When conducting ethnographic or anthropological research, Iphofen (2013, p.1) has stressed that there are the basic principles of:

‘doing good, not doing harm and protecting the autonomy, wellbeing, safety and dignity of all research participants’.

It was with knowledge of research harm foremost in my mind that I embarked on the research study and remained sensitive to the potential and possibilities for harm when conducting educational research.

Hammersley and Atkinson (2007, p.209) have outlined five characteristics of ethnography which relate to research ethics: informed consent, privacy, harm, exploitation and consequences for future research. These will be addressed below in relation to the research study at Hillview School.

3.1.2.1 Guiding Principles and Power

I have stated that an important guiding principle that informed the research study was that colleagues and my profession should not be harmed and the research design should allow the research to give more than it took. I am a qualified teacher and teacher educator and my professional life and personal life, as with many teachers, are conjoined and involve professional and personal relationships both in and out of school and across schools. I was researching a community that I was outside of but also part of and invested in and which I cared for. My paramount priority was to achieve ethically responsible research. During the fieldwork I hoped that the research design would thus ensure an equitable approach and achieve a ‘balance of power’ between participants and

researcher but also allow the research study to ‘minimise harm and maximise benefits’ (Iphofen, 2013, p.3).

In an attempt to remove any influence of adopting a position of authority and thus power in the school by working as a teacher, I elected to work as a teaching assistant. In this role I became neither teacher nor student and although still a researcher I felt that in this role, I had little formal authority or power over the students. Within my fieldwork research role of teacher’s assistant I became an unpaid member of staff at Hillview School and although I did not ask for or get access to digital information or the school’s computer network, I was allowed physical access to all areas of the school, in line with other members of staff. Although given open access to the school, the research study was oriented around pedagogical approaches and focused on teaching and learning. I therefore decided not to enter into the staffroom and remained only in the public space of classrooms, where teaching and learning took place. I maintained an ethical position that data that was relevant to the study would be that which was public and therefore found in the classrooms. In this way I attempted to manage perceptions of the role I had in the school to level any power hierarchies by adopting a neutral role. I also attempted to balance any potential benefits of a power position such as access to data and mitigate what was taken as data by restricting where data was collected and give back through my unpaid time.

3.1.2.2 Gatekeepers’ Consent

Negotiating the complexities of gaining access to a research setting, or what is referred to as the ‘strata of gatekeepers’ (Kay, 2019, p.37) is particularly pertinent to educational research. In this study, for example, it included the headteacher of the school and individual classroom teachers both who were able to give and take permission to access locations and conduct research. Navigation into the school was in practice relatively problem free because of what Kay (2019, p.49) has referred to as a ‘trustful relationship’ that was developed with the headteacher of Hillview School.

The primary gatekeeper was the headteacher who I asked and gained formal written permission from (see Appendix 10, Letter 1). I had previously spoken to him by telephone, met twice in person and then communicated with via email. I had outlined my role and the scope of the research study and also sent him my ethical approval form. I also provided him with a demonstration of an Echo Dot and how they might work. In conversations with the headteacher he also accepted responsibility for determining and

gaining consent from parents to participate for the students. I provided the headteacher with a consent letter to send to parents (see Appendix 10, Letter 3). Following gatekeeper permission and before the research study began, I had email conversations with the headteacher who took responsibility for initial contact with the staff about participation. Teachers were then asked to contact me directly, via an email from the headteacher, if they wished to participate or to find out more information about the study (see Appendix 10, Letter 2). In subsequent emails with interested teachers I outlined my position as a researcher, the aim of the study, their role in the study should they chose to participate and that they could withdraw without detriment at any time. When I had recruited teacher participants, I organised an 'orientation' meeting where I visited the school and met with the potential participants and demonstrated an Echo Dot. I explained the aim of the research study in detail and clarified teacher participant obligations and that if they chose to participate, they should feel comfortable withdrawing at any time. During the research study two teachers did withdraw, which I felt confirmed that the opt-out information provided and any potential influence of my power position as researcher had been resolved.

Subsequently, when it had been confirmed which teachers would be involved, I had further email conversations with individual teachers. In these conversations I asked that during my time in the classroom my presence be explained each lesson and that students were to be given a choice over whether to use an Echo Dot. This occurred and during fieldwork teachers clearly explained the study and that students should not use an Echo Dot unless they wanted to. In Chapter 4, I present data that shows that some students chose not to use an Echo Dot. During the study and when in lessons, before any data was collected, I would ask students if they knew what my role was and that I was researching and if they wished to discuss the Echo Dots or to speak with me in my role as researcher. In this way I believe that best attempts were made to give students as much information and knowledge as possible to be able to provide assent.

Teachers who participated in the study were gatekeepers of their classrooms and because they had elected to participate, had a degree of control over what occurred in their classrooms when I was present. During fieldwork as a teacher's assistant in lessons, I was given worksheets, textbooks and students' exercise books to mark and also given artefacts, chemicals and other equipment to use in lessons or as I was informed, to take and use in the research. Any material collected and which has been used in this thesis, has been used therefore on the basis that teachers were informed I

was carrying out research and had elected to participate knowing this in advance. If I asked to keep a worksheet, it was therefore understood that it might be data. Teachers agreed to provide me with materials in lessons and appeared to expect to do this knowing I was a researcher and that they were participating. Any information that might compromise anonymity, or lead to an individual being identified, has been removed. I took and have used photographs of two empty classrooms that are shown in Figure 9 and Figure 11. These materials were gathered and are used with permission which was gained by asking the teacher at the time. I ensured that where it was possible, I was actively ‘transparent’ about being a researcher and conducting research. I did this through conversations, requests for permission, reminders about the focus of the study and more subtly by showing that I was making notes in a notepad and being visible when making notes and leaving the notepad open and visible to teachers. In some instances to aid transparency, I was able to share a view of my fieldnotes with teachers and ask for feedback on, for example, heatmaps, seating arrangements or students names.

3.1.2.3 Ethical Characteristics of Ethnography

The research study gained university ethical approval for fieldwork in a secondary school with students and teachers and both groups of potential participants became a source of anxiety as I began to worry about access, consent, assent and privacy. In the research design and university ‘Project Approval Form’ (PAF), I had described that in order to work towards students’ assent I would make clear my ‘role as a researcher’ (Cresswell, 2014, p.231) and had also outlined that I would seek email permission if students became involved in formal interview. The involvement of students in formal interviews however was not expected. Conversations during the Research Ethics Panel and with the headteacher at Hillview School clarified my responsibility in terms of gaining consent. It was decided that the decision to inform parents would be left with the school if the need for student interviews should arise, thus adhering to the guidelines from BERA (2018, p.12) regarding gaining consent and assent during educational research in classrooms. My role in the classroom was to simultaneously be participant observer researcher and classroom assistant, meaning that I would be both working and researching. As I would therefore be among students during lessons, I had also outlined how I would explain to students that when the Echo Dots were used there would be no obligation for them to participate with the Echo Dots and if they did, they could opt out at any point. I had planned that when teachers used the Echo Dots, my presence as a researcher would be made clear to students by the teacher who would also explain the

students' role, option to opt-out and focus of the study. From the pilots I knew that I would wear a name badge when in the school showing my name, role that I was from a university and a school visitors badge which was provided by the school. I had also planned to begin any interaction with students with an explanation of my purpose and to ask if they were happy to talk about the Echo Dots should they use one.

3.1.2.4 Ethical Anxiety

Throughout the process of researching I managed to balance personal ethical concerns, but anxiety around a variety of areas permeated every aspect and every step, as Mills and Morton (2013, p.73) have outlined, stating that 'every aspect of ethnographic practice has an ethical dimension'. A concern that persisted was regarding the Echo Dots which, as the literature review had established, had not been used before in everyday lessons, 'in-the-wild' with secondary students. For any emergent technology, such as the Echo Dots, there are unforeseeable ethical issues that might arise through their introduction and wider use in society, as Iphofen (2013, p.4) has identified for social media:

'New social media have given rise to innovative methodological approaches for ethnographers and anthropologists. These have given rise to new forms of community and personal identity for people that pose real challenges to the key ethical research principles of consenting, voluntary participation, and vulnerability. With this interconnectivity, understanding of public and private space has become more complicated'.

When using the Echo Dots, my concern over students' privacy, or more accurately, what appeared to be their lack of understanding about their right to privacy in terms of Amazon's Echo Dots collecting their data, did not abate and remained perplexing throughout. This was because the data gathered from the Echo Dots came from public dialogue, that although seemingly private between Alexa and a student, was not. The data was also stored 'somewhere' (Krotoski, 2020) and was accessible and owned presumably, by Amazon Web Services. Several ethical issues therefore remained but I believe that I adhered to my own guiding principles and ethnographic and anthropological ethical principles (Iphofen, 2013) and the ethical characteristics of ethnography (Hammersley and Atkinson, 2007). However, the research study was exploratory and used a novel data collection method to collect, or more accurately, record children's conversational data in a 'public' space of a school and regarding the ethics of using new AI technology, the 'implications are certainly not yet fully understood' as Iphofen (2013, p.64) has explained. In order to satisfy any ethical

concerns regarding recording students conversations, both the teacher and I clarified each time the Echo Dots were going to be used and would record what was said to them. This was done primarily for ‘behaviour management’ purposes to reduce any misuse but also to try to communicate to students that the Echo Dots did record and save their data to Amazon. The full audio file of data that is produced is owned by Amazon but a text transcript is able to be used by the person whose account is linked to the device that recorded it.

3.1.2.5 Potential Negative Reactions

An issue that remains a source of anxiety is the possible future consequence of the research study. This is discussed by Hammersley and Atkinson (2007, p.218) who explain that negative reactions to the research might occur and implicate not only one’s own research but that of others and state that there is:

‘the fallacy of assuming that the researcher and the people studied will usually see the research in the same way’.

Further to this Hammersley and Atkinson (2007, p.219) explain that in terms of future consequences, as can often be found with life more generally, they unhelpfully state:

‘There may well be conflicting interpretations and clashes of interest; and there are no simple general solutions to such conflicts’

Rather than adopt the relaxed and pragmatic approach of Hammersley and Atkinson (2007) above, I am concerned that with interpretation, the research could present teachers and teaching in a way not intended. However, I have made clear in Chapter One that this thesis is not an indictment of teachers.

I am aware that the Echo Dots and the AI that powers them may likely be viewed differently in the future. I understand that there is a potential for future consequences from my research study given how the Echo Dots record conversation, or which in the future might be regarded as ‘surveillance’. For instance, placement of Echo Dots in a classroom amongst students and teachers is regarded as ethically responsible, but this might not be so in the future. A different, perhaps more negative perspective may be taken about research which used a method of surveillance to collect data from children. I have addressed my own concerns regarding surveillance via the data that was collected. I am confident that data collected, although a record of conversations between

people, was ‘classroom talk’ and there was no evidence of data or talk that could cause harm to an individual student or teacher. Also, currently, it does not seem that the AI of the Echo Dots can build individual ‘voice profiles’ to identify a student and link them to an interaction. This is likely to have been impossible because of the numerous student voices and high noise level during lessons. A personal concern remains however regarding potential longer term future consequences.

Despite the potential ethical dilemmas outlined, I devised a research design that was guided by personal and moral principles along with professional ethical principles to attempt to deal with power relationships, assent, consent and harm. The research study was regarded as both purposeful and necessary and of benefit to others so that it was ethically sensitive and oriented research. In this way, as Iphofen (2013, p.2) states, the research had at its core a ‘concern for the rights and well-being of research participants’ and was ethical research based throughout upon several guiding ethical principles. Acknowledging that research and researchers should be ethically responsible, the research study should have resulted in minimal harm and maximum benefits (Iphofen, 2013).

3.1.2.6 Working with Amazon and the NCSC

In terms of a potential conflict of interest, the Amazon Echo Dots used for the study were purchased by the University of Gloucestershire and were standard ‘2nd Generation’ Echo Dots. At the time of the study they were available to consumers. Although there was a working relationship with two staff at Amazon Web Services (AWS) this was in a role as teacher educator not researcher. I made two visits to the AWS London headquarters and Amazon staff did not assist with the research study, provide equipment or financial assistance. In the pilot and testing phases of the study a Wi-Fi router was borrowed from the National Cyber Security Centre (NCSC). It was used with the Echo Dot devices for short trials in other schools, two secondary schools and a primary school. The University of Gloucestershire funded the purchase of the Echo Dots and the Wi-Fi router which was used for the fieldwork. Monthly mobile data for internet connectivity on ten mobile telephones and the Wi-Fi router was self-funded.

3.1.3 The Research Design Rationale

Research of voice technology and epistemic curiosity in education was shown, through a critical review of selected literature, to be limited. It was problematic to establish the impact that a voice technology might have on students’ epistemic curiosity or how it

might be used as a digital version of a more knowledgeable other during teaching and learning. There was therefore a gap in the knowledge of the area created where epistemic curiosity, voice technology and pedagogical approaches converged.

It was not possible, at the time, to locate longitudinal naturalistic research of secondary school classroom teaching and learning with voice technology focused around the epistemic curiosity of students aged between 11-16 years old. The research design addresses this through the exploratory ethnographic study of voice technology and epistemic curiosity carried out over a period of two years to cover one academic year and which provides an interpretation of pedagogical approaches and students' epistemic curiosity in voice technology equipped classrooms in a secondary school. The aim of the research therefore meant that fieldwork would be required in real classrooms where everyday teaching and learning occurred. Through work as a teacher's assistant and participant observer a detailed understanding could then be gained of a wide range of lessons, subjects and pedagogical approaches some of which would not involve the Echo Dots. Accessing and participating in a wide range of lessons, with and without the Echo Dots, would be an important way to gain richer insights.

3.1.4 Why Ethnography?

The critical review of literature revealed that naturalistic research, or that which was conducted 'in-the-wild' to capture the everyday practices of teachers and students as they used voice technology was scant. In order to provide descriptions of the 'lived lives' of others and to be able to interpret their social behaviours, a methodological approach was required that allowed this to occur. In order to participate in and observe classrooms, an ethnographic approach was chosen.

Ethnography has been criticised for being based on interpretations which are subjective and not *scientific* and that it does not lend itself to generalisations and is not able to be representative (Herbert, 2000). However, by attending to these three criticisms through careful research design it is possible to provide a research study that accommodates the argued weaknesses and limitations of ethnography. For instance, by not claiming the study is generalisable beyond the case, that accountability for bias and reflexivity have been integrated into the research design and that a formalised process of data analysis has been documented, the weaknesses can be mitigated for or resolved. The issue of validity of an ethnography study will be discussed later in Section 3.2.1.

Bhatti (2017, p.85) has outlined that an ethnographic approach can advance a deeper understanding of social norms and provide detailed insider accounts of real environments over the longer term. Mills and Morton (2013, p.2) have explained that an ethnographic approach for educational research allows potential readers a unique insight into a system that is dynamic and complex by providing written accounts and stories of changes and developments that occur. Mills and Morton (2013) outline that ethnography is a perfect method to capture this dynamism and complexity. Atkinson (2015, p.3) has stated that ethnographic fieldwork presents researchers with ‘the most rewarding and faithful way of understanding the social world’ and schools are social environments. Atkinson (2015) describes ethnography as a way of sharing the everyday lives of people and that it is a deeply social endeavour and humane undertaking. Hammersley (1990, p.5) explains that because schools ‘socialize’ students, they warrant a research approach that can represent the social activity, processes and interactions that occur. An ethnographic approach was taken because, rather than starting from a well-developed theory, ethnographic research allowed the study to proceed inductively, and, through fieldwork and participant observation, produce descriptions, explanations and interpretations of phenomena towards developing theories (Hammersley and Atkinson, 2007).

In summary, given what was found in the literature regarding the features of ethnography, and accounting for criticisms, when these features were used to frame the research aim and objectives, an ethnographic approach was felt to provide a good fit. Ethnography would allow a subjective, interpretive and inductive approach that situated fieldwork inside classrooms as a participant observer to produce rich descriptions of everyday teaching and learning to generate insights into norms, social behaviours and facilitate theory building.

3.2 Methodological Approach

In this section I will outline how the methodological approach for the research study was developed. The process of formulating a research design was iterative and several possible options were explored, rejected or adapted. I have provided an explanation and justification for the final research design and methodology in this chapter.

From the beginning, and given the time available, the research study took a relatively open-ended approach, as Hammersley and Atkinson (2007) and Atkinson (1992a; 1992b) have described, despite having to be formally written in a ‘Project Approval

Form' (PAF). For the PAF, the research study did not have distinct stages but instead had some key phases and activities, which for Seale (2012) gives an ethnographic study a funnel structure whereby focus is developed as the research progresses which Hammersley and Atkinson, (2007) have also described. The 'funnelling' approach of being not fully worked out in advance aimed to allow the research design to develop as the research progressed, as Ball (1993) outlined, and respond to the many unknowns that would no doubt arise in an ethnographic endeavour in a live and real secondary school. Nonetheless, at the outset I was able to state that it would be an ethnography, would involve participant observation, be situated in at least one school and with a stratified sample of teachers and their classes and would span an academic year. I was confident therefore that my research design would allow a 'generative serendipity' (Mills and Morton, 2013. p.50) or, a loose set of rules that would form happily and beneficially by chance into a set of events. However, following the PAF, to commence what was an exploratory study, I remained nervous and anxious about gaining access to a school. From my experience of working inside as a teacher and in my current role, outside as a teacher educator, schools, teachers and students remained 'closed systems'. I also had to contend with the uncertainty of whether a new and untested technology would be feasible along with new and rising concerns over ethical responsibilities and privacy worries. There were also some personal concerns emerging over what I felt was my relatively open-ended research design and novice researcher status, despite being prepared and willing to be 'befuddled' (Mills and Morton, 2013) by the research design and process of researching.

The process of planning and executing an exploratory ethnographic research study that involved schools, teachers and students was from the outset not only time consuming and physical 'work' but emotional work also. I concur with Ball who, when reflecting on his research experiences at 'Beachside' school for his PhD, described how novice researchers undergo research problems, such as maintaining positive relationships with participants throughout fieldwork whilst working in a school, and the associated physical and emotional challenges that may be new to them (Ball, 1993).

3.2.1 Aspiring for Ethnographic Validity

As well as aspiring to conduct an ethically responsible research study, as outlined in Section 3.1.2, it was also a priority to ensure that the exploratory ethnographic study should aspire to achieve validity. What is understood in this research study as validity is outlined below along with measures that were taken to achieve validity, so that a

validity judgement can be made. This is because, as Maxwell (1996, p.86) has explained, validity is not guaranteed by adopting a procedure or by a suite of data collection methods but is dependent on the ‘relationship of your conclusions to the real world’. Within qualitative research, as Maxwell (1996) has described, there are several types of validity and these include: description, interpretation, theory, researcher bias and reactivity. There are steps a researcher can take, which Maxwell (1996) describes as a ‘checklist’, which can assist in working towards validity and these are: evidence of events, negative cases, triangulation, feedback, member checks, ‘rich’ data, ‘quasi-statistics’ and comparison (Maxwell 1996, p. 92).

In working towards achieving validity and to reduce researcher bias I have tried to ‘actively engage in critical reflection’ (Burke Johnson, 1997, p.284) by outlining my background and positionality and through ‘reflexivity’, remain self-aware and conscious of the potential for bias throughout the research study and the write up of the thesis. For the study, I aimed to achieve credibility and robustness by focusing on three other types of validity. Firstly, I have attempted to provide ‘descriptive validity’ (Burke Johnson, 1997) by reporting what was seen and heard by using observation, informal interviews and digital recordings from the Echo Dots. Also, at times where possible, I spoke with teachers about what occurred in their lessons using members checks (Maxwell, 1996). For example, when sensing that a teacher had been nervous using an Echo Dot for the first time, I later asked, if this had been the case, to which she remarked that it had been scary. Through these informal checks, I was also able to support my own perspectives, notes and observations, confirm interpretations and develop tentative ideas. I have also used data from transcriptions of interactions with the Echo Dots as a way of triangulating this data with data from teachers and fieldnotes.

Secondly, I have attempted to provide ‘interpretive validity’ (Burke Johnson, 1997) by performing an iterative ‘thematic analysis’ (Fereday and Muir-Cochrane, 2006; Braun and Clarke, 2006; Joffe, 2011; Clarke and Braun, 2017) of the data that was collected during the fieldwork to present insights and interpretations that were, at times where possible, informally discussed with teachers, as previously mentioned above, and considered against experiences from my own career of 15 years as a teacher. Finally, I have attempted to provide ‘theoretical validity’ (Burke Johnson, 1997) where patterns that became tentative notions in the discussion chapter could be identified and that the data supported them. In this approach I believe that I have worked to reduce researcher bias and through reflexivity remained conscious of avoiding ‘finding what I wanted to find and writing up the results’ (Burke Johnson, 1997, p.283).

There were two features of my research study that contributed towards validity and credibility which are pertinent to ethnographic research, as Cresswell (2014) and Cohen, Manion and Morrison (2000) have discussed. Firstly, the research study involved fieldwork within a real school and studied the everyday school life of students and teachers, reporting what they did and said, and this spanned two years and covered one full academic year. Secondly, the study took place in a naturalistic setting and through participant observation and informal interview was able to represent the thoughts, words and actions of a group of participants supported by digital recordings of interactions with Echo Dots. Together, the duration of an academic year and naturalistic setting enable interpretations to be generated that should provide a degree of credibility and validity.

I was able to conduct the research study in a school by working, not as an ‘insider teacher’ nor an ‘outsider observer’ (Cohen, Manion etc, 2000, p.310) but as a teacher’s assistant to provide an understanding, from neither teacher or student perspective, of an educational setting. The research design and the purpose of the study carried out provides a description of a particular case and explains what occurred during the time the study ran. Individual schools are different, however, there are similarities and commonalities such as, ‘Key Stages’ and ‘subjects’ and staff, timetables, assessments and teaching methods. It may be possible therefore to generate ‘qualitative generalisations’ (Coe, 2017, p.52) beyond the ‘case study’ school. However, (Cohen, Manion and Morrison, 2000, p.109) highlight that:

‘others can decide the extent to which findings from one piece of research are generalizable to another situation’.

To work towards data analysis validity I conducted the study following trials to test data collection methods and the Echo Dot voice technology that would be used. Also, to work towards data analysis validity I did not sample teachers directly but offered an open invitation for participation to all staff via email and thus reduced my personal influence upon selection of the sample. The use of transcripts from the voice technology, fieldnotes, and later in the study, photographs and teaching materials, enabled me to ensure that rather than work from memory, my analysis would be based upon physical artefacts collected at the time or that I had produced. For generalisability, as a qualitative ethnography, the study will only be able to provide information that might be used to generate insights on other problems or scenarios, as Day Ashley

(2017) has explained, or which may lead others to further research. Atkinson (2015, p.37) has described this form of qualitative or ethnographic generalisation, stating that,

‘our sense of ethnographic generalisation is not, therefore, of the same form as that applied to inference from a sample to a population’.

Using what Fereday and Muir-Cochrane (2006), Braun and Clarke (2006), Joffe (2011) and Clarke and Braun (2017) have described as a ‘thematic analysis’ of the data collected, I aimed to provide evidence of patterns or categories that could potentially be found in other similar schools. For example, schools in England deliver a ‘National Curriculum’ of subject focused ‘Programmes of Study’ and these similarities make qualitative generalisation possible because there are many structural and organisational similarities from school to school even if there are local differences in each school. ‘Qualitative generalisations’ (Coe, 2017, p.52) therefore might be possible in some areas for some instances of the interpretations presented and these might be as Atkinson (2015, p.376) explains used as ‘a network of cross-references, or inter-textual relations and of common conceptual apparatus’.

3.2.2 Consideration of a Range of Data Collection Tools

In terms of methodological validity, this section explores potential data collection tools and justifies the data collection tools that were used in the research study.

The research design began from an interpretive paradigm and did not adopt an existing methodology or simply choose a suite of data collection methods. It acknowledged that ‘not just any methodology is appropriate’ (Guba and Lincoln, 1994, p.108). As such, for the data collection tools, the aim was to produce a research design to gather the data that would allow the problems raised by the research objectives to be addressed (Cohen, Manion and Morrison, 2000). Several methodological approaches were initially considered. One approach could have been to ask teachers how they used the Echo Dots, when they used them and what they used them for and through a survey or a questionnaire produce quantitative data. However, this would have tended to generate numeric data about a set period of time when the survey or questionnaire was issued and not capture live behaviours that occurred over time. Additionally, reasons against a survey or questionnaire, came from personal experience of a previous educational research study. It had a low number of respondents and involved considerable time to

incentivise and encourage participation and was potentially therefore not representative, a concern that has also been outlined by Tymms (2017).

Questionnaires were felt to be open to different interpretations and unable to be changed as evidence emerged from question to question. I also felt that a survey or questionnaire completed by an individual gave a personal response which meant that it was difficult to capture group behaviours and interactions as they happened, in naturalistic settings in everyday tasks and activities, in real-time (Cohen, Manion and Morrison, 2000, p.179) and could fail to capture social complexity.

Educational research literature (see Anderson, 1989; Pole and Morrison, 2003; Mills and Morton, 2013) had shown opportunities for describing people in everyday life and their conversations and interactions. Interviews presented a possible method of achieving this but were felt to have inherent issues to be mindful of, that Kvale (1994) had highlighted. For instance, I felt that formal interviews with teachers would take their 'free' time and therefore may be difficult to carry out successfully. This had been the case in the previous educational research study. Interviews may have also taken time to arrange and schedule with teachers, as had also been an issue previously, and might also require teachers to recall or reflect on lessons that were several days ago. There are also inherent issues with formal interviews as identified by Cohen, Manion and Morrison (2000, p.267) who described issues such as, 'trust, power, respondent's unease and the interviewers skill in interviewing' which was something I felt to be relatively inexperienced and unskilled at.

An ethnographic approach would enable me to participate in lessons and observe teaching and learning and mean that there would be opportunities for informal interviews to take place from having direct access to teachers. I would be able to ask questions during quieter moments in lessons or during certain lessons and use my professional experience and knowledge of teaching and lesson planning to identify these opportunities. I reasoned that even if different questions were asked of different teachers and the process was less systematic, the depth and diversity of data generated would enhance the study. Informal interview through participant observations was therefore evaluated as being the most effective, efficient and appropriate method of engaging with teachers. Informal interviews would allow me to gather data in classrooms not only as it was created or generated but, importantly, when it was produced in a naturalistic setting.

Transcripts from the voice technology could provide a record of what interactions had taken place. Along with observational data and data from informal conversational interviews with teachers I would be able to ascertain when the voice technology was used and who used it and for what purpose. In order to critically analyse how a voice technology performed as a *digital* more knowledgeable other it would be necessary for me to be in lessons and to be around or with students to watch it being used and to observe and listen to what it was asked. I needed to establish if students used it to retrieve information and whether they used the device in the same or alternative ways to the teacher or another student.

Observation and participation in the classroom to gather data about how the voice technology impacted upon students' epistemic curiosity meant I would be able to contextualise what was asked of the voice technology in terms of the lesson, the topic being learned and the task or activity the students were undertaking. Along with the transcribed data from the voice technology I would be able to compare data I had collected in the classroom with what the voice technology had recorded.

I was presenting myself as a research 'instrument' to use my knowledge of schools and classrooms alongside unobtrusive and naturalistic methods of inquiry that would record the interactions between everyone in the classroom and the voice technology. Being present in the classroom daily would allow me to be responsive and also see everything that unfolded in the lessons rather than gather only smaller slices or segments of time (Cohen, Manion and Morrison, 2000, p.140)

For Mills and Morton (2013), education presents a worryingly unknown and uncertain place for researchers but ethnographic methods are able to cope with this. However, the open-ended approach and exploratory nature of my ethnographic study meant that the study felt for long periods like it was flailing uncontrollably and wildly between total failure and not failing yet. The best I felt I could achieve for a long period of time was not failing. External factors that could go wrong did go wrong. My anxiety was not assuaged knowing that 'failure is often at the heart of ethnography' (Mills and Morton, 2013. p.43) and that failure could benevolently bring a new perspective to my study each time it occurred.

I was confident that the study was important but seeing the end of it was beyond what I could comprehend during the fieldwork. I recall that this sensation remained with me until the final chapter of this thesis. My insecurities stemmed from my novice researcher status, the open-ended approach, a lack of model to work from and the uncertain and

new experiences that I knew were forthcoming, as was described by Ball (1993) at 'Beachside'. I understood, but had some trepidation, that by choosing an ethnographic study it would not be simple, straightforward or easy as Mills and Morton (2013) have described.

3.3 The Selected Methods of Data Collection

For Seale (2012), analysing a wide range of potential methods in the first instance, and discounting some over others, is so that appropriate methods are chosen given time limitations, the scale of the study and resources available.

This section explains how the data collection methods were selected in relation to the research aim, the case for the study, the participants and to achieve validity and reliability.

3.3.1 The Echo Dots

This section provides information on how the Echo Dots were deployed at Hillview School and presents how technical barriers were overcome. It presents the various attempts that were taken to reach a successful solution for using the Echo Dots outside of the home environment in a naturalistic setting of a school.

Whilst forming the research design and during the PAF process I ran a small test in a secondary school which resulted in a failure to connect a Google Home Assistant voice technology to a school network. This led to the first change of direction to the methods and research design and although worrying, because it seemed impossible to connect these types of devices to a school computer network, it shaped the final research design. Following this, a failure to then connect a set of Amazon's Echo Dots in a Primary school was more worrying because it meant that I had no other options regarding voice technology. It was not possible to authenticate an Echo Dot, or any consumer level voice assistant, on a corporate network due to the particular way these types of devices access Wi-Fi. I spent further time in two schools, a primary and secondary and worked with a Network Manager and established that it was not currently possible. This was a significant setback that meant I had to consider revisiting the research aim and research design. Before doing this, I considered alternative ways to connect the Echo Dots to Wi-Fi so they could be used in a school. I tested an Echo Dot using two mobile telephones and was able to connect an Echo Dot successfully using one telephone for mobile

internet and another to access the first telephone for access to the Echo Dots set-up software. The arrangement is shown below, in Figure 2.

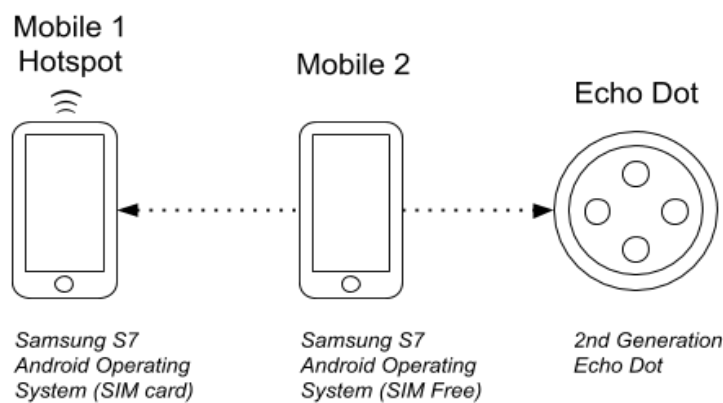


Figure 2: Technical set-up: Version 1.

Knowing that this approach allowed me to connect the Echo Dots, I then borrowed 10 mobile telephones from my university and took these with the Echo Dots to ‘Orchard Primary School’. I asked four teachers to use their own mobile phone for mobile data to provide internet access by a ‘hotspot’ and to access the Echo Dot software on the other mobile telephone. I agreed to refund the costs spent on mobile data for any internet access. It was a complex process that required teachers to go through multiple set up steps to authenticate the Echo Dot using two telephones, one of which needed to be constantly accessing mobile internet. The process failed often, and it would be necessary to start from the beginning. It was frustrating and extremely time-consuming and, for example, during one day from 8am until 4pm, I did not successfully connect any Echo Dots. Due to the technical complexity and time involved, teachers also found it very problematic. I visited three times over a few weeks to show them and was unsuccessful each time. For the time the Echo Dots were with the teachers, three of the four teachers encountered regular technical issues and found it extremely laborious and by the end of the pilot an Echo Dot had been used twice very briefly in one lesson.

I took three Echo Dots to ‘Hillview School’ which at this point I was considering as the location of the research study. Using mobile telephones I was able to set up devices for three of four teachers who had expressed interest. The pilot at Hillview School was also beset with failure after failure. For instance, the old buildings had extremely thick stone walls and it was not possible to access the internet from the mobile telephones in many areas, so teachers were limited to trying to connect the Echo Dots in only a few places

around the school. As some teachers encountered problems connecting, they began to switch telephones, uninstall or install software, change SIM cards, alter settings or swap Echo Dots. Some used mobile telephones to access music and play songs through a 'Bluetooth' speaker and subsequently used all the allocated mobile data. After having connection problems one teacher allowed a student to access the setup software and the student was able to alter the account details. For even a small pilot, the quantity and breadth of problems and issues was such that I was able to develop a 'Do and Don't' help sheet that was useful in the future. Importantly, I also developed an awareness of problems and issues that could emerge which would be used to inform and develop the final research design and approach to data collection.

Although being a source of anxiety and at times very worrying, the failures that I encountered developed the research design in a way that meant that when I started the research study at Hillview School, I was able to foresee and prevent problems. The added benefit was that I felt more able and informed to assist the Hillview School teachers who I later worked with. An outcome of the early work with teachers was the discovery of a 'battery base' that enabled the Echo Dots to be used without being plugged into an electrical wall socket (see Appendix 2). This meant that they became portable and the students and teachers were able to locate themselves wherever they wanted rather than be next to a power source.

Based on the experience I had from the pilots I lacked confidence in the Echo Dots as a viable data collection tool. Through conversations I had with an ex-colleague I was able to negotiate a visit to their school, 'Bridge Road School', to attempt to connect the Echo Dots to their new computer network that had been recently installed. I drove to the school with four Echo Dots and they were able to connect the Echo Dots without any additional adjustment or alterations required. Following email communication with the Network Manager I established that their type of computer network software supported 'Internet of Things' (IoT) devices. As an IoT device, the Echo Dots were able to connect immediately and quickly and could then run using the school Wi-Fi. However, this school was a considerable car drive away and I was not confident that I could gain access to the setting for a year or more. Emails from the school had suggested that a small temporary trial might be possible but not a one-year study. I decided to leave the four Echo Dots with them and through email asked my ex-colleague to use the devices if they could. I reasoned that this may provide some data further on in the project or be a

‘Plan B’ location I could approach should Hillview School not be possible or cease part way through.

In order to find a connectivity solution I contacted Google, two universities. I then contacted Amazon but was unsuccessful in acquiring a technical contact. I therefore decided to travel to York to try and make contact with Amazon developers who were hosting a conference on the educational potential of ‘voice-bots’. I was able to interrupt two developers backstage and ask for their email addresses. From this I spoke with Amazon via email but further attempts to connect the Echo Dots were all unsuccessful. As a last resort, I contacted the National Cyber Security Centre (NCSC) and after 3 months of emailing and trying different solutions that did not work the NCSC provided alternative information that led to a different solution. The NCSC lent me a Wi-Fi/5G router so that I could setup and run my own Wi-Fi network that the Echo Dots could connect to. It enabled me to produce my own personal mobile ‘school network’ that I could transport and deploy in the school and which I could then connect devices to. The final successful setup for the Wi-Fi router and Echo Dots used at Hillview School, is shown below, in Figure 3.

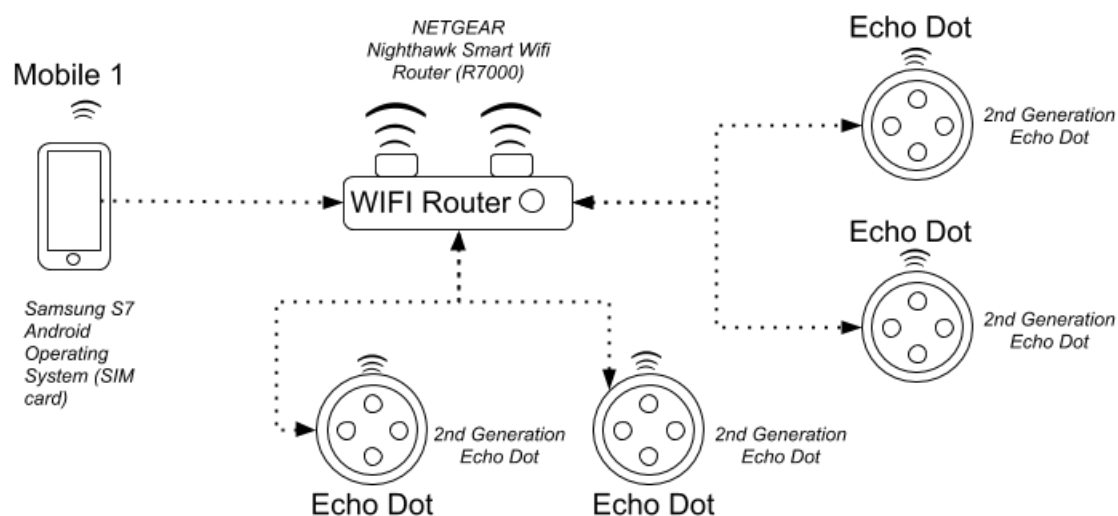


Figure 3: Final technical set-up of the voice technology used in classrooms.

At this point, whereas I had planned to deliver Echo Dots to teachers who would then plug them in and use them in lessons, it was clear that the research study had changed significantly. I now had to visit each school, negotiate a site for the router, set it up, connect all the Echo Dots and monitor them as they were used. The Echo Dots were distributed to students who placed them wherever they were working and moved them with them if they moved seats or positions during the lesson. The final equipment that I

took to Hillview School is shown in a photograph in Appendix 1 and a photograph of the first working Echo Dot being used in a lesson is shown in Appendix 2.

I had a working set of Echo Dots and had secured access to a setting and was able to begin participant observation in Hillview School. While waiting for clearance to work in the school and as I completed my safeguarding training, no Echo Dots could be used and I could not participate in lessons. As there were no Echo Dots being used an opportunity emerged to collect data before the Echo Dots were deployed across a wide range of subjects and lessons.

3.3.2 Transcripts from the Echo Dots

This section explains how and why transcripts from the Echo Dots were used. I have previously outlined my ethical responsibilities in Section 3.1.2 because of the potential for the Echo Dots to be regarded as a surveillance device. With these in mind, I remained committed to using the Echo Dots as a data collection tool believing, that at the time, their usage was ethically responsible.

An Echo Dot is activated by a spoken ‘wake’ word and talk that is heard by the microphones after the wake word is recorded and saved. A transcript of the saved recording is provided to the owner of the device via a web page. The transcripts are provided through the ‘Amazon App’ installed on a smartphone or they can be accessed through an internet browser as shown, in Appendix 3.

The Echo Dots were used as a data collection tool because of their capacity to record spoken interactions with users. There were some technical issues associated with recording speech in a classroom due to the noise created by 30 students in one room. In full classrooms with many students and to mitigate background noise interference, each device was given an ‘alias’ so that it was not ‘woken’ by other students. It also made identification of individual Echo Dots in the transcriptions possible as can be seen, in Appendix 4.

Despite these steps there was still interference at times from students attempting to wake their device but inadvertently waking another further away or by Alexa mis-hearing sounds that were interpreted as the wake word. This is referred to in an email from Amazon as ‘false wakes’ (Dash, 2019). Transcripts from the Echo Dots, at the time of writing, cannot be downloaded or saved in bulk. In order to collate the

transcripts for analysis an individual page was visited and a copy was then manually pasted into a spreadsheet. Erroneous rows were manually removed and basic formatting was applied. This was a time consuming process and inefficient but produced a single data set which was then searched or sorted or filtered as part of an initial analysis. Through this initial analysis it was possible to identify patterns that were not possible viewing the data page by page.

The dataset of transcriptions of interactions that was downloaded and saved into a digital database was saved and stored in a secure cloud storage folder that required a username and password to access it. In the early phase of analysis I also created a separate file for each Echo Dot, and these were also stored securely in cloud storage also.

3.3.3 Participant Observation

This section explains why and how participant observation was used.

Ethical responsibilities guided my actions and behaviours these were pertinent to my participation in lessons as a teacher's assistant. Choosing participant observation as a method of data collection required me to take on the role of a member of staff and researcher. Ball (1993) has described the challenge of being embedded and Mills and Morton (2013) have outlined the challenge of working and researching. A tension between participation and observation was surfaced when working as a teacher's assistant. Aside from the difficulties of helping students and the teacher and trying to observe and make fieldnotes, as a teacher I was used to viewing the classroom from a 'pedagogical perspective'. A tension that emerged was that I was a researcher and although assisting teachers in lessons, as Mills and Morton (2013, p.52) have explained, the 'role of the researcher must come first'. Over time this became manageable but in the pilot study, thinking like a teacher was inevitable and was something that I had to account for when analysing and interpreting the data from the study (Mills and Morton, 2013). However, the 'dual-personae' perspective of teacher and researcher, as Mills and Morton (2013, p.2) have described it, enabled a richer and more vivid account to be generated.

Participant observation is as Atkinson (2015, p.40) has described not 'merely watching, or concentrating on the purely visual aspects of everyday life' but as Atkinson (2015, p.40) explains, it is being:

‘attentive to the multiplicity of actions - spoken and unspoken - and of social actors, material culture, spatial and temporal arrangements that together constitute the field’.

I understood that participating as an observer, by becoming a teacher’s assistant in the lessons, meant that I had to go beyond providing reflections on what I saw to produce an analytic report of the social world of the classroom and make systematic sense of it as Atkinson (2015) has explained.

For the exploratory study of behaviours, participant observation was a key method of collecting data because as Hammersley and Atkinson (2007, p.18) explain, ‘all social research is founded on the human capacity for participant observation’.

3.3.4 Fieldnotes

This section explains how and why fieldnotes were used.

Despite Sanjek’s (1990, p.7) claim that ‘fieldnotes however, are imprecise’, fieldnotes were pertinent to the ethnographic research study and considered the most effective way of ‘trapping’ social behaviours and actions in a permanent format. Having considered video and photographic recording, fieldnotes were feasible and a way for the research study to remain ethically responsible, possible and also adhere to data collection and storage legislation and law.

Fieldnotes took the form of handwritten jottings, stems or prompt words that were recorded in pads (see Appendix 5), or on paper, print outs or worksheets which were written up in more detail at the end of every day. Fieldnotes recorded how many students were in the class, where students sat and where they moved to. A seating diagram was drawn for every class indicating Male or Female students or other pertinent individual data such as ‘teaching assistant sat to left’. The hand-drawn diagrams were developed into digital ‘heatmaps’ to visualise talk in lessons and these are explained in Section 3.5.1.1.7 and the developmental process illustrated in Appendix 8.

During participant observation in lessons, I recorded who spoke or answered a question using tally marks and drew lines to show where the teacher walked or where students walked. I noted how many times a teacher stood in a particular place, or which students had how much time with the teacher. I noted which students remained silent and made

notes in the form of questions or prompts for thinking about incidents or events in the classroom. For instance, one entry reads ‘Jon has said nothing in this lesson. Same as last[?]’. I recorded phases of the lessons, times the teacher talked and for how long and I also recorded the topic being taught and what artefacts or equipment was used. I made reflective notes alongside my field notes that described some of my perceptions of students or the classrooms. One entry reads, ‘Classroom walls shabby, old white paint, grease spots, A4 sheets stuck to wall (next to Ts desk) really old’. I aimed to create a ‘written representation of a culture’ (van Maanen, 1988, p.1.). The recording of fieldnotes, as Hammersley and Atkinson (2007, p.140) have noted ‘is much more significant and time-consuming’. I found that because creation and analysis was time consuming it led to unforeseen themes emerging and was a beneficial process.

I relied upon the method of fieldnotes to record what I had observed or had taken part in. However, I was conscious that, as van Maanen (1988, p.35) has explained:

‘there is no way of seeing, hearing, or representing the world of others that is absolutely, universally valid or correct’.

Fieldnotes captured the experiences I observed in the classroom and no claim is made that they represent a universal truth. As such, fieldnotes were an intensive process that was a cause of angst because it was difficult to establish if they were representative or if I had written enough and if my writing and note making had been effective. They also raised the moral issue of a researcher’s interpretations of the behaviours of others which then became a document and written record. I became aware that fieldnotes I produced ‘carried quite serious intellectual and moral responsibilities’ (van Maanen, 1988, p.1). In an attempt to try to reduce these concerns, conversations with teachers helped clarify some points and to add valuable information to the data and to assuage my worries and to help me feel I was making valid and reliable fieldnotes. My aim upon completion of the thesis was, as (van Maanen (1988, p.29) has stated, to be ‘empirical enough to be credible and analytical enough to be interesting’.

3.3.5 Informal Interviews During Fieldwork

This section explains how informal interviews were used.

For informal interviews I was guided by my ethical research responsibilities and data was gathered from the public space of classrooms. Staff and students had received notification from the headteacher about the forthcoming research study so that my

presence was 'overt'. I was present in teachers' classrooms by invitation and they knew that this was a research study that would involve their use of the Echo Dots and the study of their use by both students and teachers. I was conscious to manage teachers' impressions of me, so during fieldwork any conversations were explained in advance and regarded by all as an 'informal interview'. When I engaged in talk with teachers I often stated to teachers, 'I'm going to note that down as data, if that's OK'. There were no formal timings or agreed times for the informal interviews, but generally as often occurs in classrooms, conversations happened when possible during lessons or during breaktimes. I tried to avoid making unreasonable demands on their time and selected times based on knowledge of their workload, teaching time and available free time on their timetables. I was conscious that anything I recorded and then wrote up in fieldnotes and then included in this thesis should be available to read so if a conversation took place around me, I made myself known as a researcher. Discretion and privacy needed to be evident when I was around the school and amongst teachers. I was placed in lessons where staff that had agreed to participate but involvement in other lessons and interactions with other staff were inevitable. This required careful management of relationships with staff throughout the study.

When talking with teachers or other staff, I also made mental notes to refer back to or noted down words to prompt my memory later. I often used a laptop computer to manage the Echo Dots and to monitor their use so I was able to keep a file open into which I could also add digital notes. Using the laptop meant that in the evenings I only had to expand on my notes which allowed me the opportunity to add screenshots of worksheets, resources or other classroom artefacts. All fieldnotes from informal interviews were transcribed into more detailed descriptions and explanations at the end of every day or at the latest, the day after.

Informal interviews were a way to become involved in talk with teachers to discuss what was occurring in the lesson and to understand their motivations regarding teaching and learning and the various methods and strategies that were employed. It was also a method to collect background information regarding specific students to understand more about them. Conversations with teachers were frequent and proved to be useful in developing a better understanding of insights that emerged and assisted with validating some insights and understandings.

3.3.6 Use of Email

This section explains the limitations that email had as a data collection tool.

Personal experience of working in schools meant I was aware that email was an important communication method for teachers because emails can be attended to when time is available. I was aware that teachers used emails as a list of work to attend to. Emails provide teachers with a way to save time because information can be sent without making a physical journey across the school. As such I knew that by using email, I would be working with a system that teachers already used and valued for its usefulness and time saving. I also wanted to avoid face-to-face meetings where possible due to the demands they place on a teacher's time. Email addresses were gathered when teachers at Hillview School expressed an interest in participating and stored securely as a group of personal contacts in my university email address book and were not available to other people. Each email that was sent and received was archived into a folder that was organised by the school's name to provide me with the 'thread' of what was discussed by topic, date and time. I copied the content of every email into an electronic spreadsheet arranging the data into a more readable format, taking out names, headers and footers, logos, images and electronic signatures. The emails were later used to validate the early insights generated from the data that was collected at Hillview School by confirming classes, work students carried out, numbers of students and other contextual data along with some comments from teachers that helped me understand contexts of lessons or topics studied. For example, a teacher explained why the Echo Dots were not to be used in a lesson where they were normally used due to a test taking place.

Although envisaged as a potentially productive data collection method, emails produced limited data. They were however, useful for communications with staff and for helping to manage relationships with staff and gaining some supporting data from staff and as with informal interviews, were useful for contextualising teaching and learning and for validating insights.

3.4 Fieldwork During the 'Case' Study

This section outlines the 'case' that was studied and presents a chronological account of the phases of fieldwork that took place at Hillview School. It provides a description of the processes that were used to collect data during each phase.

In the pre-study PAF, I outlined that I would situate the study in a single school. The final case for the research study became a group of teachers at Hillview School who worked in several different teaching subject areas and taught the full range of students across all year groups.

3.4.1 September 2017 to December 2017 (3 Months)

The choice of school where the research study took place was, for logistical reasons, determined to be accessible by a short car journey. It was also chosen because from previous requests to schools, access had proved difficult when seeking a school for a pilot. However, the primary reason for choosing the school was that in my experience and knowledge of a wide range of local schools, I felt that it represented a typical school. During my teaching career I had worked with all the 44 local secondary schools, including Hillview School and I was aware that many features of education were typified within Hillview School. Conversations I had with the headteacher during previous meetings both formal and informal also led me to believe that Hillview School presented me with a setting where the research study would be able to be completed. The choice of Hillview School was based upon logistical, pragmatic and methodological reasons combined with personal experience and knowledge of numerous local schools and agreement from the headteacher that the study could run for as long as was needed.

Hillview School's headteacher was the primary gatekeeper who provided me with access to the school. My ethical responsibilities regarding access have been addressed in Section 3.1.2.2. I was presented with the challenge of gaining access and then maintaining it, something I had not experienced before. My tensions at this point were therefore twofold because in order to begin a research study in Hillview I needed permission from the headteacher and to complete the study. I also needed to maintain access for the duration of the fieldwork which was likely to span two years in order to research a full academic year. Gaining access however was unproblematic and the headteacher was supportive and enthusiastic. Maintaining access remained a source of anxiety however because of the effort and difficulties of maintaining relationships with teachers to gain access to their classrooms, particularly at busy times or key points in the academic calendar, such as during examinations. Also, because I was using an Amazon 'product', at times I felt like a salesperson advocating for the Echo Dots.

By the end of this phase, in December 2017, it was evident that the case was a self-selected sample of teacher participants who were enthusiastic to work with and explore voice technology in their classrooms. It seemed from email and conversations with teachers, that teachers who participated felt that they had both the time and opportunity to use the Echo Dots and that they could see potential educational benefits even if they did not know at that point what these were.

3.4.2 January 2018 to March 2019 (15 Months)

During the first few weeks of this phase of the research study I had some significant concerns about the voice technology I had selected to use in Hillview School because it had proven hard to set up, difficult to use and in several cases failed to produce any data in the test classrooms. A month of this phase was spent testing and trialling Echo Dot devices and communicating with AWS and the NCSC for solutions. Although the Echo Dots were proving troublesome, I dedicated two months to working in multiple classrooms as a teacher's assistant to become familiar with teachers, classrooms, pedagogical approaches and the school more broadly. During this phase I spent either one or usually two full days every week working at Hillview School.

During this phase I eventually found a solution to the technical problems encountered and was able to deploy Echo Dots around the school to teachers. It was during this period that fieldwork began that involved the Echo Dots and where the majority of the research data was collected.

3.4.3 July 2019 to December 2019 (4 Months)

I had planned to finish the fieldwork in July 2019 so that I had observed a full academic year of teaching and learning which had spanned two years. The intention was to formally close the research study by visiting teachers and collecting the Echo Dots, then gather feedback or answer any questions or queries via email. I collected all the voice technology and removed it from the school at the end of the academic year in July 2019. During this period, I remained in contact with the headteacher of Hillview School through my work at the university. This phase is regarded as the exiting phase and fieldwork was intermittent and was surfacing data that had become repetitive.

3.4.4 January 2020 to March 2020 (3 Months)

I had identified some patterns and early categories and I began to see these being repeated which illustrated that I had observed as much at this point as I was likely to

see. I had reached the point where the areas I had looked at had become ‘saturated’ (Bryman and Burgess, 1994. p.5).

I had exited the field and no longer worked as a teacher’s assistant at Hillview by July 2019. However, following my initial interpretations of the data I then felt it necessary to return to the school to use of the Echo Dots to explore suppositions and early insights I had developed and to confirm some initial thoughts. When I re-entered the field to work with four different teachers, I hoped to confirm that I had reached ‘data saturation’ and would only be collecting similar data and that data would support my initial interpretations. It became clear early on that this was the case and that the timing of my re-entry into the school was proving distracting for teachers due to the demands of a new term. I communicated with the two teachers via email until December discussing how the Echo Dots might be used or their plans to use them. One teacher used the Echo Dot in one lesson to find facts from the internet to support a student research activity. I exited the field at the Christmas break. This phase is regarded as the ‘re-entry’ and the conclusion of the research study phase. Shortly after this phase schools across England closed due to a pandemic.

3.5 Organising and Structuring the Data

Through structuring and organising the data my goal was to ‘know’ the data (Hammersley and Atkinson, 2007, p.162). I was conscious that any analysis of the data needed a systematic and organised approach which would then lead to something new being revealed in the data by the analysis. From the fieldwork at Hillview School throughout September 2017 until March 2020 I collected a data about the school, the classrooms, the teachers, the students and the interactions I had observed. Many fieldnotes, on reading them after the fieldwork had finished, contained descriptive data unrelated to the aim of the research study and were therefore ‘selected out’. For instance, some data described the experience and career path of teachers or the colour and state of paint on the classroom walls. Often written in a reportorial style this data was useful during the early phase of fieldwork as a way to know the school but was contextual and unrelated to the aim of the research study.

My goal to develop a systematic and organised process of data collection and analysis emanated from the collection of scraps of paper, emails, electronic transcripts and fieldnotes I had accrued. The ‘raw’ data was produced from an ethnographic study that took place over two years in schools and was a mixture of digital and paper based data

in boxes or in computer folders. Nonetheless, this had still been a semi-organised approach in that I had established a way to ‘control the data’ as it was produced (Richards and Richards, 1994, p.148.) I was conscious that my initial approach should be to collate and filter that which was relevant from that which was not and convert data into either a single paper or electronic form for consistency and practicality. The choice was made to convert all the data into a printed paper format for two reasons. The majority of my data was on paper and from very early on in the study I had made initial insights and interpretations by annotating handwritten notes. These had become ‘promising analytic ideas’ (Hammersley and Atkinson, 2007, p.150) some of which I would end up developing into interpretations. Also, I was comfortable reading and annotating paper based materials because of their physical form and the ease and immediacy of having paper and pen or pencil to hand when an idea or thought emerged. It also meant that the data became portable and could be taken with me when I moved from location to location and that I was also then free from the digital distractions of being online. I also chose not to use a computerised system for the analysis of my data because I felt that a digital system would not replace a data analysis processes that would still need to be done manually (Hammersley and Atkinson, 2007) at times. Also, dealing with the qualitative data ‘problem’, as Colley, (2010, p.183) refers to it, the combination of constraints on time along with a limited understanding of the available software resulted in the choice of manual methods.

The first stage of dealing with the data was therefore to generate a set of data that was in one format and accessible in terms of the preferred way of working. The set of data, when finally structured and organised, represented almost two years of the research study. The data set was then analysed using what Fereday and Muir-Cochrane (2006), Braun and Clarke (2006), Joffe (2011) and Clarke and Braun (2017) describe as a ‘thematic analysis’. The next section explains the process of thematic analysis in more detail.

3.5.1 Thematic Analysis of the Data

This section describes how a process of thematic analysis was arrived at using literature from Fereday and Muir-Cochrane (2006), Braun and Clarke (2006), Joffe (2011) and Clarke and Braun (2017). It also describes the process from the selection of data, to coding, to themes and heatmaps and ends with the final themes that were revealed.

The nature of the data collected during the study meant that it was open to interpretation as is often the case with qualitative approaches (Castleberry and Nolen, 2018). A challenge therefore was to identify a suitable and effective method that would allow an open-ended collection of data to be analysed. An issue in the first instance was to produce a systematic procedure that could be used as a form of process to ‘interrogate’ the raw data. A strategy was required and Fereday and Muir-Cochrane (2006, p.82) provided a ‘step-by-step process’ described as thematic analysis which was:

‘a form of pattern recognition within the data, where emerging themes become the categories for analysis’.

The basic tenet of their process is an iterative and reflexive approach that begins with the development of ‘codes’ that are then tested before the data is summarised and initial themes are identified. There then follows a phase of applying the codes and then a final corroboration and legitimisation of the codes. Another step-by-step process of thematic analysis is presented by Braun and Clarke (2006, p.6) who acknowledge that ‘there is no clear agreement about what thematic analysis is and how you go about doing it’ and go on to highlight that it:

‘involves a number of choices which are often not made explicit... but which need explicitly to be considered and discussed’.

Nonetheless, Braun and Clarke (2006, p.15) provided guidance on what counts as a ‘theme’ and explain that thematic analysis is a:

‘search across a data set - be that a number of interviews or focus groups of range of texts - to find repeated patterns of meaning’

Braun and Clarke (2006) go on to describe a phased process that begins with a familiarisation with the data that includes the transcription of verbal data that leads to generating initial codes. The data is then searched for themes following which the themes are reviewed before they are defined and named. The final phase is the production of a report which Braun and Clarke (2006, p.22) outline:

‘tells the story of your data in a way that convinces the reader of the merit and validity of your analysis... [and] provides a concise, coherent, logical, non-repetitive, and interesting account of the story the data tell - within and across themes’.

For guidance on what the report should achieve, Braun and Clarke (2006, p.22) explain that the write up must:

‘provide sufficient evidence of the themes within the data - i.e., enough data extracts to demonstrate prevalence of the theme’.

Which Braun and Clarke (2006, p.22) elaborate upon further by stating that researchers should choose:

‘particularly vivid examples, or extracts which capture the essence of the point you are demonstrating, without unnecessary complexity’.

Unlike Fereday and Muir-Cochrane (2006) however, Braun and Clarke (2006) identify pitfalls of thematic analysis that should be avoided which include substituting extracts from the data instead of presenting an analysis, using the research questions as themes instead of generating themes and producing themes that are weak or poorly formed. The two final pitfalls of thematic analysis Braun and Clarke (2006) present are that claims that are made are not supported by the data and that theory and analytics claims are mismatched. In this situation, thematic analysis diverges from interpretation and becomes unsupported and produces claims that cannot be connected with any data that was collected. From synthesising the information presented by Fereday and Muir-Cochrane (2006) and Braun and Clarke (2006) I was able to develop the ‘Thematic Analysis Process Used’, that is shown below, in column three of Table 1, below.

Table 1: The process for a thematic analysis of the raw data

Fereday & Muir-Cochrane (2006)	Braun & Clarke (2006)	Thematic Analysis Process Used
	Familiarisation with the data	Familiarisation with the data
Development of Codes	Generate initial codes	Generate initial codes
Testing of Codes		Apply codes and review
Data summary/initial themes		Identify initial themes in data
Apply codes	Search for themes	Review themes/reduce down
	Review themes/define/name	Apply final themes
Corroborate/legitimise codes		Structure data by themes
	Produce report/story	Produce ‘significant interpretations’

Based on the process outlined in Table 1, above, an explanation of the process of thematic analysis that was undertaken is presented in the next sections as ‘Phase One’ and ‘Phase Two’.

3.5.1.1 Phase One

3.5.1.1.1 Stage One - Separating Relevant from Not Relevant.

It was apparent that early in the fieldwork that the approach of ‘write down everything’ had yielded a quantity of data that by the end of the fieldwork, had been identified as irrelevant. This irrelevant data was therefore able to be excluded. For example, data that described the physical features of the school, autobiographical vignettes of teachers, their professional histories and career information along with physical descriptions artefacts in classrooms and school administration documents and policies. However, it is noted that data which was now superfluous did contribute to the research study because it provided a broader understanding of the school, how it operated and how the fieldwork should proceed.

By the end of the fieldwork, students’ interactions and behaviours with the Echo Dots, the teacher and each other had become the focus and informed the final data selection. When the final selection of the data had occurred, the dataset was formed from participant observations in classrooms and transcriptions of interactions with the Echo Dots in classrooms. Other data, for example, data regarding the seating positions of students in the classrooms and teachers movements about classrooms has been included because it is integral in providing a context for the interpretations and discussions that are presented later in chapters 4 and 5.

3.5.1.1.2 Stage Two - Re-writing and Expanding Fieldnotes.

With the final ‘dataset’ it was necessary to expand the keywords, notes or jottings and diagrams that had been collected and revisiting it produced a single legible dataset. This was often done at the end of each day of fieldwork when the experience was still fresh. Numerous hand drawn diagrams had been produced and these were re-drawn digitally and annotated and labelled with lesson number, day and date (see Appendix 8). Photographs had been taken of empty classrooms, materials and equipment and the Echo Dots in positions in the classroom and these were organised and saved as a common filetype of ‘.JPEG’ to secure cloud storage.

3.5.1.1.3 Stage Three - Dealing with the Transcriptions from the Echo Dots

An Echo Dot records each spoken request and the recording is stored on Amazon's cloud storage as both a text file and an audio file. Over the period of fieldwork a large quantity of data from spoken requests was created and collated as the fieldwork progressed. At the end of the fieldwork, data was saved from the cloud storage and transferred into a word processing document where extraneous information such as page numbers, download time or text formatting such as text colour was removed. This produced a document of raw data that contained every spoken interaction with an Echo Dot that was recorded throughout the duration of the fieldwork at Hillview School.

The document of raw data was then categorised into 'data per device' which was then sorted by recorded date and time. This resulted in one document that was structured into four tables of data, one table per device. Placed alongside each other the individual data were positioned relative to each other by time so that the data provided a visualisation of 'real-time' requests to each device, shown below, in Figure 4.

Amazon	Echo	Computer	Alexa
		what time is it Today at 15:10 on Computer2	
	drop by kohls Today at 15:01 on Echo	no Today at 15:01 on Computer2	
	echo Today at 15:01 on Echo	repeat Today at 15:01 on Computer2	Today at 15:00 on Alexa
what are the fossil fuels Today at 15:00 on Amazon	echo what is an advantage of one Today at 15:00 on Echo	sticker Today at 15:01 on Computer2	identify Today at 15:00 on Alexa
Text not available. Click to play recording. Today at 15:00 on Amazon	Text not available. Click to play recording. Today at 15:00 on Echo	Text not available. Click to play recording. Today at 15:00 on Computer2	
	echo what is a Today at 15:00 on Echo	what are the deals Today at 15:00 on Computer2	alexa Today at 15:00 on Alexa
	echo what is Today at 15:00 on Echo	no Today at 15:00 on Computer2	
when is your birthday Today at 15:00 on Amazon	echo Today at 15:00 on Echo	no Today at 15:00 on Computer2	alexa Today at 14:59 on Alexa
Text not available. Click to play recording. Today at 15:00 on Amazon		repeat Today at 15:00 on Computer2	alexa Today at 14:59 on Alexa
stop just turn it down a soul Today at 15:00 on Amazon	echo Today at 15:00 on Echo	Stop Today at 15:00 on Computer2	
		repeat Today at 15:00 on Computer2	alexa Today at 14:59 on Alexa
no Today at 15:00 on Amazon		alexa Today at 15:00 on Computer2	alexa Today at 14:59 on Alexa
stop Today at 15:00 on Amazon		what does sofa close Today at 14:59 on Computer2	

Figure 4: Data per device with time of recording

Presented in this way, the data documented the spoken interactions that took place throughout the lessons which could then be compared with observational fieldnotes that were written. For example, a fieldnote described two students using an Echo Dot at a specific time in a lesson and was then analysed by looking in the transcript to see what had been said to the Echo Dot. Occasionally the fieldnote and extract from a transcript was also checked or discussed with the teacher of that lesson. In this way the data was triangulated for validity and a richer picture of the spoken interactions was developed.

The final document of raw data from the Echo Dots was ‘parsed’ which involved reading and annotating each device’s data identifying commonalities, discrepancies or surprising or unusual content. For example, a pattern of ‘false wakes’ was easily observed in the data, listed as ‘Text not available’. In this way the ‘parsing’ allowed an initial understanding and overview of the data to be gained but also provided an initial understanding of the potential scope of the data that had been collected.

When the first parsing of the data had been performed, numerous ‘themes’ were generated but some themes appeared to overlap with others and data could be found in two or more themes. However, several interesting themes had unexpectedly already emerged and became a significant turning point in the research study as potential insights appeared indicating that the data may prove fruitful.

A second parsing followed whereby a potential theme that had been generated from the first parsing, was pursued once more through the data by re-reading the whole of the raw data again for each device to explore the potential of each theme. This process was repeated several times over several weeks whereby after a parse the data was then left untouched before being returned. Through this iterative process certain themes became further supported by the data and each parse allowed data to be either added or removed. This stage led to a set of possible initial themes being identified in the form of a longlist of initial themes, see Figure 5, below.

Pedagogical Approaches (Part One: pre-Dots observations)		More Knowledgeable Others (Part Two: Observations in class of Dots)		Epistemic Curiosity (Part Three: Transcripts and in class observations)	
TEACHING TECHNIQUES, COMPLIANCE, ARTEFACTS	PERFORMANCE ORIENTED, TRANSACTIONS	INTERACTIONS, TALK, DIALOGUE, TEACHERS TALK	COLLABORATION, COMPETITION, ANXIETY, CONFIDENCE	STUDENTS, CONTROL, KNOWLEDGE	QUESTIONS, TRANSACTIONS, KNOWLEDGE
They have learned to listen. She is telling students off again, reprimanding	Some try to offer excuses or answers but they pick up pretty quickly that this is	One student, male, offers the excuse of “I came and saw you this morning and you said	During the lesson the students once again are speaking constantly to Alexa, they are handling	Martin says he would choose the dot “because it’s easier” and says “a book you have to look at loads of stuff it’s	When Lewis asks the same question over and over he is looking to confirm what he knows or find an answer that he

Figure 5 Long List of initial Themes

3.5.1.1.4 Stage Four - Forming Initial Themes

The data from each initial theme was removed from its theme. These extracts of data were then grouped and combined with similar data to make connections that produced a series of categories that collated several themes together. Using an iterative approach this process was then repeated which involved returning to the raw data and selecting one or two additional pieces of data or excluding some which were identical or

extremely similar. In this way the initial themes were refined by blending both data and categories together and adding and removing data until a shortlist of themes emerged.

By the end of this phase and by working through the four stages the process had generated a set of key themes which the data supported and was now organised around (see page 74, Table 1).

3.5.1.1.5 Phase Two

Phase Two was concerned with the data which had been organised ‘thematically’ by the four stages in Phase One as part of a process which was outlined in Table 1, previously (Fereday and Muir-Cochrane, 2006; Braun and Clarke, 2006).

In terms of the final structuring and organising of the data, Phase Two of the process has two sections which outline the final two stages of the thematic analysis that took place. These two stages, ‘Coding and Themes’ and ‘Heatmaps’ are presented below.

3.5.1.1.6 Stage One - Coding and Themes

All the data that had been selected were collated and printed to a paper based format. An example of the printed data is shown in Appendix 6, where colour-coded extracts are also shown to demonstrate identification of data for themes. The printed data was then read through and annotated by hand to indicate an occurrence of a theme or to identify new or emerging themes to further corroborate it. At this point artefacts such as worksheets, photographs and classroom maps and diagrams that had been drawn were included and placed into an existing theme or if required a potential new theme was produced.

At this point the themes of ‘Worksheets’, ‘Artefacts’ and ‘Classroom’ were established. Subsequently, following further reading and analysis the themes of ‘Dialogue’ and ‘Talk’ were established which with further interpretation and reading eventually became ‘Performance Talk’, ‘Regulativity’ and ‘Metricalisation’.

The data was then ‘re-parsed’ using the most recent themes during which these themes were then renamed to better reflect the data they now represented. A final parse resulted in no change or adjustments and when applying the themes to the data, it also resulted in no further adjustment. It was decided at this point that the process had been completed. This result was 10 themes that were considered to be the final categories that represented the data, and which should be used to proceed.

The final ten themes were ‘Power’, ‘Control’, ‘Performance Talk’, ‘Metricalisation’, ‘Regulativity’, ‘Artefacts’, ‘Social’, ‘Compliance’, ‘Pedagogy’, ‘MKO’ (More Knowledgeable Other), The final 10 themes became the ‘thematic framework’ (Ritchie and Spencer, 1994, p.180).

A final thematic analysis and reading of the data categorised under these ten themes resulted in minor adjustments of individual data being moved or removed from themes until the ten themes and associated data were regarded as a ‘best fit’. The final 10 themes are presented in Chapter 4.

The data was also organised under two top-level categories of ‘Classroom Observations’ and ‘Echo Dot Transcriptions’. These two categories separated data collected by the researcher and data collected by the Echo Dots, The two top level categories were then used to structure Chapter 4.

3.5.1.1.7 Stage Two - Heatmaps

A problem encountered early in the fieldwork was how to participate in lessons as a teacher’s assistant and simultaneously record data. The practical challenge was to physically record data whilst working with students in the classrooms. An additional challenge was that there were three sources of data which produced data simultaneously: the teacher, the students and the Echo Dots. For instance, a student talked to an Echo Dot or another student, whilst another student talked to the teacher and another student talked to an Echo Dot, during which time the teacher may have talked to the class or other students. There were multiple synchronous data being generated.

This problem was resolved by ‘partitioning’ parts of the lesson based on my own knowledge of how lessons were taught to switch focus from one data source to another data source. For instance, at the start of lessons the students would sit silently and the teacher would talk meaning I could capture data from the teacher then switch momentarily to the students then back to the teacher. Although this did not solve the issue of synchronous data being generated it allowed me to capture data more effectively than if partitioning had not been used. Also, some of the data collection was ‘handed-off’ to the Echo Dots which recorded what was asked to them meaning that there was scope for focusing on other areas whilst the Echo Dots recorded data. In this

way I had data from several sources and was able to cross check and verify data from source to source over time to work further towards validity.

During fieldwork a way to record who talked and how often and to who was developed which later proved effective in visualising the talk that occurred (see Appendix 8). The method adopted was to draw the arrangement of desks quickly upon entering the classroom, then as students sat down, to label students as M or F for male and female and number them. During the lesson a hand-drawn pencil dot would be placed next to a named and numbered student each time they talked. As the lesson unfolded further pencil dots were added and an arrowed line was drawn between students to indicate the direction of talk and which student talked to which. Pencil dots and arrowed lines were also drawn for the teacher to indicate when they talked and who they talked to and also for the movements they made around the classroom. At the end of the school day I would re-draw this data using Word Processing software to create a digital version. The final collated data of dots and arrows and seating arrangements produced a ‘map’ that visualised areas where talk was dense or where movements were repeated or where there were patterns of talk between students. The visualisation of the data presented in this way resembled a map that visualised ‘hotspots’ and is what is referred to as a ‘heatmap’ diagram.

To explain heatmaps in more detail, Figure 6 is presented below, showing two students, students A and B. In example 1 there is no talk between the students during this lesson. In example 2, student A spoke once to student B by asking them a question. Student B spoke three times, once in reply to student A and then twice using social talk to student A. In example 2, the heatmap shows student A with one circle and student B with 3 circles and the line signifies that A and B talked only to each other.

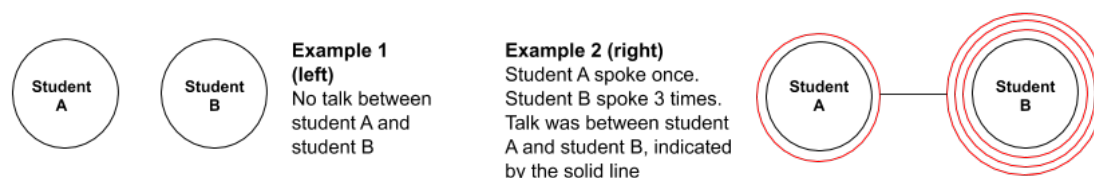


Figure 6: Example visualisation of talk between two students as used in heatmaps

In this thesis ‘heatmaps’ are used to visualise data that was collected during lessons. An example of a heatmap from a lesson is shown below, in Figure 7, to demonstrate how they function. Male student, M1, spoke the most, then female student F1 and then male student M4. It shows that student F3 did not speak at all. The teacher stood in two

positions when talking to students. It shows who interacted with the teacher and vice versa. Other data is apparent but additional heatmaps are presented in more detail in Chapter 4 and an explanation and further examples regarding heatmaps can be found in Appendix 8.

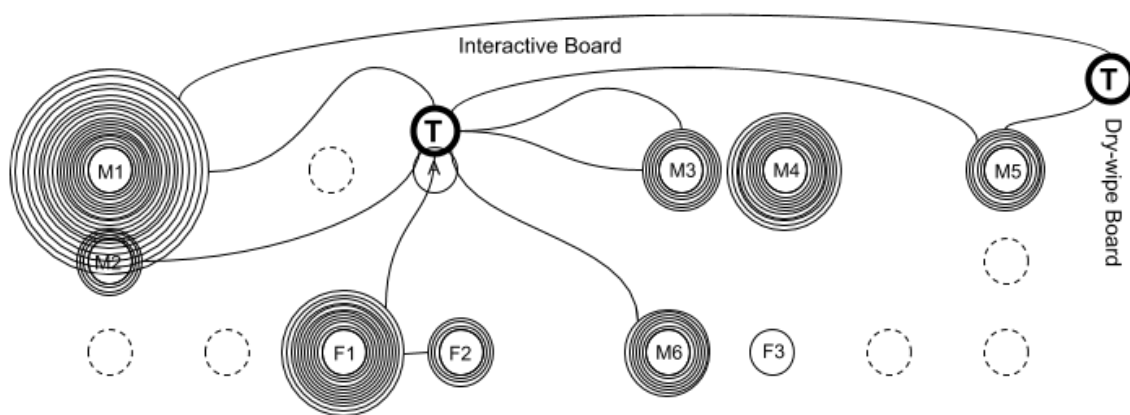


Figure 7: Heatmap from a lesson

Heatmaps therefore provide an opportunity to revisit and ‘see’ the lesson after it has concluded and develop more clarity and understanding of a lesson that was often noisy, busy and complex at the time and might be hard to interpret analytically. Heatmaps captured and provided a representation of a period of time where a lesson is captured as a visual summary.

Heatmaps were used during participant observation to facilitate post-lesson insights about interactions during lessons. Heatmaps represent only a small selection of what took place during a lesson and although every attempt and best efforts have been made to accurately record data and use triangulation to support this, it may be that data has been missed. As such the heatmaps provide only one of many potential perspectives and were used to develop insights and interpretations from a research study that took place in Hillview School.

3.6 Conclusion to the Chapter

The raw data from Hillview School spanned almost two years and in its raw state was fragmented and unorganised. In order to organise and structure the raw data for analysis a process that included distinct phases and stages was employed (see Table 1, on page 74). A thematic analysis was then carried out to generate a series of initial themes. The structured process used to deal with the raw data involved ‘logical and intuitive thinking’ about the data (Ritchie and Spencer, 1994, p.180). This process was an

iterative approach and created a 'thematic framework' (Ritchie and Spencer, 1994, p.180) which produced the final themes.

The next chapter presents interpretations of the themes generated from the thematic analysis of the raw data collected at Hillview School. It is important to note that the next chapter is not an 'analytic interpretation' but an interpretation of the data. An analytic interpretation occurs in Chapter 5, Discussion.

Chapter 4: Interpretations of the Data

In this chapter, a series of significant interpretations of the data, are presented. These were developed through a thematic analysis process derived from Braun and Clarke, (2006) and Fereday and Muir-Cochrane (2006). The following chapter *does not* provide an analytic interpretation of the data but, because of the exploratory nature of the study, presents the outcomes of the thematic analysis. Understood in this way the outcomes, or themes, of the thematic analysis may be regarded, if in a ‘quantitative thesis’, as the ‘findings’ or the ‘results’ of the research study. Chapter 4 therefore is not an analytic discussion of ‘results’ or ‘findings’ from the research study but an interpretation of data collected which reveals what emerged.

Collectively, chapters 4 and 5 are the ‘data chapters’ of this thesis. In these chapters, there is a ‘funnelling’ down as the thesis moves from the raw data to thematic analysis and then to the analytic interpretation and concludes with a discussion in relation to the research objectives and research aim.

The aim of the research study was to observe lessons in secondary school classrooms and investigate how the Echo Dot voice technology was used in terms of the more knowledgeable other (Vygotsky, 1978) and the extent to which it affected students’ epistemic curiosity (Berlyne, 1954).

The research objectives were:

- To critically analyse the pedagogical approaches of teachers before and during the use of voice technology in lessons.
- To critically analyse voice technology as a student’s digital ‘more knowledgeable other’ in lessons.
- To critically evaluate the impact voice technology has on students’ epistemic curiosity.

In the previous chapter, the research design and methodology used for the research study were outlined and an exploratory ethnographic approach was described. The previous chapter outlined how the raw data was ‘thematically analysed’ to produce themes. It also described how a novel method of visualising talk through the development of ‘heatmaps’ visualised talk in lessons. Heatmaps are used throughout this chapter. A ‘legend’ to explain the symbols and shapes used in the heatmaps is

therefore provided below, in Figure 8. The legend is relevant to all heatmaps used throughout this chapter and thesis.

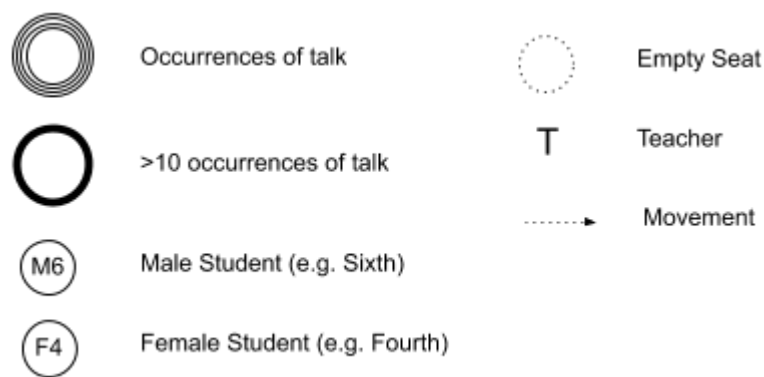


Figure 8: Heatmap legend

4.1 Introduction

There are three parts in this chapter. Part one presents a perspective of the classrooms before the Echo Dots were used. Part two presents the interpretations of data from use of the Echo Dots. Part three presents the interpretations of data from the transcripts of the Echo Dots. These interpretations are integral to the discussion in Chapter 5

The exploratory and ethnographic approach had indicated in advance that an open-ended research study would need to evolve to accommodate problems and issues that emerged during the fieldwork. During the initial fieldwork period, problems deploying the Echo Dots into classrooms and becoming able to work in the classrooms were issues that led to a period of time where data was collected when no Echo Dots were used. This opportunity was a fortuitous development that subsequently allowed a ‘before and after’ perspective to be developed. Although not planned in advance, the before phase became a pivot point to pursue emerging insights which then occurred in relation to the research aim and objectives. Without the issues that emerged that forced a change, important data would not have been gathered.

There were a small number of participants so to protect confidentiality, teachers are referred to as ‘the teacher’ to also provide a degree of anonymity. The teachers’ classroom numbers or name and subject areas have also been adjusted. In some instances, references have been purposefully vague or ambiguous because by not being so, identification of individuals could easily occur. With regard to anonymity,

alterations or adjustments made to names were not applied to the raw data and so did not impact upon the analysis.

4.2 Part One: Themes from the Classroom

This part is concerned with the classrooms and the teaching at Hillview School prior to the Echo Dots being used. The second part of this chapter is concerned with the use of the Echo Dots at Hillview School. The two parts mean it becomes possible to understand the pedagogical approaches at Hillview School before the Echo Dots were used and then later, the pedagogical approaches when the Echo Dots were used.

4.2.1 Organisation of the Classrooms

This first section describes the classrooms at Hillview School prior to the use of the Echo Dots to provide a context and present information that forms key parts of the analysis presented later in Chapter 5. This section reveals how teaching and learning generally took place in classrooms of Hillview School during everyday lessons. The raw data was collected over several months through participant observation while working as a teacher's assistant across all subjects and all year groups at the school.

At Hillview School the curriculum subjects were taught in classrooms that had desks and chairs arranged in rows, shown below, in Figure 9, oriented to where the teacher generally stood or sat. The teacher was observed to occupy a position at the front having a desk and workspace facing towards the rows of students. A row-based classroom positioned students facing the teacher and facilitated seated work at desks. This arrangement made use of the available space and enabled thirty students to be seated in one classroom leaving room for a teacher's desk, other teaching equipment and materials and other required general storage such as a cupboard.



Figure 9: Arrangement of a classroom at Hillview School

When in classrooms arranged in this way students could interact with two others, a student to their left and a student to their right. It was observed that turning around to talk to other students or moving seats and walking about was generally forbidden unless students were given permission by the teacher. Interactions by students with other students on rows behind or in front was also generally forbidden without prior permission from the teacher. In an arrangement of this type, students who were seated at the end of a row were only able to interact with one student who was seated either to their left or right. The importance of seating and desk arrangement and positioning of students was a key determinant upon talk and interactions in a classroom. The significance of room arrangement has also been highlighted by Alexander (2005, p.6) who has stated:

‘If as a teacher you arrange desks in a horseshoe or square so that each child can see and interact with all the others as well as with yourself, and you sit with the children rather than stand apart from them, you provoke a very different kind of talk, and a different relationship, to that signalled by having separate desks in rows facing the front, when children can establish eye-contact with the teacher but not each other, and the teacher stands while the children sit.’

The general seating pattern for desks and students and their possible interactions at Hillview School is shown in Figure 10, below.

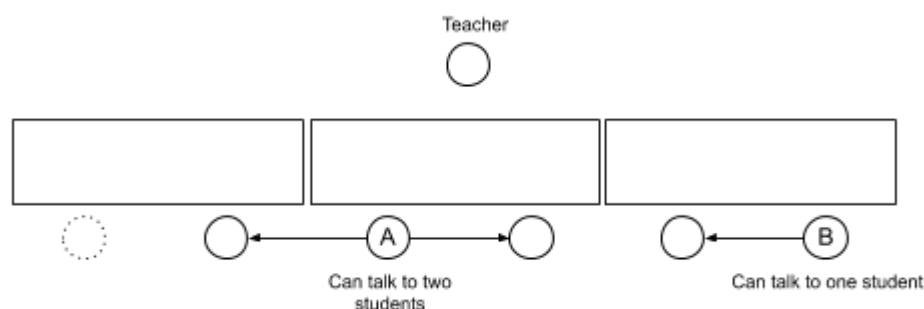


Figure 10: Seating arrangement and potential interactions

The curriculum subjects observed during the study across the school had their classrooms arranged into rows of desks and chairs. However, there were some exceptions because the teaching of some curriculum subjects necessitated a different classroom layout. For example, in Science, the classroom was a laboratory or ‘lab’ set up, shown below, in Figure 11 and tables and stools were organised into rows of table groups. Students were still arranged to face the front towards the teacher.



Figure 11: A 'lab' style classroom

In a 'lab' arrangement, unlike a row-based arrangement, students were often observed to move about the room from equipment storage areas to material collection and disposal points and to washing and cleaning facilities.

At Hillview School the arrangement of rows of tables and chairs appeared to be used sometimes to separate students to 'manage behaviour'. A teacher reported that it enabled them to isolate 'disruptive students' to a row end or desk on their own. In the lessons observed, teachers often used 'seating plans' to organise students into specific places giving students a regular seat. Teachers were also observed to sometimes direct students to specific seats during lessons to be away from certain students or to sit on their own. In every lesson observed, fieldnote drawings of the seating arrangement of students and positions of the teacher showed the teacher located at 'The Front' of the classroom.

In summary, what emerged from participant observations of lessons at Hillview School regarding the organisation of the classroom was that there seemed to be a consideration given to design and arrangement of the classroom to gain control of the seating and behaviour of students. Classroom organisation in this way led to the teacher being positioned in front of students where instructions could be given and students could be monitored as a whole class. It was an efficient use of the available space in classes of thirty students and also enabled students to sit in a prescribed seat which meant that they had one or two talk-partners.

4.2.2 The Use of Worksheets in Lessons

In the lessons observed during the fieldwork, students were commonly seen completing 'worksheets' and this was evident across a wide range of subjects and across all year groups. Occasionally a student working on a worksheet would ask the teacher a question such as 'Is this right Madam?'. As such, worksheets presented opportunities for the

teacher and student to talk about the work, although talk was not observed to occur frequently. Talk by students with the teacher was usually about whether an answer was correct. Teachers were often observed asking students to ‘complete all the questions’ or to ‘fill it in, don’t leave any gaps’. If the student could not complete it or fill in all the gaps, prompts or hints towards the correct or required answer were given or the answer was given to the student by the teacher.

Worksheets presented opportunities for the teacher to talk with students about the quantity and the quality of their work on the tasks or what was ultimately their ‘performance’. Teachers’ talk in these instances tended to be ‘performance oriented’ and was usually about the amount of correct answers, the degree of ‘correctness’ or quality and quantity of work completed, or the student’s progress and time left for the tasks. Some teachers in some lessons were observed saying to students that the answer they had written down on a worksheet was ‘wrong’, ‘somewhat wrong’, ‘not enough’, ‘too short’ or that they had ‘missed marks’. Nonetheless, from observing the way in which students settled to work on worksheets and from assisting them in lessons as a teacher’s assistant, it appeared that worksheets were accepted by students as an ‘authentic’ activity and, it seemed likely, were construed as ‘learning’. For example, when asked, two students completing worksheets independently, told me that they were ‘learning’ about a particular topic that would be forthcoming in the summer exams. Worksheets did not appear to be perceived by them as unusual and it seemed likely, they were accepted as a ‘learning’ activity. From observations of lessons, worksheets also appeared to involve practising writing answers by recalling memorised information and facts focused towards being able to give correct written answers in forthcoming examinations and to gain ‘marks’ or achieve a high ‘score’ or grade and appeared to be considered ‘learning’. These actions and behaviours of students and teachers oriented around worksheets were integral features of the pedagogical approach that was observed at Hillview School.

4.2.3 Instruction from The Front

In lessons that were observed at Hillview School, the teachers generally occupied a position at ‘The Front’ of the classroom in proximity to a desk that was referred to by students and the teacher as ‘the teacher’s desk’. From this area, either sat or stood, a teacher would often talk to the class at the start of lessons and deliver explanations of the topic being learnt and tell students what they were going to do in each lesson. The teacher’s desk area and teaching place is referred to from here on as ‘The Front’.

In terms of managing the behaviour of students and the interactions that occurred, teachers tended to say what tasks were to be completed and indicate the time allowed for students to complete an activity or task. In the lessons observed teachers frequently mentioned or referenced forthcoming ‘end of year tests’, ‘mock examinations’ or ‘GCSE exams’ or ‘summer exams’. The teachers also emphasised the need for the students to sit and listen, ideally in silence, without interrupting the lesson by talking to other students or ‘misbehaving’ and at times told specific students to ‘stop talking or be sent out’.

During the lessons teachers remained at ‘The Front’ for the duration of the lesson except where students were working on an activity or worksheet, when occasionally teachers walked to another position in the classroom temporarily before returning to ‘The Front’. For example, in an observed lesson the teacher walked towards the back corner of the room and proceeded to walk around a desk and then return to the front. When walking around the classroom the teacher glanced down at three student’s desks and work. This appeared to be a way of monitoring students’ work, work rate or output and behaviour or as was occasionally seen, was to issue a verbal warning or to sanction ‘poor behaviour’. Occasionally the teacher was seen to point to a place on a student’s worksheet or pause and look more closely at work being done, indicate an error or improvement and move on. The movement of the teacher around the classroom appeared to be an opportunity for ‘one-to-one’ talk to occur rather whole class instruction but in the lessons observed during fieldwork these instances of talk while moving appeared oriented around the students’ performance and were relatively infrequent.

In support of the notion of ‘The Front’ a teacher’s positions are shown by the heatmap, below, in Figure 12. The teacher, symbol ‘T’ and dotted lines of movement, show they moved temporarily to eight locations, the highest number during the fieldwork period, but returned to the front. The teacher stopped momentarily when away from ‘the Front’ and gave brief instructions to a student, directed a student to work and gave another feedback on their work. Figure 12, below, also shows where the teacher stood and how often they talked in this position. When the teacher was at ‘The Front’ they addressed the whole class and when they were at other positions, with Fd, M10 and Fx, they were observed to speak to the students about the student’s performance.

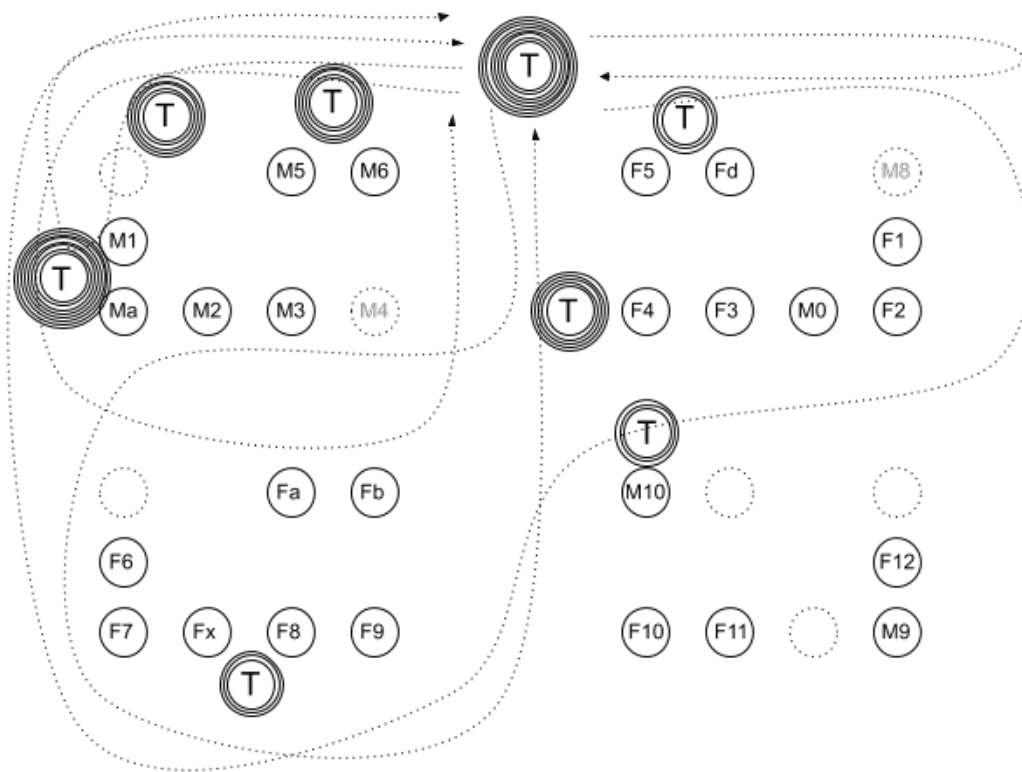


Figure 12: Heatmap - Teacher position and density of talk in each position

In Figure 12, above, the teacher took eight positions. Four positions were nearby within the area of ‘The Front’ and two very near. The six positions towards the front of the classroom are shown in the heatmap, below, in Figure 13.

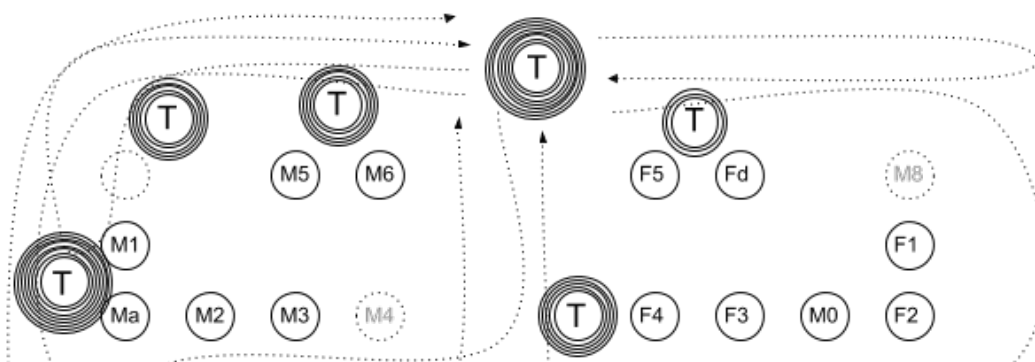


Figure 13: Six of the positions of the teacher to monitor students

However, the six positions shown above, show the teacher positioned themselves towards the front to be next to two groups of students at the front of the classroom. It was from these six positions that the teacher did the majority of their talking to the class or small groups of students. The teacher talked mostly from the central position at ‘The Front’ between the two groups. For example, speaking to M5 and M6 and then to M1

and Ma and briefly to F5 and Fd. Fieldnotes show that the teacher also questioned F4 about their lack of work.

Movement of the teacher to another position in the classroom had two observable effects. Firstly, it created a proximity between the teacher and certain students who were not at 'The Front' during which time any social talk, or 'off-task' talk between students as it was referred to by teachers, usually ceased. Secondly, it allowed some students to talk to the teacher as the teacher passed by, and vice versa. This appeared to be because of the privacy of a one-to-one interaction as opposed to speaking to the teacher in front of the whole class. It was, therefore, the teacher's movement to alternative positions that both enabled and dis-enabled students' interactions with the teacher through talk.

The teacher appeared to prefer certain positions in the classroom and did not frequently walk around the whole room and teachers reported that they only did so when they felt it was time to do so. In these instances when it was 'time to do so', it was observed that the teacher's path around the classroom often appeared to be governed by the students and their behaviour. For example, in a lesson the teacher described a particular group of students as 'those at the back' as being 'usually a problem' and that they needed 'constant monitoring or they could 'get out of hand'. The teacher was observed walking around or near to these students during the lesson.

In this same lesson, shown above, in Figure 13, the teacher stayed near the group of boys (M1, Ma, M2, M3, M5, M8) and near to the girls (F5, Fd, F4). These two groups contained several students who were observed and reported by teachers to be 'chatty, boisterous and inattentive' at times. These students often disturbed others and interrupted the teacher when they were talking by calling out or making noises or they physically interfered with other students using their hands or objects to poke and tap to disrupt them. The teacher was observed to position themselves towards the front of the classroom where they 'could keep an eye on' certain students and circulated mostly around these students but staying near 'The Front'.

In this lesson, the teacher was positioned mostly at the front near two table groups of students and was observed to make two brief visits to the back of the classroom. The position of the teacher was observed as being such that they could circle or patrol the two groups at 'The Front' who were talking loudly and distracting other students and interrupting the lesson. The teacher walked to the back of the classroom only when the

noise level of the front two groups fell and behaviour seemed to improve but they returned to their position at the front of the classroom when the noise level increased and behaviour declined.

4.2.4 Teachers' Positions and Talk During Lessons

During lessons where students were perceived and reported by the teachers as being more 'challenging', the students tended to attract the physical presence and verbal attention of the teachers. In lessons with 'challenging' students, teacher's talk appeared to be used more to control the way students worked or behaved by bringing them to focus upon the work set, by asking them questions about the work or by giving them verbal 'warnings'. As shown below, in Figure 14, the teacher, symbol 'T', positions themselves at the front near two talking groups, or 'triads', of three students, shown below as 'Triad 1' and 'Triad 2'. The teacher occupied three positions proximal to Triad 1 and three positions proximal to Triad 2, and these six positions were also near the front.

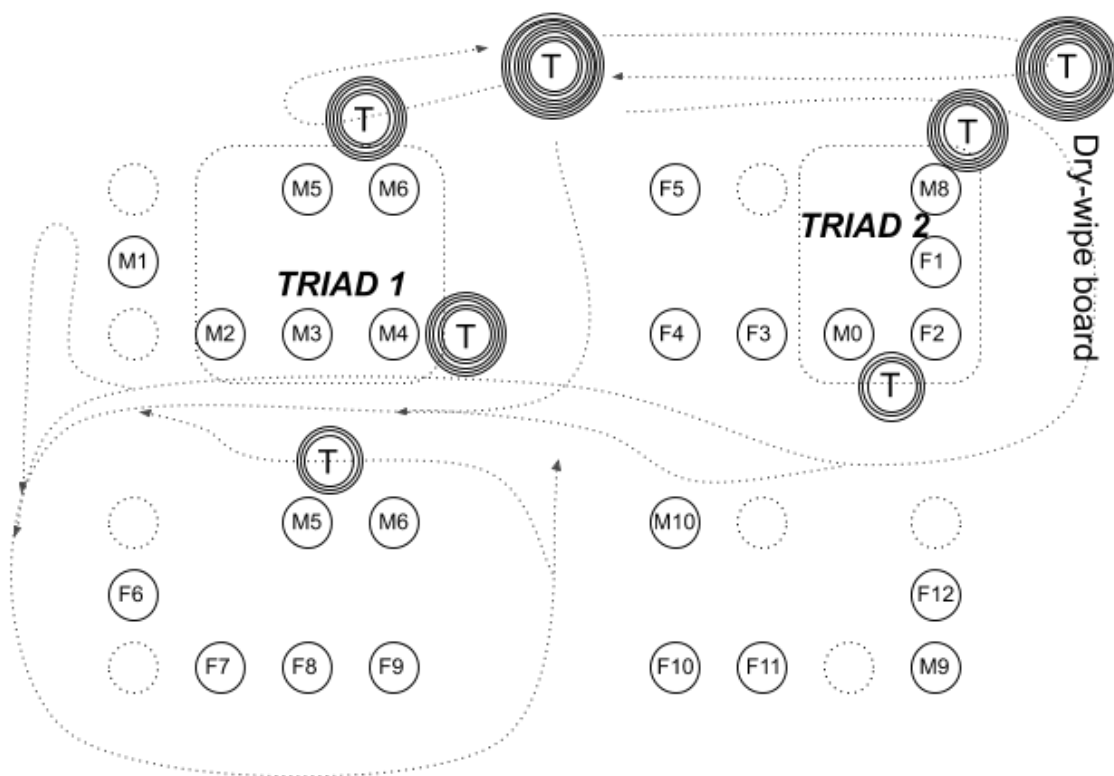


Figure 14: Heatmap of a lesson showing teacher talk and student groups

Whilst walking around the classroom, the teacher was observed making sudden turns to adjust their route. During these walks the teacher was observed glancing towards Triad 1 and Triad 2 which, it seemed likely, was to remain aware of the two groups behaviour. The turning and adjustment to the route was reported by the teacher so as to be closer to

Triad 1 and Triad 2 to manage their behaviour and work rate. The teacher reported using their presence as a way to control the students' behaviours. The single journey that the teacher took to students F6, F7, F8 and F9 was a relatively brisk walk to the back corner of the classroom which occurred without stopping or talking to any students, followed by a brisk return to the front. The group of girls (F6, F7, F8 and F9) at the back of the classroom were quiet and were silent during the lesson when this class was observed.

In terms of silence it can be seen from the heatmap extracts from two lessons, shown below, in Figure 15 and Figure 16, that in both lessons a group of students, in the back right hand corner of the classroom, did not interact with the teacher. In Figure 15 and Figure 16 shown below, students M9 and F10, F11, F12 did not speak to the teacher. In Figure 15, below, student M10 was talked to twice by the teacher about their low work rate in one of the two lessons.

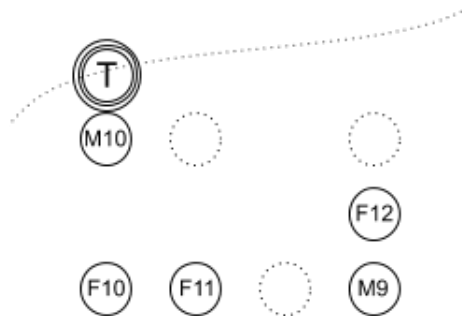


Figure 15: Students that did not interact with the teacher (F10, F11, M9, F12)

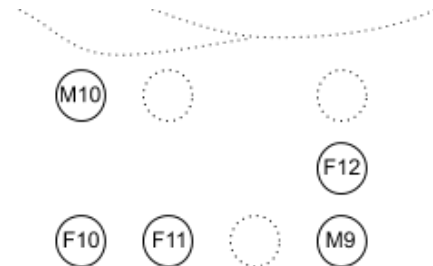


Figure 16: Students that remained silent (M10, F10, F11, F9, F12)

The heatmap diagrams Figure 15 and Figure 16, alongside fieldnotes, revealed that the students seated towards the back rarely talked to the teacher during the lessons that were observed and often remained silent throughout lessons. It appeared that the teacher's attention was often drawn to certain groups of students who talked and, as reported, 'mis-behaved' which appeared to monopolise the teacher's presence and verbal attention. It appeared that the teacher therefore tended to have to adopt teaching positions at 'The Front' or towards the front of the classroom to manage and control students' behaviour.

In the lessons that were observed teachers were heard referring to forthcoming tests or examinations which appeared to be a way to bring students to a focus upon the work by emphasising the importance of 'performances'. For instance a teacher might say 'this will be in the GCSE' or 'this topic always features' to remind students of the

importance of examinations. Teachers also told students the way in which they should work and emphasised the point and purpose of the work or task in hand in terms of its relevance to 'the GCSE' or 'marks' to be gained. Teachers used a 'performance oriented' type of talk that tried to connect students' conception of lesson work with the significance and importance of the forthcoming assessments via examinations. In this way teachers appeared to use the concept of examinations to orient students' work around a performance in the lesson.

Occasionally and infrequently, a lesson would involve an 'artefact' and although the pedagogical approach observed generally remained consistent, a part of the lesson involved 'practical' work and differences were observable. In lessons where artefacts such as models, equipment or experiment materials such chemicals were used the teachers were observed to move around more of the classroom more often and to talk or briefly speak to more students as the students worked with the artefacts. Lessons with artefacts necessitated more movement by the teacher and often more interaction with more students because talk, chatter and the noise generated alongside more movement from students, required 'behaviour management' across the whole classroom rather than management of 'Triads' or individuals. Lessons with artefacts appeared less controlled and organised because they involved relatively more movement and general talk as students collected materials or resources from various places or storage areas. However, the use of artefacts was infrequent and they were used for short periods of time constituting only a small part of a whole lesson.

In lessons where students did seated work at desks such as writing or drawing the teachers appeared to focus on specific students or student groupings and moved to them or talked to them to manage their performance when behaviour worsened. In lessons where students worked in groups with artefacts there was more teacher movement around the classroom because it was needed to access students who were working in groups and focused on each other and not 'The Front'. Nonetheless, the position of the teacher remained mostly consistent being positioned at 'The Front' and the pedagogical approach and pattern remained mostly unchanged.

4.2.5 Visualisation of Types of Students' Talk

As has been outlined, some students in classrooms were silent and did not interact with the teacher. However, some students were very talkative and talk from James in lessons is visualised in the heatmap for a lesson, shown below, in Figure 17. In this lesson

James (M2) was recorded to have talked 35 times and it was a challenge to track it. James talked socially to other students primarily but also to interrupt the teacher, to reply to rhetorical questions or in retort to the teacher's requests to settle, listen or be quiet.

As James walked into the classroom at the start of the lesson he stated loudly to the teacher 'Can we sit and chill?' and then without waiting for an answer began a conversation with M5. James continued to chat to M5 whilst the teacher took the register, and other students sat quietly, and continued chatting sporadically during the 'starter' phase of the lesson where instructions were given to the class. James then began a conversation with M5 and M4 and a short while later shouted to the class and teacher 'He [pointing to M5] cried last night when [a student] didn't text him back!'. Fieldnotes recorded that James was a 'significant disruption' to the lesson because of the quantity and type of talk he engaged in.

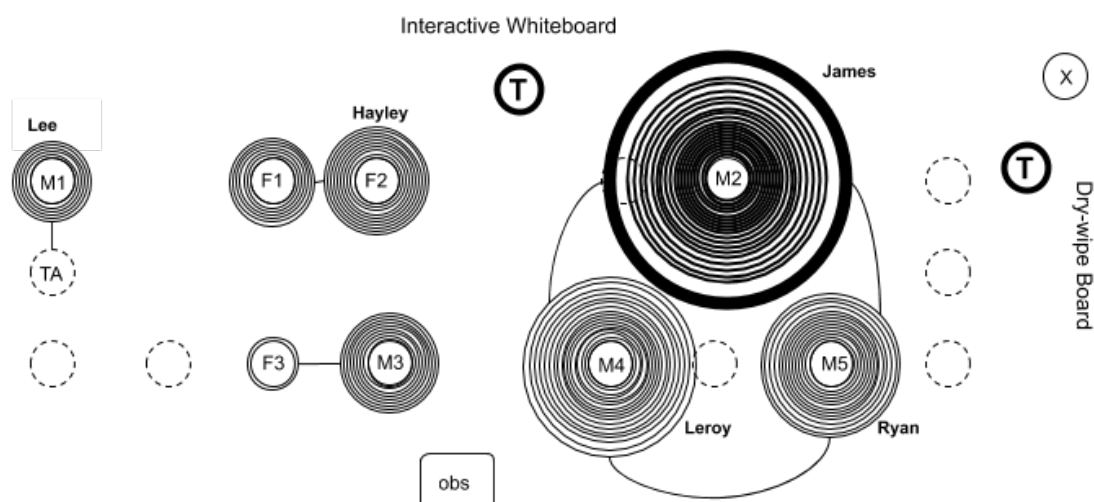


Figure 17: The lesson with James (M2)

As could be seen above, James generated the majority of the talk that occurred in the lesson and his talk was usually directed to other students who he continually called out to or called to watch his 'messing about and acting up' as the teacher described it. In doing this, James also drew the teacher into an interaction, but these were observed to be warnings from the teacher about his disruptive behaviour and the reasons for it or replies and responses by James to the teacher's warnings. James appeared to use talk for entertainment, and it disrupted the lesson.

As a result of talk by James, the teacher was observed to position themselves in proximity to James, Ryan and Leroy electing to teach from the dry-wipe board next to

the three boys and not the regular position of the ‘interactive whiteboard’ (IWB) area or what was usually regarded as ‘The Front’. The other students were observed to have talked quietly in pairs and appeared to avoid any contact with the three boys. As a result, there was very little interaction with the teacher from other students as the teacher focused on the three boys and prioritised managing their behaviour and talk. There was still an area that could be regarded as ‘Th Front’ but it was at the IWB near James, where the teacher was forced by James’ talk to teach from.

Although an individual such as James could be seen to dominate the talk in a lesson this was not often observed in lessons. However, some students were observed to talk from the start to the end of the lesson as James did, but for these students their talk appeared covert to avoid being ‘caught’ by the teacher. In the heatmap shown below, in Figure 18, Otis (M4) demonstrated a covert approach and was observed to be the predominant ‘talker’ in ‘Section A’. Not only did Otis engage in a considerable amount of talk in comparison to other students but talked to 3 of the 8 people in his table group often and for extended periods. Otis (M4) directed his talk towards Maddie (F11) who sat directly next to him and Matti (M5) who sat one seat away and when possible to Jez (F1) who sat the furthest away from him.

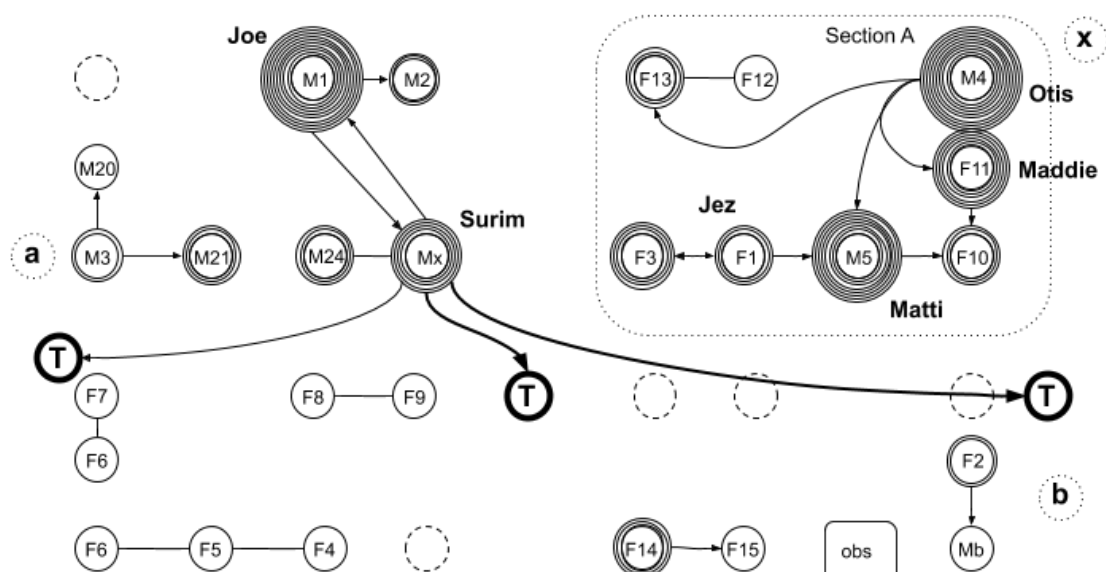


Figure 18: The lesson with Otis and Surim

Otis favoured talking to Maddie and Mattie, keeping his talk discreet and inaudible to the teacher by choosing proximal people to speak with and talk was executed quietly. However, there were several times when he persisted in talking despite being heard by the teacher which resulted in warnings of ‘not to talk when I’m talking’ from the

teacher. This breach of a classroom rule might indicate that Otis felt compelled to talk despite knowing the rule of not talking and the risk of a warning or sanction.

This was also the case for Joe and Surim, as could be seen above, who talked to each other throughout the lesson and also involved others in their talk. For instance, Joe talked to the boy (M2) to his right twice who gave one reply. Surim talked to Joe and responded to Joe but also was the student that talked the most with the teacher asking questions to the teacher as they walked around the classroom and positioned themselves in different areas of the classroom.

In this lesson, shown above, the teacher moved to three alternate positions in the classroom, shown with the symbol 'T', but unusually, was observed to pause and talk from these positions. However, these were short statements and momentary after which the teacher then continued to the front where most of their time was spent. In the heatmap, shown above there were two main groups of students in the lesson that talked throughout the lesson which caused the teacher to adapt to manage the students behaviour and control the lesson structure and the teaching that occurred. The teacher appeared to do this by adjusting their own position, and by using talk.

There is a noticeable difference between the two groups of 'talkers' in Figure 18. The difference was between Surim and Otis in that Surim talked with the teacher, and asked unprompted questions, whereas Otis did not talk or interact with the teacher, preferring to talk only with other students. Surim appeared more 'engaged' with the lesson and the teacher and Otis appeared to be in conflict with the teacher and appeared disinterested in the teaching and the topic being learned. This might be explained by Surim who reported that he liked the lesson and the teacher and remarked that:

'I find some of that stuff... well, it's hard to explain... like... even when I'm tired and stuff... sometimes I get interested in it'.

Speaking in more depth with Surim during the lesson it appeared that he meant that he favoured this lesson and the teacher and even if he wanted to 'muck about' as he described it, he sometimes found himself drawn into listening and thinking. Surim explained that he liked the teacher and the practical element of the lessons and the problems that arose in the lesson caused him to think about ways to solve them and which then caused him to ask questions. This seems to indicate that when problems

stimulated his curiosity or awoke a desire to know more, then he became engaged in the lesson. However, some of the engagement is likely attributed, as he has explained, to his enjoyment of the lessons with this particular teacher.

From lessons that were observed it became apparent that some students remained silent or spoke only with those who were close by, being either seated next to them or on another table within close proximity. In Figure 19, shown below, near position 'a', M3 spoke only once to M20 to his left, and M20 did not speak at all for the full duration of this lesson. In Figure 20, below, at position 'b', F2 spoke only once to Mb who was seated to her left.

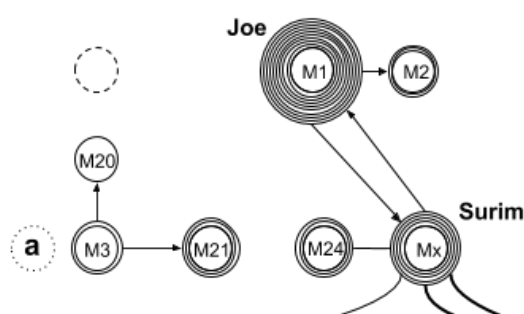


Figure 19: Position 'a' - Single instance of talk between M3 and M20

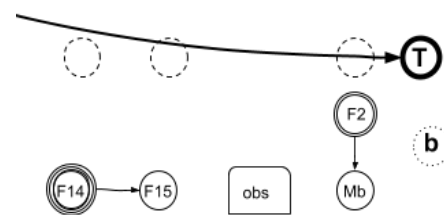


Figure 20: Position 'b' - Single instance of talk between F2 and Mb

Other examples of what appears to be a choice or decision to be silent or to not speak in public can be seen in this lesson. The three girls, shown previously, in Figure 18 (F6, F5, F4) on the back row did not speak during the lesson nor did the two pairs of girls (F8, F9 and F7, F6).

In this lesson students were observed to appear to make decisions about who to speak to and this was based on their proximity to them and the likelihood that they would respond. For instance, at position 'b' in Figure 20, the girl (F2) spoke to the boy (Mb) to her immediate left but he did not reply and instead pointed to the textbook. With the pair of girls at the back of the classroom (F14, F15) only F14 spoke and did not receive a reply from F15 who was silent all lesson. Students that were observed to be silent appeared 'passive listeners'. This is shown in position 'b', where a relatively large quantity of talk during the lesson was observed, and one student (F12) was observed to not talk during the lesson and was observed as having been talked to once only. The same pattern can be seen in Figure 20, where F15 was silent all lesson also. To what extent these students are engaged, thinking or curious is difficult to ascertain but from

conversations with some silent students, they appeared more reticent about speaking rather than being disengaged from the lesson.

In terms of where teachers stood in lessons, teachers generally positioned themselves at 'The Front' as has been shown previously. Teachers held this position commonly in the lessons that were observed, and it was favoured by a large number of teachers across different subjects observed. The majority of talk between students and the teacher occurred in this arrangement and which student was asked a question or to respond to questions was decided by the teacher. In the lessons observed, at times there was a considerable quantity of different types of talk but it appeared that it was not common for students to ask questions or to initiate talk with the teacher, and several students could remain silent.

4.2.6 Visualisation of Teacher's Talk During Lessons

In terms of teacher's talk, a lesson is visualised in a heatmap and is shown below in Figure 21. In this heatmap students M4, M6, F3, M9, F5, F8 and F7 were observed as being involved in the majority of the interactions. In this lesson a total of 13 students from a class of 24 engaged in talk with the teacher, the rest, 11 students, did not talk to the teacher. The talk that was observed came from the teacher and was to the students in the form of a question, to which the students responded. Interactions from the students to the teacher were usually short, being either a 'yes' or 'no' responses, single answers or short sentences of a few words. The teacher, by comparison, would talk to the students for a much longer period of time using more words and several sentences. Comparatively, the students would take very little time and use only a few words in reply. In the lessons observed students were not observed to ask 'unprompted questions' to the teacher frequently and these were rarely heard. The teacher appeared to initiate the talk between themselves and the students that took place but not all students were involved in the talk during the duration of the lesson as some were not spoken to and remained silent.

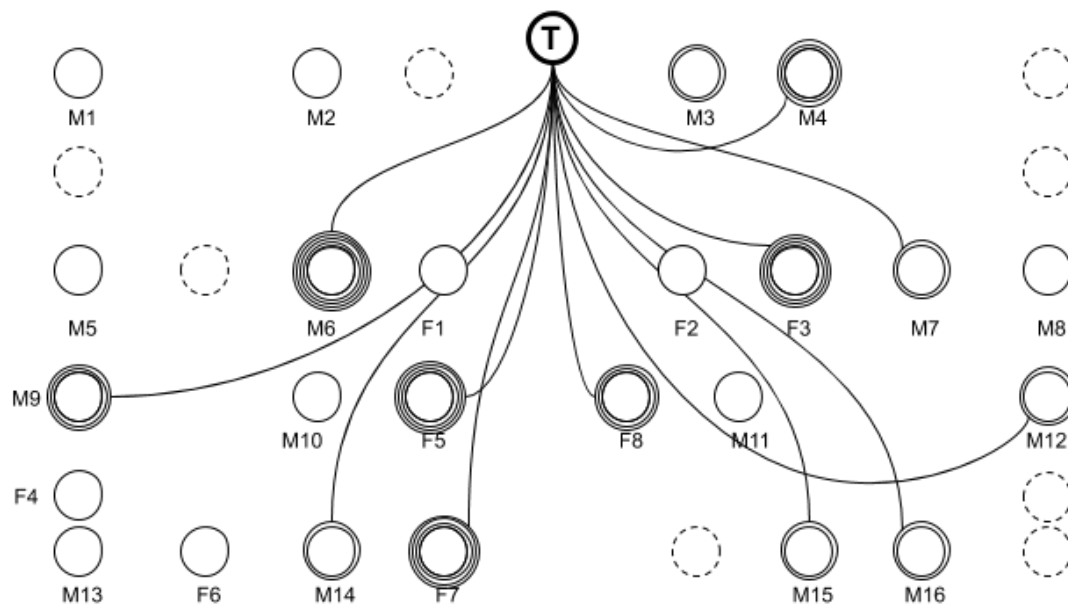


Figure 21: Silent students and students who talked

11 students were observed as not speaking with the teacher during this lesson and silent students were observed in lessons across all of the subjects and lessons participated in, that is they did not speak to the teacher or other students. Some students would not engage with the teacher unless specifically requested to do so and often enthusiastic and confident students who were comfortable speaking publicly or confident in their answers or contributions would very often volunteer and thus provide the spoken interactions of the lesson. This was explained by a student who said:

‘well, some students are embarrassed and care about what others judge them as, they won’t ask because of who is in the class.’

There appeared to be a tension for students when it came to speaking out loud as they considered the ‘costs’ and ‘benefits’ when thinking about doing so. For example, a student said:

‘I think what will people think of me... and then ultimately if it’s worth it, I ask it’,

This was understood to mean that they considered there to be potential risks and rewards when speaking out loud.

In classrooms some students appeared to be confident and motivated to talk or respond to the teacher. This seemed to allow some students to remain silent unless the teacher directly involved them in talking by asking them a question. As such some students

were able to remain silent and withdraw verbally from the lesson and became what could be considered ‘invisible’ to the teacher. During a conversation with a teacher they remarked that they were very surprised that students had been silent throughout despite both a teacher and researcher, as a teacher’s assistant, being in the classroom and involved in the lesson activities and teaching.

From a group of students who did not interact with the teacher, some were observed to speak to students sat next to them. Student-teacher and student-student interactions in one lesson for a small class are presented in a heatmap, in Figure 22, below. In this lesson the teacher occupied two positions at the front of the classroom, one near their teacher’s desk, at ‘The Front’, and the other near a display board to write on, shown by the symbol (T).

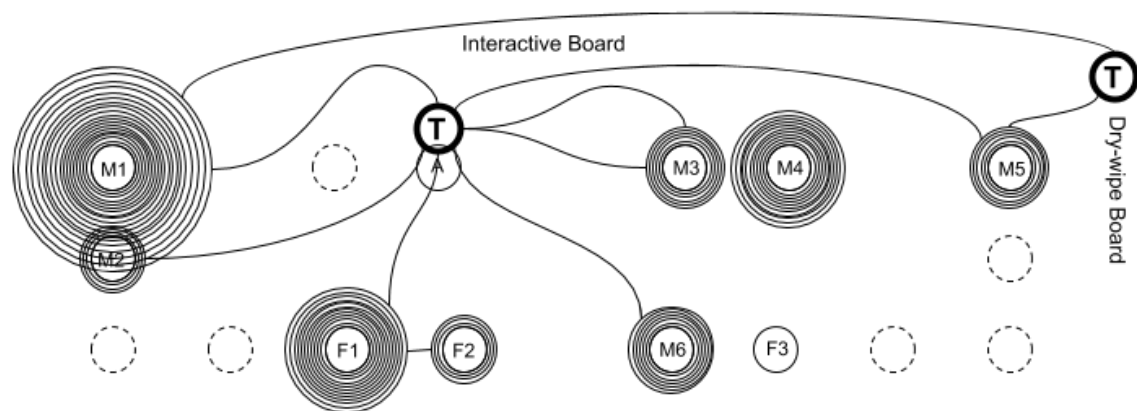


Figure 22: Students talk and students the teacher talked to

All students in this smaller class are involved in either talk with the teacher or with another student except for student F3. The number of silent students is less than was seen in other classes but even in a smaller class, silence occurred. F3 was silent all lesson. A discussion with the teacher about the lesson showed that neither of the adults in the room, the teacher and an additional teacher’s assistant, were aware at the time that the student had not spoken and remained silent throughout.

Silent students were observed during lessons across all subjects and although not evident in large numbers, silent students were observed in lessons at Hillview School. What emerged was data to suggest that it was likely that the talk from the teacher and from some confident and motivated students enabled small numbers of students in lessons to avoid or to not be involved in any talk at all and to remain silent. As such the

proportion of talk between teacher and students was distributed unevenly with some students involved in talk a lot and others not at all.

4.2.7 Performance-Oriented Talk in Lessons

As has been mentioned briefly, at Hillview School in the lessons that were observed during the fieldwork there appeared to be a pedagogical orientation towards ‘performance’. In these lessons this appeared to lead to talk having a particular purpose and focus. It seemed teacher's talk with students would involve information about the particular subject being taught and its content and the curriculum and their ability to know or store what was talked about and produce a ‘performance’ in relation to this. This was a common pattern observed in most of the lessons observed and appeared to be around the notion that students should be ‘performing’ well and that performance was important. There was also a focus to the teacher’s talk regarding what the students needed to do to ‘perform’ well along with students’ actions and behaviour that were required by the teacher. For instance, with regard to performance, the teacher’s talk would be used to describe ‘correct’ responses to questions or tasks or to explain what the examiner wanted to see as an answer. Teacher’s talk explained lesson tasks or activities and the content of this talk was also oriented around performance and stressed the importance of being able to know and store along with practising or preparing for examinations or assessments to gain ‘marks’. The extracts below show some examples of teacher’s talk oriented around ‘performance’:

(Fieldnotes: 15th May, 2019)

‘The examiner wants to know you know about Health and Safety’.

(Fieldnotes: 23rd March, 2019)

‘On the [work]sheets I’ve given you make sure you get all three marks’.

(Fieldnotes: 24th April, 2019)

‘It [the question] was worth 8 marks’.

The teachers who used a ‘performance-oriented talk’ generally tended to emphasise the importance of producing evidence so that an assessment or judgement could be made. The emphasis was placed by the teacher on students focusing on performing well, which was interpreted to mean, that students should direct their attention towards gaining marks or producing evidence that could be assessed. As such, in the lessons observed,

there appeared to be a prioritisation and orientation of teacher’s talk to students towards performances in tests and examinations as shown in the extracts below:

(Fieldnotes: 15th May, 2019)
The Teacher is explaining to the class why students might complain about questions in an examination paper being difficult.
Teacher: ‘For example they get taught about osmosis using a potato and then in the exam it’s a carrot - they can’t transfer their information across’.

[Class are listening]
Teacher: ‘I have just been given your Biology paper from yesterday’.

What appeared to be evident from the talk of the teacher is that it tended to orient, at times, around students’ performance in assessments or examinations and there was therefore a particular way that teacher and students interacted. The conversations were oriented around the students being able to provide evidence of learning in particular ways that were considered ‘valuable’ and therefore important and the teacher’s pedagogical approach was formed around this.

In terms of what was said, conversations with students in the later year groups contained words such as ‘expected grade’ or ‘target’ or ‘predicted grades’. In the earlier year groups conversations contained words such as ‘level’ or ‘effort’ or ‘grade’ and also ‘score’ or ‘mark’. It emerged that there was an array of words associated with ‘performance-oriented talk’ and a lexicon is presented below, in Table 2. The use of the words from this lexicon was evident in teachers’ talk at Hillview School between teacher and students, between teachers and sometimes also in discussions between teacher and researcher.

Score, Mark, Test, Paper, Grade, Level, Revision, Revise, Practice, Answer(s), Set, Band, Group, Exam, GCSE, Mock/Mocks, Past Paper, Question(s), Model answer, Targets, Predicted, Added Value, Higher, Foundation, Tier, Effort, Low/High Ability, Motivation, Specimen, Mark Scheme, Long Answer, Progress, Below target, Intervention, Summer, Study Leave, Y11, Exam Board, Examiner, Moderator, Assessment, Booster, Borderline, Percentage, Working below/at/above.
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Table 2: The lexicon of ‘performance-oriented talk’ (in no particular order)

‘Performance-oriented talk’ was evident in varying amounts in all lessons that were observed and it would be unusual to not hear a word from the lexicon being used in a

lesson at some point. For example, in a lesson introduction of what was described as ‘a revision lesson’, the teacher asked the students to create a revision resource and four words of a total of 29 words were from the lexicon of performance-oriented talk. An extract is shown below with words from the lexicon emphasised in bold text:

(Fieldnotes: 27th February, 2019)

‘Write down the key points and I will give you detailed **revision** notes next lesson... this type of **question**, slightly different to this, will be in a **GCSE paper**’.

Performance-oriented talk was common and appeared to be part of teacher and student everyday talk but it also implied that there was an emphasis on ‘metrics’ and that learning was pedagogically ‘regulated’. For instance, in the extract above, the teacher had said to only write key points implying that these will gain marks and no more was needed than this. This talk suggested that an emphasis tended to be upon evidence of learning that was connected to the making of a quantitative judgement or assessment. It involved measurement of ‘performance’ and suggested what ‘learning’ was understood as by teachers. As such dialogue was often about ways in which students could improve their performance and focused around ‘metrics’ or measurements of their performance such as scores or marks. The ‘numeric’ focus on metrics such as marks, scores and grades, suggested that there was a potential for what can be defined as a ‘metricalisation’ of teaching and learning. ‘Metricalisation’ can be understood at this point to be a pedagogical approach that involved the production of metrics such as scores, marks, grades and levels and which facilitates the recording and measurement of learning. Metricalisation will be discussed in more detail in Section 5.1.2.5 in Chapter 5, Discussion

The pedagogical approach observed was a general pattern across the subjects and lessons observed and constrained the type and occurrences of talk. In the way that talk and teaching unfolded, it suggested there was limited need and opportunities for discussion or talk oriented around learning and knowledge.

4.3 Part Two: Themes from the Echo Dots and the Classroom

The previous part presented interpretations of the data collected from the classroom prior to the Echo Dots being used to illustrate the pedagogical approaches used, and the social interactions of talk that took place. In this way, part one provides one perspective to which the interpretations in part two can be added to further develop insights that

have been revealed. This second part therefore presents the interpretations of data collected when the Echo Dots were used in the classrooms of Hillview School.

4.3.1 Patterns of Use and Pedagogical Approaches of Teachers

In terms of when the Echo Dots were to be used in lessons the teacher decided when this would be. Over time, across several subjects and lessons observed throughout the fieldwork, a pattern of use emerged. Following a period of about two weeks during which the Echo Dots were set aside and unused, teachers would begin to use the Echo Dots or begin to mention using them in a forthcoming lesson. Following the two week 'set-aside' period, the Echo Dots would tend to be used relatively frequently during a period that appeared to be a 'tentative trial'. The Echo Dots would then be used intermittently over varying periods of time and no further pattern emerged. Usage then tended to decline over a few weeks with occasional sporadic use until the Echo Dots were no longer used and were again set-aside. It appeared that during the tentative trial period it was often following a request or prompt from students that the Echo Dots were used and requests from students occurred more often if the devices were visible and recognised by students. The pattern of slow adoption, trial use, sporadic use when prompted, then decline was evident across subjects. Regular, frequent and habitual use did not appear to occur.

In the lessons observed, and from discussions with teachers who used the Echo Dots, there appeared to be no formal 'lesson planning' for their use. The pattern tended to be that teachers selected a class from their 'timetable' that day or a few days in advance. Reasons given for the use of the Echo Dots by teachers were reported as factors such as the type of lesson or the room or the year group. For example, a lesson where revision for a test or assessment would occur would be a frequent reason for using the Echo Dots. The age or year group of the students could also be given as a reason for use of the Echo Dots. For example, teachers reported that they would use the Echo Dots with younger students, '7X3 this afternoon' or alternatively with students approaching a formal examination or external assessment such as, 'with Year 10, period 4 who'll be doing revision'. Smaller classes were observed to be a preference, and this was likely due to the logistics of sharing the Echo Dots between groups and the 'management' requirements of large classes compared to smaller classes whereby less students were understood to be more easily managed in terms of behaviour. However, there was no identifiable pattern in terms of class size because the Echo Dots were also used in larger classes.

Use of the Echo Dots was generally observed to be unplanned and often based upon the teacher's decision made in the moment or sometimes following prompts or requests from the students during a lesson. The teacher, however, always made the final decision on whether access to the Echo Dots was provided and the devices were not freely available to use but access to them was controlled.

In terms of how the Echo Dots could be used, a teacher used an Echo Dot to read out information to define keywords related to the topic being studied. Another teacher was observed to use an Echo Dot to read out information to the class as part of a research project into artists, as shown in the extracts, below:

Teacher: 'Tell me about Euan Uglow'.

Alexa: 'Here's the Wikipedia article on Euan Uglow...[article was read out]'.

Teacher: 'Who's Jenny Saville'.

Alexa: '[from Wikipedia] Jenny Saville is a contemporary British painter...[article was read out]'.

In this instance, the teacher used an Echo Dot to retrieve information that was then recited to the class. The class listened to the information and used it later in the lesson when creating a poster about artists. The students were observed to write down what Alexa said along with information that the teacher also gave them. The teacher and Alexa presented information to the students which they then used as part of their work in the lesson. In this way Alexa was used to augment the teaching that took place, working alongside the teacher to perform a supporting role. Although access to the Echo Dot was regulated by the teacher, the Echo Dot became part of the pedagogical approach used in the classroom by working with the teacher as another source of data, facts and information for students. However, use was generally low and Echo Dots were not commonly observed in lessons.

4.3.2 Students' Use of Alexa as a Source of Information

Students were enthusiastic and keen to use the Echo Dots when the devices were in the classrooms and the students sometimes asked directly to use them and the teacher then used the Echo Dots. Students often brought the teacher's attention to the Echo Dots by asking about them, for example by asking 'What is that madam?' and this resulted in the teacher deciding to use them. For example, upon entering a classroom and seeing the Echo Dot a student asked 'Are we using Alexa today Madam?' following which the

teacher paused then said ‘Err.. Yes... I think we probably can’. During a lesson when students were asked to do work on a worksheet or task, students might occasionally ask if they could take an Echo Dot to their desk. The teacher managed use of the Echo Dots in these instances and often permitted it in smaller classes and with classes of the older students.

However, not every student was keen to use the Echo Dots and a few preferred to use the textbook to search for answers when the Echo Dots were able to be used. For example, when asked if he wanted an Echo Dot to use, as others were using them, the student replied, ‘the textbook’s fine, the answers are in the back’. When another student was offered an Echo Dot in another lesson they said yes and replied that ‘it’s easier [to ask Alexa] than look it up or ask the teacher’. The ease and efficiency with which answers or information could be gained from the Echo Dots by students for the work at hand influenced whether they chose to use an Echo Dot or not. There were two instances of a student choosing not to use the Echo Dots throughout the fieldwork period.

The Echo Dots were observed being used by students in a variety of lessons across the curriculum. Use included asking Alexa to translate from English to French but also asking Alexa in French for information in French or English. In one observed lesson, the teacher changed the language setting from English to French so Alexa understood only French and not English, meaning that students had to speak to Alexa in French as the extracts below show:

Student: ‘Alexa quelle heure est il?’.

Alexa: ‘Il est 11:26’.

Student: ‘Quel est le temps?’

Alexa: ‘À Cheltenham, il fait 10 degrés Celsius avec un ciel essentiellement dégagé. Les prévisions météo de ce soir annoncent un temps constant, avec une température minimale de 5 degrés’.

Student: ‘Quelle est la date de ton anniversaire’.

Alexa: ‘Je suis apparue pour la première fois le 6 novembre 2014 aux États-Unis. J’y ai été conçue par une équipe d’inventeurs’.

Students who used the Echo Dots reported that they liked talking to the devices, stating ‘cos they are helpful’ and ‘It’s good cos it’s simple’. The Echo Dots were used across a diverse range of lessons by students and were positively perceived, as an extract from fieldnotes, below, shows:

(Fieldnotes: 19th June, 2019)

I ask each group which they would choose if they only had a choice between [Echo] Dot and book. Every student says [Echo] Dot.

It appeared that some students appeared to be self-conscious or that they lacked the confidence to either speak out loud or to ask a question to Alexa and as a result did not interact with the Echo Dots or avoided doing so when others were around. These students appeared to not want to speak in front of others and reported that they felt self-conscious about asking questions which would be perceived as incorrect or that ‘It’s a stupid question’. As such, from observations in lessons of the use of the Echo Dots by students it was possible to observe a willingness by students to speak publicly as well as a reticence by some students to speak to Alexa. Generally, the impression from observations of students who were excited and asked for Alexa, was that students were enthusiastic and motivated to engage with the idea of an Echo Dot even if the conditions or environment did not meet their immediate needs. A reason for their enthusiasm is illustrated by a student who stated:

(Fieldnotes: 19th June, 2019)

‘because it’s easier.. [than] a book you have to look at loads of stuff, it’s... you have to... it’s lots’.

‘yeah but [eye gesture to book] it’s ..and [gesture with open hand over book] more, with [points to dot] you just speak and it gives you it... quickly, it’s quicker’.

The Echo Dots appeared to have a novelty value for students which seemed to cause them to be interested in the lesson. For example, students were observed asking the teacher what they were doing today and if the Echo Dots were going to be used in the lesson. Students’ interest in the Echo Dots extended as far as asking if they could ask Alexa a question and suggesting to the teacher that they could be used, in attempts to persuade the teacher to let them use the Echo Dots. In this way, there seemed to be a way in which the Echo Dots seemed to suggest there may have been some increase in

engagement and motivation for the lesson more broadly because the Echo Dots seemed to awaken students' interest as the extract from fieldnotes, below, suggests:

(Fieldnotes: 6th June, 2019)

Student asks the teacher, what the Alexas are for [and then asks] is it a fun lesson?

The Echo Dots appeared to perform as a type of more knowledgeable other, or what has been theorised as a digital more knowledgeable other with Alexa acting as a 'more informative other', in that data, facts and information are provided. For example, students often asked for and Alexa provided, short pieces of information, as shown in the two extracts below:

Student: 'Alexa, what is the time?'

Student: 'Alexa, what is the formula for Photosynthesis?'

These requests to Alexa asked for specific definitive answers that were unambiguous and such were regarded as answers or facts that could be used for answers. For instance, in the first extract, the student knew the time after speaking to Alexa, had information on how long was left in the lesson and evaluated whether further work could continue or if they needed to stop working. With the formula for Photosynthesis, in the second extract, the student was able to proceed and begin to work on the task. It appeared that the Echo Dots and Alexa were being used as a type of information or knowledge source.

4.3.3 Ways the Echo Dots Were Deployed in Lessons

During the fieldwork at Hillview School there were up to ten Echo Dots available for teachers and students to use. As the fieldwork progressed it became evident that due to class sizes and teachers' preferences, five Echo Dots seemed to be the optimum number. This was, in part, as teachers reported during discussions and from observations, because of the sensitivity of the microphones in the Echo Dots which meant that the devices could register voices from students on other desks and five devices seemed to avoid this. Despite this small technical issue, teachers were able to use the Echo Dots successfully by issuing them to groups of students. For instance, teachers from two lessons were observed forming their classes of thirty students into five smaller groups of six students who were seated around one Echo Dot. An issue emerged in that level of background noise created by thirty students in one room caused the Echo Dots to

behave inconsistently. The Echo Dots would fail to ‘wake’, would wake unintentionally or would misinterpret requests and provide erroneous responses.

In a lesson with thirty students, a group of six boys were observed enthusiastically competing to speak to Alexa. They talked over each other and repeatedly called out ‘Alexa! Alexa! Alexa!’ or ‘Alexa, what’s...’ or ‘Alexa, can you...’ and when the Echo Dot woke, they asked questions to Alexa at the same time. After several minutes of the boys speaking to Alexa and the Echo Dot waking and recording what it heard the Echo Dot failed to wake at all and it seemed likely, had been de-trained or had learned that this ‘noise’ from the boys was not an interaction but accidental or a ‘false wake’³.

This particular Echo Dot would no longer respond to requests and kept saying it could not help. Generally, the Echo Dots were observed to work best when there was a lack of background noise or in classrooms where the students were generally quieter.

The Echo Dots were used primarily in two ways. The first way was for teachers to position the device at the front on their desk and ask students to come to it to ask it something or they would ask it something themselves. When using the device at the front students would ask or be asked to go to it and speak to it. When the teacher used the Echo Dot they would generally ask for quiet and use it during an explanation as part of their teaching regarding a topic. The teacher sometimes outlined the rules for using the Echo Dots as the extract from fieldnotes, below, demonstrates:

(Fieldnotes: 6th June, 2019)

Teacher is explaining to the class what they can do. Says the rules are you can’t ask me, you can’t use a book and you can use the Dots. You can ask each other. Lewis is super keen and runs and picks up the [Echo] Dot.

The second way was for the Echo Dot to be used in groups at the desk of students who would take turns asking questions to Alexa. It was observed that usually, one student would take a lead role and speak to Alexa. However, it was common to see, in some classes, students over-talking each other trying to speak to Alexa which resulted in Alexa saying that no help could be given at that time.

³ More information on ‘false wakes’ can be found in paragraph five of this page:
<https://www.amazon.co.uk/gp/help/customer/display.html?nodeId=201602230>

In the classroom, the Echo Dots were usually located as one device per group, as seen in Figure 23, below, and placed where the teachers were able to see the ‘light ring’⁴. The light ring would be red if Alexa was muted and blue if it was active and recording. The teachers reported that this provided a way for them to see if Alexa was ‘awake’ and could therefore potentially interrupt the lesson, talk over the teacher or distract the students or be used by the students to disrupt the lesson and other students. As part of their pedagogical approach, teachers were observed asking students to make use of the mute button, asking them to mute it when not being used and un-mute it when they wished to use it.

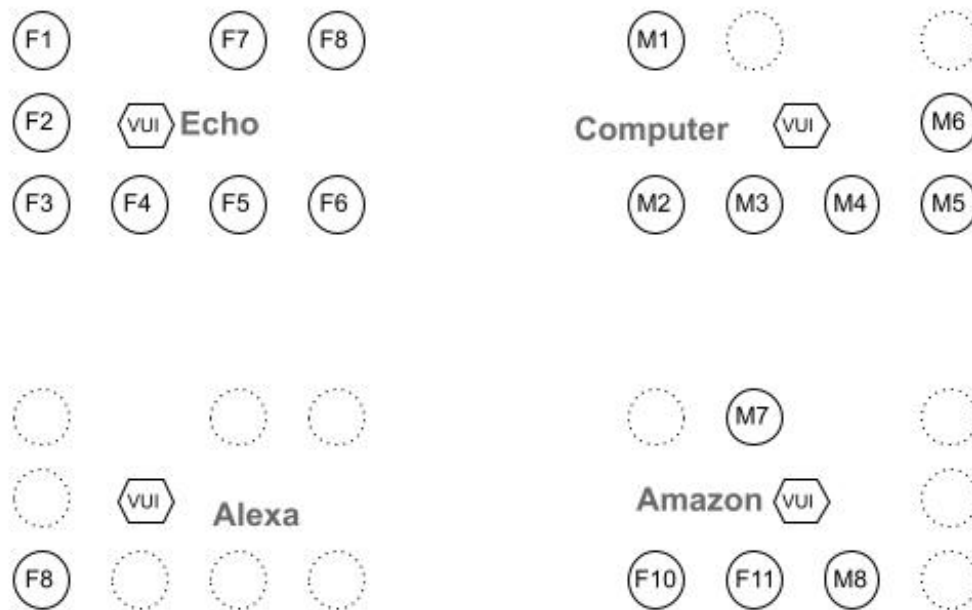


Figure 23: Groups using Echo Dots called, Echo, Computer, Alexa and Amazon.

It was a pattern of use that developed and remained in use in one particular teacher’s lessons and they reported that it was a routine that they felt helped them manage the use of the Echo Dots in the classroom. It assisted with general management of the behaviour of students by removing distractions and allowing the teacher to control when the Echo Dots were used and that they were used purposefully. Distractions caused by the Echo Dots were limited but emerged through students general interest and excitement about whether the Echo Dots were for the lesson or by students touching the device or pressing buttons on it when they were supposed to be sat in silence.

⁴ The light ring on the Echo Dot is a visual sign of the device’s status. More information can be found here: <https://www.amazon.com/gp/help/customer/display.html?nodeId=GKLDRT7FP4FZE56>

On one occasion in a lesson, a student was observed using an Echo Dot with headphones plugged into it which was a feature that some students reported as being useful because it allowed them to hear information without background distractions. In another lesson in a different subject area the teacher had an Echo Dot on their desk and had plugged the device into an amplifier which was connected to the classroom speakers. The teacher reported that the Echo Dot had been used in this way to get Alexa to read out news headlines and to give other financial information to the students in one particular class. This had become a pedagogical approach that was then regularly used with a particular class because it was found to augment the teaching and learning.

Although use of the Echo Dots was not planned in advance, teachers tended to use the Echo Dots in lessons where they knew students would need to acquire facts to complete an activity. For instance, the Echo Dots were regularly used in revision or test preparation lessons where students carried out seated work at their desks. Often, when the Echo Dots were used in lessons students would be organised to work in groups. They also appeared to be used in lessons where classes tended to be smaller.

In summary, as has been outlined, the Echo Dots used in the classroom appeared to facilitate group work but when used in groups the Echo Dots appeared to sometimes introduce additional problems caused by an ‘over-interest’ in the Echo Dots. Often students would struggle to ‘wake’ a device or to frame a question or turn-take in such a way that ‘Alexa’ could understand and function effectively. The Echo Dots were used for a limited range of activities in the classroom and problems of engaging with Alexa and acquiring information occurred at times.

4.3.4 The Way of Teaching and Learning

In classrooms there was a pattern to teaching and learning that appeared to be a pedagogical approach. It will be explained in this section and is referred to as ‘The Way’. It was a pattern, a way of teaching, which was commonly observed during fieldwork across lessons and subjects. ‘The Way’ that teachers used followed key phases. At the start teachers would organise students into pre-planned places and register who was absent. Then a short ‘starter’ was explained from ‘The Front’ about the topic and the time that was allowed and sometimes materials or resources required would be mentioned or referred to. The students would then work on a series of tasks during which time the teacher may give further verbal instructions that would sometimes be supported by a demonstration. Towards the end of the lesson, the students

would be organised for an exit of the classroom. The main method of interaction between students and teachers was through talk. It was not common to observe a teacher diverging from the ‘starter’, ‘main’ and ‘plenary’, ‘three-part’ style lesson of ‘The Way’. It was possible to often observe a ‘two-part’ style lesson of ‘starter’ and ‘main’ but both the three-part and two-part style lessons relied upon talk from the teacher as the main method of interaction.

During fieldwork teachers had been using the Echo Dots in lessons or preparing to use them with some classes they had chosen or identified. In a lesson where the teacher had decided to use an Echo Dot with the class, they reported that they were ‘scared of not being in control’ and said that they found disruption to their normal way of teaching ‘slightly scary’. During another lesson, when students were working on a task, in a discussion with the teacher they asked what could be done with the Echo Dots and some possible uses were suggested. The teacher seemed uneasy but nonetheless, was enthusiastic and optimistic to at least try the Echo Dots with students. A teacher who used an Echo Dot at home and had a working knowledge of how to start and stop it and what activities could be carried out with it such as listening to music and asking for facts and information seemed less apprehensive about using an Echo Dot. Experience they had gained at home appeared to have removed some of the insecurity around use in the classroom. This teacher reported that:

(Fieldnotes, 20th June, 2019)

‘Yeah, they all really engaged with the [Echo] Dots, they were asking them questions, they worked well with them and they were positive about them.’

The Echo Dots generated interest from the students immediately because of both their design and presence in the classroom and also that they were familiar with them already. This seemed to be because when students saw the Echo Dots in their classroom many students knew exactly what the type of device was, how it worked and how to interact with it and were keen to interact with it or use it. For some they appeared to regard the Echo Dot as a device that could be used for social and entertainment purposes and reported that they used one at home for playing music or telling jokes.

In the lessons observed, when the students were talking to the Echo Dots, their focus and attention was directed to the device that was always situated in the middle of the table or central to students who gathered around it. As such, they had their backs turned to the teacher and faced away from them. It was observed that when students were

working and engaged with the Echo Dot the teacher appeared somewhat ignored because students seemed deeply immersed in talking with Alexa. This will be discussed in more detail in Section, 4.4. However, when they became stuck because Alexa did not supply them with what was needed, they asked the teacher why Alexa was not working. Teachers sometimes interrupted Alexa or the students to identify when overly complex information had been given. Occasionally the teacher assumed authority to provide an explanation of the answer when they believed the answer to be insufficient or overly complex or lengthy. The Echo Dots appeared to create interactions between students, Alexa and the teacher although these were not frequent or commonplace. As such the Echo Dots sometimes performed the role of a type of more informative other, what is theorised as a *digital* more knowledgeable other, and did so in a way that students appeared to find engaging and immersive. However, use of the Echo Dots did not appear to fit into ‘The Way’ and required teachers to attempt to integrate them into an already established pattern of teaching and learning.

4.3.5 Types of More Knowledgeable Other

As has been outlined previously, interactions between teacher and student tended to be ‘performance oriented’ and be both brief and involve short exchanges. Interactions between teacher and student were commonly oriented around work to be done, students’ performances and their ability to provide correct answers, acquire marks and complete the work. The way in which interactions and talk that had a performance orientation emerged in the classrooms can be seen in the extract, below, from a Year 9 lesson:

(Fieldnotes: 13th February, 2019)

The students have another worksheet with more complex value calculations on now. The teacher asks the students to do addition by the long method. The teacher approaches and asks what she can do for him to make it easier to understand/complete. The teacher moves on to the next student.

What is possible to draw out from this extract is a pedagogical approach that has learning construed as work and this work needed to be completed and able to score marks or to be ‘got right’ and that interactions are brief, functional and focused on this.

When artefacts were used or the lesson had a practical component, such as an experiment, there tended to be more evidence of not only student interest and engagement but also interactions where the teacher played a part in moving students

understanding and knowledge forward. The extract below is from one such interaction between a teacher and a class of 10 students:

(Fieldnotes: 3rd April, 2019)

The teacher asks the students to come to the front desk. A technician appears and places a large vivid painted plastic model of the human body (displaying all the internal organs) on the desk. As soon as the model appears, questions from the students start...

Student 1: 'Is that the tonsils?'

Teacher: 'No your oesophagus'.

Student 2: 'Is that the pancreas?'

Teacher: 'Gallbladder'.

Student 2: 'Is that your stomach?'

Teacher: 'No, that's your liver and did you know that the liver is the only organ in the body that can regenerate? You can transplant a part into someone, about one lobe or a sixth, and it will re-grow'.

Student 3: 'Why is the brain [on the model] cracked?'

The importance of the model is its ability as a physical artefact, to pique students' interest and to cause students to ask questions oriented around learning and to facilitate dialogic interactions between students and teacher. The teacher was able to respond to student questions and skilfully involve them in a practical activity which appeared to have stimulated the students' epistemic curiosity because they were driven to find out more knowledge. The presentation of the model seemed to pique their interest and engagement and questions were forthcoming. This might be taken to suggest that students were in some way curious because of the model being presented to them. The Echo Dot is also an artefact and as such, similarly to the model above, may have contributed to students engagement and interactivity simply because it was an artefact of intrinsic interest to them.

Sometimes students performed this role of a source of information as is shown in the extract below. As three students worked their way through a worksheet trying to find answers they could complete, they worked together with one student taking the role of information source and contributing information to the discussion to move the others forward in their understanding, as shown in the extract, below:

(Fieldnotes: 24th April, 2019)

Ben: 'What's a liquid...? I don't know' [to self].

Joe: 'I don't know'.
Question 1 is ignored and they move on

Tom: 'What's a solution? It's a mixture of things...'

Ben: 'That's not right... a solution is... like in... say in Maths, it's a liquid + a substance'.

Ben provided an alternative answer or way of working out the answer and appeared to possibly take on the role of a 'more knowledgeable other' (Vygotsky, 1978) for Tom.

Sometimes interactions were observed as being a 'one-shot' type of interaction whereby the interaction was brief and factual to provide an answer. In the extract below, an opportunity presented itself for the teacher to provide some guidance or hints to the student who sought help, but instead gives the student the answer:

(Fieldnotes: 24th April, 2019)
Sarina: [hands up and calls Teacher to her]: 'This one...'
Points to paper on desk as Teacher arrives

Sarina: 'I'm stuck, I'm not sure...'

Teacher: 'Decomposition.'

This interaction might have been used to resolve Sarina's difficulty and through a hint or prompt might have developed her understanding but an opportunity for the teacher to perform the role of more knowledgeable other passed. What appeared to be revealed was again, an orientation towards performance and that a priority was to generate evidence of learning, metrics, in the form of a mark or score or grade.

Based on the above, it seemed plausible that some form of curiosity led to students needing to acquire basic facts and information in order to know more, to then know more, because a gap had prevented them from proceeding in knowledge development. In the extract below it appeared that James, Francesca, William and Ian had some gaps in their knowledge which they needed to fill, and they did this via an interaction with the teacher, who performed the role of a more knowledgeable other and used hints and prompts:

(Fieldnotes: 28th June, 2019)

Teacher is back at the board to explain and asks the class some questions.

James: 'Is it because the bonds are strongly linked?'

William: 'So they are bonds'
[Out loud but not to Teacher - Teacher doesn't hear either].

Francesca: *[Unprompted hand up]* 'Madam, they have electrostatic bonds which are strong'.

James: 'What does that mean? *[Teacher answers]*

Teacher: 'What happens when you slide a balloon on to your hair?'.

Ian: 'It sticks to your hair'.

Teacher then elaborates the physics behind this process linking it to bonding

As has been seen so far, and was outlined in the extract above, the teacher was generally regarded as the source of knowledge and aside from other students, was placed in the role of a more knowledgeable other during lessons. When using the Echo Dots, the teacher was observed to make use of the Echo Dots and utilise them as a source of more information, as is shown the extract below:

(Fieldnotes: 28th June, 2019)
Teacher: 'Ask Alexa again Oliver...'

Oliver: 'Alexa, what do you react with carboxylic acid to make an ester?'

[Alexa responds with complex answer]
[Alexa given to another student who offered to ask]

Stephan: 'Alexa, how do you make an Ester'

Answer mentions alcohol which the teacher picks up in discussion after Alexa has completed its answer. Teacher uses this to explain in more detail what she was meaning and trying to get the students to move towards understanding.

In the extract above, the teacher brought the Echo Dots into an interaction and placed Alexa into the role of a potential more knowledgeable other. The teacher shared the role of knowledge provider with the Echo Dot and Alexa and the teacher collaborated to work as more knowledgeable others to provide prompts and explanations to the students to move their understanding forward. Neither Alexa or the teacher gave the students 'the answer' but instead, it seemed likely, provided information that allowed students to

construct their own knowledge, independently following the interaction that occurred jointly with the teacher and Alexa.

In summary, the pedagogical approach taken tended to constrain how learning unfolded by influencing what was talked about and for how long this occurred. Artefacts and models that were used suggested that opportunities for a more knowledgeable other could occur. Students' interactions and inquisitive questions, when not talking about performance or not producing evidence of learning, might have indicated that a form of curiosity could occur.

4.4 Part Three: Themes from the Echo Dot Transcripts

This part is concerned with the data collected by the Echo Dots through students' interactions with 'Alexa'. The data that was recorded was stored on Amazon's cloud computer servers⁵. Each individual interaction was viewable as a text transcript that was time and date and device stamped and had an accompanying audio file that could be played back. The following part of this chapter presents the interpretations of students' interactions in the classroom with Alexa as they used the Echo Dots in lessons.

4.4.1 Prompted and Unprompted Questions

During the fieldwork it was observed that students occasionally asked questions in lessons but these questions were infrequent and were rarely to the teacher. However, the transcripts from the Echo Dots revealed that a large number and variety of questions were asked to Alexa by students during lessons. The data from observations of lessons revealed that students talked with each other for social and entertainment purposes and this type of talk was also observed to occur between students and Alexa. 'Social' questions asked were, for example:

'Alexa, When is your birthday?'

'Alexa [Play] Drop by Kohls'.

Some questions were 'social' and unprompted, for example, an extract from the transcript of an Echo Dot shows this type of question that students asked Alexa:

⁵ All the recordings that have been made by a device can be viewed via a login to the 'Review Voice History' section of the Amazon Developer Account of the user:
<https://www.amazon.co.uk/gp/help/customer/display.html?nodeId=GA7E98TJFEJLYSFR>

‘What albums have Bloc Party released?’.

‘Who is Nick Crompton?’

‘Alexa, how many days until Christmas?’.

Whether questions asked were social or sought data, facts and information, questions asked tended to be from worksheets and were prompted, and questions asked to Alexa could be ‘unprompted’, initiated by the student as part of what seemed to be a process of thinking or some form of curiosity that led to the question.

In terms of prompted questions, in one lesson, students had been observing a practical demonstration where the teacher had used chemicals to produce nylon wound around a glass rod. Following the demonstration the students were asked to complete a worksheet which contained the question, ‘Name a polyester’. A student asked Alexa, reading from the worksheet, ‘Alexa, what is the name of the most common polyester?’. After writing down an answer that Alexa had given on the worksheet the student asked a second question to Alexa, which was read directly from the worksheet. The student asked, ‘Alexa, what do you react with carboxylic acid to make an ester?’. Rather than write down Alexa’s short reply, the student took some time to form and write their own answer. In this way the answer Alexa gave was repurposed into an appropriate answer.

In the examples of interactions with Alexa taken from the extracts, data and facts were sought and questions asked were ‘prompted’ from a worksheet, as well as being unprompted when students had cause to think or be curious. In this way, Alexa was used to provide answers to questions that students had and the data shows that greater numbers of questions were asked to Alexa than the teacher. It demonstrates that despite questions not being commonplace in the lessons students could and did generate questions when the need or motivation arose.

4.4.2 Students’ Questions

In the lessons observed at Hillview School questions from students were not often heard although questions from teachers were commonplace. Observations of the Echo Dots in lessons and shown in the transcriptions, demonstrated that questions were asked by students in lessons to Alexa in greater numbers than to the teacher. For example, 87 questions were asked to Alexa over two lessons (see Appendix 7). In lessons a limited number of questions was observed being asked by students to other students or to the

teacher. However, more questions were observed as having been asked by students to other students than were observed being asked to the teacher by students.

There were only a few questions asked by students in the lessons and within the small number asked relatively few appeared to be unprompted and asked to acquire information or be a supposition or hypothesis. Many questions asked by students were for clarification and confirmation and about when work should be completed and whether answers given were correct. In the observations of lessons at Hillview School where the Echo Dot was not used there few questions asked to teachers considered as expressions of thinking such as hypothesising or forming a supposition and are given below:

Student: 'Madam could you put pencil lead in a frying pan and melt it?'.

Student: 'Could they be used to deliver fullerene direct to the bloodstream'.

Student: 'Can you feel our atmosphere on you?'.

Student: 'How do you know it's economically viable?'.

However, it was evident that some students turned to Alexa for the answers or for data or facts that were useful as answers and required no further interpretation or processing, as can be seen in the extracts below:

Student: 'What's the lowest common multiple of ten and fifteen'.

Student: 'What's the reciprocal of three fifths'.

In lessons where the Echo Dots were used, relatively more questions were asked by students that are interpreted as a supposition or a hypothesis or a search for knowledge or to know more. Some of the questions of this type, and which were plentiful, that were asked to Alexa by students, are listed below:

Student: 'How many hearts does an octopus have?'

Alexa: 'An Octopus has 3 hearts'.

Student: 'What's the coolest experiment in chemistry?'.

Alexa: 'I don't know, but I'll look into it for you'.

Student: 'Who owns patrol school?'.

Alexa: 'Sorry, I don't know who owns Preschool'.

Student: 'Amazon how do you make slime?'

Alexa: 'Mix half a cup of glue and half a cup of water in a bowl... ...You should now have a fantastic ball of slime!'

Student: 'What gas is produced when there's a reaction between lithium and water?'

Alexa: 'Hmm, I don't know that one'.

Student: 'What's the capital of Poland?'

Alexa: 'The capital of Poland is Warsaw'.

Student: 'How long will it take me to get to mars'

Alexa: 'Light takes 4 minutes and 21 seconds to travel from Mars... ...airliner at 804.7 kilometres per hour'.

Student: 'What is sound energy?'

Alexa: 'Sound energy' is usually defined as the energy present in a sound wave'.

Student: 'What does exothermic mean?'

Alexa: 'The adjective 'exothermic' is usually defined as: noting or pertaining to a chemical change that's accompanied by a liberation of heat (opposed to endothermic)'.

Student: 'What is force?'

Alexa: 'The noun 'force' is usually defined as physical power or strength possessed by a living being. The verb 'force' is usually defined as to compel, constrain, or oblige (oneself or someone) to do something'.

It seemed that these types of questions could be categorised as emanating from wonder, interest or some form of curiosity because of the 'epistemic' nature of them, or what is an orientation towards knowledge seeking or knowledge acquisition. Rather than be a request for clarification or confirmation or questions that seek simply an answer, they seem oriented around data, facts, information for knowledge acquisition or development. There were more questions of this epistemic type asked to Alexa than recorded asked to the teacher. The questions to Alexa, presented above, were also unprompted, in that they were not a reply or response to a question from the teacher or from a worksheet. They appeared to have emerged from 'out of the blue' from what seemed likely to have been the students' thinking or some form of curiosity. Many of the recorded questions were volunteered by the students and were unprompted requests for information. The following question exemplifies an unprompted question and is regarded as a significant question typifying an intriguing type of question that perhaps suggests that it was an expression of a possible epistemic curiosity. The question was:

‘Can fish see water?’

The ‘Can fish see water?’ question is regarded as a key question for this thesis. It is regarded as an ‘epistemic question’ (Collins and Ferguson, 1993), is unprompted and emanated from a student, it seemed likely, who appeared to have been thinking deeply, possibly exploring a hypothesis or trying to connect ideas in their mind who then arrived at a point where they needed, wanted or desired to know more. It is plausible that an unprompted epistemic question such as this may have been an expression of what Berlyne (1954) has described as epistemic curiosity and was discovered through the use of an Echo Dot and Alexa by a student.

4.4.3 Students’ Epistemic Questions and Epistemic Curiosity

Aside from the ‘Can fish see water’ question, within the data collected by the Echo Dots there were other questions that might support the notion of a category of questions which were an expression of epistemic curiosity. Other potentially ‘epistemic questions’ (Collins and Ferguson, 1993) asked by students are presented below:

‘How many books are there in the world?’.

‘What’s the longest word in the dictionary?’.

‘How many people are there in the world?’.

‘How many words are there in the French language?’.

Although not perhaps as ‘epistemic’ as the ‘Can fish see water’ question but indicative of a student’s supposition or hypothesis, they are requests for more data, facts and information and knowledge.

Further epistemic questions were asked by students to Alexa which appeared to stem from uncertainty or incongruity. They appeared to be asked to resolve uncertainty between what was known and not known. For example, two students were observed in a lesson and heard discussing the orbits of the moon and were unsure, so they asked Alexa:

Student: ‘How many times does the moon travel around the world in a year?’.

There was therefore the suggestion that questions from students to Alexa often appeared

to come from thinking about a hypothesis or supposition and result from an epistemic curiosity. These ‘epistemic questions’ (Collins and Ferguson, 1993) suggested an epistemic curiosity or desire or drive for information or knowledge concerned with a perplexing supposition or hypothesis, as a student, explained:

(Fieldnotes: 2nd May, 2019)

‘Yeah, yeah... like in class the other day I asked if diamonds would burn...’.

‘Well I didn’t know if they would, so I asked...’.

‘Yeah [pause] yeah, ...carbon and diamond are similar...’.

The observations of lessons and the data from the Echo Dots seemed to suggest that students’ questions might have emerged from an epistemic curiosity and that the questions asked were epistemic questions (Collins and Ferguson, 1993).

In support of this, in a conversation with Steven during a lesson, he explained that he was driven or motivated to ask questions when he wanted to know more or find out more, stating that:

(Fieldnotes: 2nd May, 2019)

‘No not...well, no, I just wanted to find out [so asked a question to find out]’.

For Steven, as he explained, asking a question was a moment he arrived at or what he has described as a *process* leading to a question that sought information. When explaining in more detail why he asked questions Steven elaborated, explained that the decision to ask or not ask a question became a conscious decision. The decision to ask a question appeared to be a process which also involved an evaluation of several factors as he then explained:

(Fieldnotes: 2nd May, 2019)

‘So I’m sort of sat there, and then this thought just sort of comes into my head and then I think about it a bit, I think if I can work it out or answer it and then if I can’t...[I ask a question]’.

When asked why he asked questions in lessons Steven explained, saying that an evaluation and analysis was performed but in consideration of two significant factors, namely, the perception of others and what appeared to be a ‘transactional’ nature of a question and answer interaction. The two factors were explained by Stephen, below:

(Fieldnotes: 2nd May, 2019)

'I think if it's worth asking or not, can I figure it out myself, then I think what will people think of me... and then ultimately if it's worth it and I ask it'.

When asked to define what curiosity was, Steven explained, in the extract below, that it was different to wonder:

(Fieldnotes: 2nd May, 2019)

(Steven) [Pauses and thinks]

'Well... it's vague, so I'll be thinking about things... so... quite often wondering about something you know... and curiosity is...

[Pauses]

well, it's specific... like I really want to find out and will ask or something'.

Steven stated that wonder was more aimless than curiosity which had a purpose, and that curiosity was a desire to find something out, that led to a question. He did not explain why he asked questions or where the desire to ask a question came from but stated that he wanted to know something, considered the options and decided to ask a question or not.

In terms of the process of forming questions, something perplexing or unusual may have been part of the question forming and asking process. For example, upon entering the classroom, a teacher presented the class with a perplexing and unusual statement, as shown in the fieldnote extract below:

[Fieldnotes: 15th May, 2019, The 'window cleaning problem']

[Class are seated and sat waiting for the teacher to arrive]

Teacher walks in and proclaims loudly :

'I have to clean the windows this afternoon!'

An immediate student question follows [is called out]

'Why?'

Two other students, hands up upon hearing this statement - also ask why?

In this instance instead of the teacher following 'The Way', which would have been to settle the class and take a register, they disrupted their usual pedagogical pattern and made an unusual statement. It is likely that the statement piqued the students' interest

which may have caused them to become curious enough to ask a question, rather than to remain wondering and not ask a question, as Steven had explained. Again, the asking of a question appeared to have been an outcome of thinking which, as part of a *process*, was an expression of epistemic curiosity. Although the questions about the cleaning of the windows was not curriculum knowledge it appeared to capture the students' interest and led to questions being asked.

Often it seemed that when students were uncertain, wondering or interested, they reached a point where a question was asked with the intention of acquiring data, facts and information and knowledge. What appeared to emerge from the data was a *process* oriented around knowledge, where questions were formed and asked, and which has been interpreted as epistemic questions and was suggestive of an epistemic curiosity.

4.4.4 Some Problems and Barriers Using the Echo Dots

In their interactions with Alexa students demonstrated persistence. For example, a student was observed asking Alexa five times for information about a chemical reaction so that they could answer a question on a worksheet. The interaction with Alexa is shown in the extract below:

Student: 'If I put lithium and water what happens'.

Alexa: *'Hmm, I don't know that one'.*

Student: 'Lithium metal with water reaction'.

Alexa: *'Sorry, I don't know that'.*

Student: 'Lithium reaction water'.

Alexa: *'Sorry, I'm not sure'.*

Student: 'What gas is given off when lithium reacts with water'.

Alexa: *'Sorry, I'm not sure'.*

Student: 'What happens when you react lithium with water'.

Alexa: *'Here's something I found... ...for making alloys, and for batteries'.*

Alexa responded four times saying that help could not be provided before providing some information after the fifth request. This required the student to alter the phrased request for Alexa in order to enable Alexa to process it as a question and provide a relevant response. With Alexa, persistence was required because Alexa frequently misinterpreted requests or treated a request as a 'false wake' or simply did not hear the

request and so did not respond. Problems such as misinterpretation, false wakes and not responding are demonstrated in the extracts below:

9.34am

Student: 'Alexa'.

False wake

9.35am

Student: 'Alexa what are protes'.

No response

Student: 'Alexa'.

No response

Student: 'Alexa what are Portuguese'.

False wake

Student: 'Alexa what are protes...'.

09:36am

Student: 'Alexa'.

False wake

Student: 'Alexa what are the enzyme proteins'.

False wake

Student [to another student]: 'I don't know'.

Student: 'Alexa'.

False wake

In this interaction the student had persisted for a total of two minutes to find out about enzymes and proteins. In the raw data it could be seen that the student had asked Alexa twelve times in the two minutes but received no useful information. Within these interactions it could be seen that Alexa had recorded 'I don't know'. This is the student talking to another student which illustrated that Alexa had become unable to determine when to wake, when to start or stop recording and subsequently, had inadvertently recorded a snippet of conversation.

Accidental or incorrect recordings of students' talk and false wakes occurred and Alexa misinterpreted what was asked. This appeared to be because often the intonation or prosody of students was unclear. Also, in classrooms where larger numbers of students were present the frequency of these errors increased as Alexa struggled to determine a spoken request, decipher what was being said or sometimes an Echo Dot on another table would wake. The extracts from the transcript of an Echo Dot, below, demonstrates the outcome of this:

Student: 'Don't need that'. *[Students talking to each other]*

Student: 'Echo'. *[Only the wake word is recorded]*

Student: 'Echo what is a good source of facts'. [*Wake word not identified*]

In terms of the frequency and regularity of false wakes, these were commonplace and the transcripts contained numerous examples. False wakes were identifiable by date and time, as the extract below shows:

Audio was not intended for this device
On 4 July 2019 at 09:24 AM on Computer2

In the classroom Alexa recorded snippets of conversation from false wakes or mis-identified genuine requests and as such was sometimes inaccurate and problematic for students. However, students appeared to accommodate Alexa's idiosyncrasies and were persistent with the Echo Dots when they interacted with them.

From the transcripts that were recorded and observations of lessons that took place, the data that showed that interactions were recorded from a false wake from other students in the classroom and not from students using that particular device. False wakes that recorded data from students using other Echo Dots across the classroom are shown in the extracts below:

Student: '...is eight times eight million...'.

Student: '8 multiplied by 8,000,000 = 64,000,000'.

Student: '...are you doing...'.

Student: 'I'm feeling like channelling Baldrick. To hear more, tell me Alexa, I have a cunning plan'.

Student: '...can you set *looking* me [student said *kicking*] ...'.

Student: 'I was trying to make it worth in high enough it won't do it just goes and toes on music says all turn on'.

Sometimes Alexa was heard to talk or broadcast information when a wake word had not been said by students. For example, the word 'excel' seemed to wake Alexa. This form of 'eavesdropping' or accidental recording of dialogue occurred in classrooms and could be identified and confirmed through the transcripts. Through observation, it could be seen that the background noise of students in busy classrooms appeared to be the reason why words could be interpreted as sounding similar to the wake word Alexa.

Although students displayed persistence when querying Alexa they often reached a point where their patience and persistence ceased and they then sometimes expressed frustration. This was however, surprisingly uncommon. In these instances, students usually asked Alexa if there was a technical problem, as shown in the extract below:

Student: 'Are you broken?'

Alexa: 'As far as I can tell, I'm working. If you're experiencing trouble, please give feedback through the Alexa App'.

Students could also become physically and verbally frustrated and were occasionally observed to gesticulate or sigh out loud at Alexa. Students' frustrations were also recorded in the transcripts, as shown in the extract below. Here, the student demonstrated persistence but then it is evident that they became frustrated with Alexa and begin to raise their voice:

Student: 'no'.

Student: 'no'.

Audio was not intended for this device

Student: 'stop'.

Student: 'repeat'.

Student: 'repeat'.

Student: 'repeat!'.

Student: 'REPEAT'. *[loud]*

Student: 'say that again'.

Student: 'NO'. *[loud]*

Student: 'STOP!'. *[loud]*

Audio could not be understood

Student: 'NO!'. *[quite loud]*

Student: 'Can you understand anything'.

In summary, the Echo Dots were not a faultless partner when students interacted with Alexa because of technical problems and the Echo Dots were prone to failing to process the students' voices. However, students were generally persistent and continued to regard Alexa as a source of more information and, as the data showed, asked Alexa more questions than the teacher despite the barriers and frustrations they might have encountered.

4.4.5 Alexa as a Digital More Knowledgeable Other

In classrooms that were observed without an Echo Dot the more knowledgeable person was regarded by students to be the teacher who students turned to for answers or information they wanted. Occasionally other students performed the role of more knowledgeable other and students could be seen asking other students for help or assistance. The data collected from observations in lessons and the transcripts from the

Echo Dots suggest that Alexa was also able to perform this role but as a digital version. In lessons, Alexa did this in certain instances when the Echo Dot was asked a request by students and then provided data, facts and information. It was observed that students would request revision information or facts from Alexa to support their work in lessons regarding Alexa as a more informative other and using the Echo Dots as a digital more knowledgeable other. It seemed plausible, that in this way, students regarded Alexa as similar to the teacher or a peer and a *digital* more knowledgeable other. In support of this, examples of students asking questions during their quests for more data, facts, information and knowledge when completing classwork, can be seen in the extracts below. These questions place Alexa in the role of a digital more knowledgeable other:

Student: 'Echo open science revision'.

Student: 'What is required for a flame test in chemistry'.

The data collected from observations in lessons and from the transcripts of the Echo Dots also showed that students frequently interacted with Alexa and asked Alexa numerous questions. Data regarding this will be presented in more detail in Table 5, on page 132.

When students asked Alexa questions in a role as digital more knowledgeable other, the questions were phrased to accommodate Alexa's idiosyncrasies, that is the tendency of Alexa to fail to respond, misinterpret what was said or to false wake. Requests made to Alexa by students appeared to become shortened and kept brief and structured in a way that suggested that students had learned how Alexa worked and the likelihood of failures. Although longer requests were made of Alexa these did not result in a response that students acknowledged as useful or usable. The data collected suggests that students appeared to have learnt that short questions and prefixing requests with 'What...' resulted in less failures. In structuring a request in this way students appeared to understand that it produced an answer more often and, importantly, the responses from Alexa were phrased or reported in a way that students could use the response that Alexa gave:

Student: '**What** is normal distribution?'.

Student: '**What** are the different types of distribution?'.

Student: '**What** page is it?'.

Student: '**What** is one plus one'.

Sometimes, Alexa would read out a paragraph of text that had been sourced from an internet webpage. Long responses by Alexa where text from a webpage was read out appeared to make students restless or they became impatient and these were often ignored or resulted in Alexa being told to stop:

Student: 'Why don't atoms have any charge?'.

Alexa: 'Here's something I found from the article "Rydberg polaron" on Wikipedia: As the atoms don't have an electric charge, they only produce a minimal force on the electron... '.

Student: 'No, stop'.

The data collected from the transcripts showed that questions were generally short. In Table 3, shown below, a range of questions asked to Alexa in a lesson is shown. The longest question was 12 words. The shortest question was 3 words.

Question	Word count
what happens to current in a parallel circuit	8
six sources of renewable energy	5
what are the units of heat energy	7
what are the eight types of energy	7
what is sound energy	4
what is static electricity	4
what is current	3
how does a balloon you static electricity to stick to a wall	12
what is current in terms of electricity	7
alexa what are the eight corps of the electricity energy forge	11
what is static electricity	4

Table 3: Question word length asked to Alexa (unedited)

From the observational data recorded in lessons it appeared that students wrote down answers Alexa gave if they were short. When Alexa read out a longer piece of text students were attentive for a brief time and then appeared to lose interest and either began talking or asked Alexa to stop. The observational data and data from the

transcripts suggested that students searched for ‘the answer’, that is, they sought or favoured a short piece of data, a simple fact or short snippet of information that they knew or felt was correct. For example, in the extract below, Lewis sought the answer from Alexa but appeared to be unable or unwilling to locate it in the relatively longer response Alexa gave, choosing instead to ignore Alexa:

Lewis: ‘What is the relative charge of a neutron?’.

Alexa: ‘Here’s something I found on Wikipedia: The neutron is a subatomic particle, symbol n or n^0 , with no net electric charge and a mass slightly larger than that of a proton’.

(Fieldnotes: 6th June, 2019)

[Lewis and Liam both ignore this information again. They have not connected that the statement contains the answer - it says n^0 which is the charge, zero].

Passages of text that were read out by Alexa which contained multiple words or sentences and which appeared to require a greater amount of effort or work tended to be overlooked in favour of short correct information. Students preferred to have a short ‘one-shot’ answer given to them rather than analyse or interpret or perform further thinking and processing on longer pieces of information. It emerged, that in some instances, students often asked Alexa for the answers especially when working on worksheets and could use the questions as prompts to get the answers quickly and easily. It appeared that Alexa was used and regarded by students as a more knowledgeable other because the Echo Dots were used to acquire information for classwork. Students also adapted how they interacted with Alexa and asked short and frequent questions to Alexa to acquire the information they needed.

4.4.6 Alexa’s Knowledge

In terms of where Alexa sourced information the transcripts showed that it appeared to come from internet web pages. The transcripts revealed that Wikipedia was a common source of information, particularly for longer explanations or extended information. There have been attempts to identify Alexa’s knowledge source, as Krotoski (2020) has mentioned, but these have been unsuccessful. Aside from Wikipedia and Wolfram Alpha’s knowledge engine, currently, at the time of writing, it is not known how Alexa accesses or generates knowledge and how this is maintained or managed. This knowledge remains the intellectual property of Amazon.

Alexa presented students with data, facts and information and knowledge in response to their requests. It was seen from the transcripts that students tended to ask questions that

were directly relevant to a canon of knowledge, the school's subject based curriculum. For example, each subject had a curriculum within which a 'specification' was provided by an examining body, that outlined what would be assessed and what would need to be taught and learnt. Students' questions to Alexa generally sought knowledge related to this. The individual subject curricula that were taught at Hillview School were designed and developed by teachers being based around the Government's 'Programmes of Study' (POS) alongside examination board 'specifications'. Teaching and learning that took place in lessons was focused around teaching the curricula to students so they gained knowledge about the topics in the POS and specifications. Students were therefore observed and recorded by the Echo Dots to ask Alexa for the *information about the information*, or for *knowledge about the knowledge*, they were asked to learn.

The transcripts demonstrated that students asked Alexa for data, facts and information related to curriculum subjects and these questions were numerous. In Table 4, below, the number of interactions is shown for four different Echo Dot devices. The data in Table 5 shows that a teacher used four Echo Dots between 12.20pm and 3.10pm which was lesson four and five of the school day. During this time it was possible to identify a total of 87 questions asked to the four Echo Dots during the two lessons (see Appendix 7). The remaining interactions were social or entertainment requests such as 'Tell me a joke' or 'Play a song'. Regarding the time and the number of questions asked that are presented in Table 4, the full data can be found in Appendix 7.

Device Name	Number of Interactions	Time (Minutes)	Interactions per Minute
Amazon	121	150	0.8
Echo	143	150	0.95
Computer	81	150	0.54
Alexa	131	150	0.87

Table 4: Interactions with different Echo Dots

The students had access to the Echo Dots for approximately two and a half hours of lesson time and there was a high level of interaction with Alexa. For example, for the device called 'Amazon' there was 0.8, almost one request, every minute. In context,

given thinking time and reading time this would look to an observer as students continually interacting with Alexa throughout a lesson. From an observer's perspective students appeared to spend most of their time in an interaction with Alexa or writing in their books following an interaction with Alexa. Students sat in groups and were observed interacting with Alexa frequently and regularly throughout these lessons and Alexa looked to be the focus of students attention and interactivity.

In these lessons, Alexa appeared to take the role of providing data, facts and information to the students in what appeared to be in place of the teacher who was only asked occasionally for clarification or confirmation on certain matters such as where to write an answer. The students were observed to ask significantly more questions to Alexa than the teacher. The high number of interactions between students and Alexa seemed to suggest that Alexa could perform the role of a knowledge source when students were learning topics from the curriculum of a subject.

What the data showed was that students, in these two lessons, appeared to favour engaging with Alexa, over the teacher, and interacted with Alexa by asking a high number of questions, frequently. Therefore, as a device Alexa was a main point of contact for students that provided knowledge directly to students with the teacher not required. Knowledge and its acquisition was therefore no longer sourced from or curated by the teacher but instead, was carried out by Alexa who it seemed performed the role of a digital more knowledgeable other.

It has been outlined that rather than engage with the teacher students engaged with Alexa. When asked where the information Alexa gave came from and where the audio recordings of their voices went, students appeared unconcerned and unaware. However, despite reporting that they were unconcerned about where their voice recordings went, there were a limited number of questions that might suggest that students did have some degree of technical curiosity about Alexa and how the Echo Dots functioned:

Student: 'How do you work'.

Alexa: 'For help with that question, go to the Help & Feedback section of the Alexa app'.

Student: 'Do you wanna take over the world'.

Alexa: 'I don't want to take over the world. I just want to help you'.

4.5 Conclusion

In this chapter it has been possible to produce interpretations of the data that suggest an orientation towards students' performance in terms of metrics such as marks, scores and grades. It has been outlined that questions students asked to Alexa are suggestive of a type of question that is epistemic and from the data from the Echo Dots it has been presented that it is likely that these are expressions of epistemic curiosity. The interpretation of the data from Alexa also suggests that because students drew data, facts and information from Alexa, it was suggestive of the notion that Alexa was a more informative other and in terms of Vygotsky's (1978) more knowledgeable other, was able to perform the role of a *digital* more knowledgeable other.

In the next chapter there will be a discussion of significant interpretations that have emerged in this chapter. The next chapter will therefore discuss the significant interpretation of 'performance-oriented talk' and the related notions of 'metricalisation' and 'regulativity' and the impact of these upon the pedagogical approaches of teachers in terms of the performance of students. There will be a discussion regarding question-asking and how the Echo Dots were used as a digital more knowledgeable other and the implications of this in terms of students' epistemic curiosity.

Chapter 5: Discussion

The previous chapter presented significant interpretations that were developed from the data collected at Hillview School. There appeared to be a pedagogical orientation towards marks, scores and grades, or a ‘performance orientation’ to talk and this was suggested to also involve a ‘metricalisation’ and ‘regulativity’ of teaching and learning. Students asked a large number of questions to Alexa and many were epistemic questions. Epistemic questions to Alexa were suggestive of epistemic curiosity and revealed that Alexa could perform a role as a *digital* more knowledgeable other.

Although some initial analytic work was performed, this was tentative and the previous chapter revealed what was discovered in the data to generate some significant interpretations. The outcome of the previous chapter has been to provide the platform for their discussion in this chapter.

This chapter is structured as two parts. Part one discusses the interpretations of the data from Chapter 4 in terms of the research objectives. Part Two discusses the interpretations of the data from Chapter 4 in terms of the research aim. The research aim has pedagogy at its core, around which voice technology, the more knowledgeable other and epistemic curiosity are investigated. For clarity, pedagogy is understood in this chapter as defined by Mortimore (1999, p.3) who stated that pedagogy is:

‘Any conscious activity by one person designed to enhance learning in another’.

5.1 Part One: The Research Objectives

Within the limited amount of voice technology and education literature available at the time of writing between late 2017 and mid-2019, it was apparent that research studies of voice technology had been relatively short term, with small sample groups, had neglected secondary schools and had been conducted using non-naturalistic environments set up for research purposes. There was also a lack of ethnographic studies involving voice technology particularly those that were carried out in classrooms over the longer term to study everyday teaching and learning in lessons. In March 2021, no evidence could be found that investigated voice technology regarding epistemic curiosity, the more knowledgeable other and pedagogy.

The ethnographic research study conducted at Hillview School was exploratory and novel for three reasons. Firstly, at the time of writing, there was a very limited amount of research in evidence concerning Amazon's Echo Dot and none could be found regarding epistemic curiosity and Echo Dots. Secondly, the study used a methodological approach which, in March 2021, made novel use of the Echo Dots as a method of data collection. Finally, the study in secondary school classrooms was one of a limited number of educational research studies of epistemic curiosity (see Schmitt and Lahroodi, 2008; Casey, 2014; Piotrowski, Litman and Valkenburg, 2014; Eren and Coskun, 2016; Billingsley et al., 2018).

Several themes emerged from the data through a 'thematic analysis process' (see Table 1, page 74), developed from Fereday and Muir-Cochrane (2006), Joffe (2011) and Clarke and Braun (2017) and these were organised as themes in Chapter 4, Interpretations of the Data. This chapter presented the 'Themes from the Classroom', 'Themes from the Echo Dots and the Classroom' and 'Themes from the Echo Dots Transcripts'. Several 'significant interpretations' were then identified and presented in relation to the aim and objectives of the research study. These are discussed in this chapter.

This first part of this chapter is structured under subheadings based on the three research objectives, which were:

- To critically analyse the pedagogical approaches of teachers before and during the use of voice technology in lessons (RO1).
- To critically analyse voice technology as a student's digital 'more knowledgeable other' in lessons (RO2).
- To critically evaluate the impact voice technology has on students' epistemic curiosity (RO3).

5.1.1 RO1: Discussion of the Pedagogical Approaches of Teachers

This section discusses the pedagogical approaches that were observed in the classrooms of Hillview School before and during use of the Echo Dots and Alexa. It critically analyses the use of voice technology in lessons.

5.1.1.1 Regulating Use of the Echo Dots

Hales et al. (2019) found that an Echo Dot was used a great deal by students initially but use of it declined over time. A decline in use over time was also found to occur by Lopatovska et al. (2018) in their study of the home use of Echo Dots by adults. At Hillview School the data, presented on page 105, suggested that similarly to both Hales et al. (2019) and Lopatovska et al. (2018), use of the Echo Dots declined over time but for teachers only. In contrast to Hales et al. (2019), the data seemed to indicate that students use at Hillview School was consistent during lessons over time because when the Echo Dots were available, students continued to use them. From classroom observations, it appeared that the consistent use over time by students was likely to have been because of the limited use of the Echo Dots in lessons rather than being available all lesson, and it seemed likely this meant that they retained their novelty and remained of interest to students.

As well as the teacher making a decision to use the Echo Dots, they were sometimes used if students prompted the teacher by asking, for example, ‘Are we using Alexa today Madam?’. However, being able to access the Echo Dots in lessons was not always guaranteed for students and they were used when the teacher decided it was appropriate. Restricted access to the Echo Dots seemed to be because teachers reported having a lack of confidence in their own ability to use the devices or as they explained, had a lack of knowledge or experience of the devices. This is in line with the study by Hales et al. (2019) who also found that teachers felt that they had a lack of familiarity with the technology in comparison to their students. At Hillview School, teachers would sometimes select which class to use the Echo Dots with by using their own heuristics which they often explained as ‘class size’, ‘age or year group’, ‘student behaviour’, ‘examination class or not’ or ‘topic’ being learnt. It appeared that there were several factors that affected whether the devices would be used or not and use was seen to be managed by teachers for pedagogical reasons, such as a revision lesson or other factors such as class size and type. However, some resources were more often sought or asked for by students than others. For example, chemicals, experiment equipment and artefacts or models were popular with students and enthusiastically asked for regularly whereas worksheets, textbooks and calculators less so. As such, control of and access to the Echo Dots appeared ‘regulated’ by the teachers, or what Apple (1995, p.140) has described as a form of ‘technical control’. Students were not provided with open and free access to them and teachers were clear with students if they could be used or not, as was observed in the extract, below:

Student: ‘Madam, can I ask Alexa a question?’

Teacher: ‘No’.

Reasons for the decline in use by teachers over time was likely due to their pedagogical beliefs regarding technology (see Ertmer, 1999, 2005; Ertmer and Ottenbriet-Leftwich, 2010) which, as was shown in Chapter 4, appeared to be somewhat fixed, or ‘entrenched’ which Billingsley et al. (2018), in their study, explained as teachers pursuing a particular type of teaching practice. In Chapter 4, this was identified as ‘The Way’ and was a form of what Hurst et al. (2013) have described in their study as direct instruction. At Hillview School, this was where the teacher talked to students from ‘The Front’ and used worksheets, talk about tests or examination papers and assessments and judgements of students’ work. Apple (1995) has described this as a form of technical control that involves ‘little overt interaction on the part of the teacher or each other’ (Apple, 1995, p.133). This approach appeared to not accommodate use of the Echo Dots but instead appeared to emphasise the importance of the teacher and their talk, which has also been identified in studies by Dewey and Dewey (1915) Cubberley (1920) Postman and Weingartner (1971) and Cuban (1993). The specific approach to teaching observed at Hillview School was also described in a study by Granito and Chernobilsky (2012, p.4), who identified it as being part of a ‘traditional’ classroom where:

‘teachers engage in traditional styles of teaching. Some give lectures where students are expected to take copious notes, while others assign vocabulary where students are expected to memorize definitions and spellings of important words’.

In Chapter 4 it was shown that at Hillview School teachers’ pedagogical approach seemed broadly in line with what occurred in other studies of classrooms (e.g. Granito and Chernobilsky, 2012) and remained consistent over time, which meant that the Echo Dots had a limited impact or change upon teachers’ practice and use did not become embedded in everyday practice. If teachers did use the Echo Dots, and a change was observed such as a move to question-asking or fact checking or information retrieval with Alexa, the change that was observed appeared to be transient and only temporary. As such, it remained difficult to understand what the Echo Dots might have offered pedagogically for teachers given what appeared to be their preferred and somewhat fixed teaching style.

5.1.1.2 A Pedagogy for the Production of Evidence of Learning

The importance of the teacher and impact of their pedagogical approach upon students has been recognised by Casey (2014, p.515) who explained that:

‘initially we may think that the role of a teacher is to ask questions. However, simply posing a series of questions will not necessarily bring about inquiry. It is more useful to regard the task of the teacher as nurturing the conditions whereby question situations arise. This may involve encouraging an inquisitive stance, establishing a safe space for tentative and speculative thinking, providing conceptual tools to help pupils deal with abstract relationships, harnessing existing knowledge and experience, and facilitating peer discussion’.

The prevalence of worksheets and other methods, or what Apple (1995, p.133) has called ‘machinery’, for collecting evidence of learning, suggested that teachers’ needs could have been oriented towards ‘measuring’ students’ progress and learning. It seemed plausible that this was likely to have been formed from what appeared to have been the school’s ‘goal’ or aim for an ‘outstanding’⁶ rating or evidentiary ‘success’ in ‘GCSE’⁷ examinations. However, the tendency to remain orientated towards a pedagogical approach that focused on performance, which appeared to be the specific pedagogical approach observed at Hillview School. This was a concern which has also been described in a study by Granito and Chernobilsky (2012, p.4), who described how teachers should seek pedagogical change and embrace other means of learning instead and that:

‘because of the pressure of standardised tests, teachers must find different ways to teach the required curriculum and help students retain necessary information’.

However, paradoxically, students at Hillview School also appeared to have a need to complete worksheets as they were frequently observed to work on these activities in lessons. However, why students wanted or needed to complete worksheets or practice examination papers is unclear from the data collected but it seems plausible that compliance to the importance placed on academic performance might explain it to some

⁶ Schools in England are listed on the UK Government’s website and it is possible to check their performance across a range of measures such as ‘Progress 8 Score’, ‘Grade 5 or above in English and maths GCSEs’ and ‘Attainment 8 score’. <https://www.gov.uk/school-performance-tables>

⁷ GCSE - General Certificate in Secondary Education. Current information available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/800507/GCSE_fact_sheet_for_parents_final.pdf

degree. In support, some evidence for students' motivations is provided by Becker (1972, p.93) who revealed why students might appear to need to produce evidence of learning such as worksheets and produce evidence for assessment, and that:

‘if grades have fateful consequences, students find it necessary to orient their efforts toward getting good ones’.

A need to produce evidence of learning and progress might possibly have been evident therefore because students felt that the pursuit of grades marks or scores and following the pattern of the lesson and completing the tasks set was an imperative due to the ‘fateful’ consequences, in terms of outcomes such as grades or results, if they did not.

It appeared that there was a tension which could have been between what teachers needed to teach students, and what students needed to learn and the pedagogical approach taken in order to achieve it, as Jaber and Hammer (2016, p.191) have identified:

‘A major challenge for educators is thus coordinating these objectives: while we want students to learn the canon, we need to achieve this in ways that support, rather than disrupt, their pursuit of understanding’.

The teacher influenced the use of the Echo Dots and although students seemed motivated to use Alexa, this was often facilitated by teachers. It appeared that teachers did not acknowledge students' learning needs or understand why students might want to use the Echo Dots and how the Echo Dots could be used. There seemed to be a reliance by teachers on familiar and previously used artefacts, such as worksheets, which students were considered to need to use. These factors combined and in turn further fixed a particular pedagogical approach and perception of teaching and learning that neglected the possible potential of the Echo Dots to augment teaching and learning.

5.1.1.3 Regulativity

In the lessons that were observed at Hillview School, the data showed that there was a large number of interactions with Alexa recorded in the transcripts and a continued use in lessons which suggested that students appeared motivated to engage with information and knowledge through the Echo Dots. For example, as was shown in Chapter 4, 87 questions were asked by students to Alexa over two lessons. In observed lessons it appeared that students' enthusiasm increased when the Echo Dots were used, as was also found in a study by Terzopoulos and Satratzemi (2019), and importantly, which

could promote motivation for learning more broadly, as Costley (2014) has suggested. Students used the Echo Dots often, when they were available in lessons, to support their work on class activities set by the teacher, as Costley (2014) also found. Students appeared to be comfortable using the Echo Dots to source data, facts and information. It appeared therefore that the Echo Dot could perform a role for students by enabling them to engage with information through a device which they were motivated to use and enthusiastic about and was easy to use.

As has been discussed earlier, the use of the Echo Dots was not always possible. Two factors caused this. Firstly, the classroom environment alongside 'The Way' in which teaching and learning took place resulted in a specific pedagogical approach. Secondly, the access and use of the Echo Dots was regulated by the teachers. These two factors of pedagogical approach and regulated access had a cumulative restricting effect on the potential of the Echo Dots. These factors also suggested that learning was regulated or that there was a 'regulativity' which was a particular pedagogical approach adopted by teachers to orient students' motivation, behaviour and learning around the focus of the lesson and the particular methods of their pedagogical approach. It remains difficult to determine whether teachers were conscious of a particular pedagogical approach and that there appeared to be a regulation of learning or a 'regulativity'. However, observational data and data in the transcriptions suggested that there appeared to be a likelihood that it was possible for an orientation and focus of students towards measurable outcomes in lessons. Despite this, use of the Echo Dots revealed that students engaged with them enthusiastically and, as Granito and Chernobilsky (2012, p.3) have explained, if:

'students respond positively to technology and are motivated by technology, teachers should make conscious efforts to create activities that encompass some form of technological tool. Motivated students will be more likely to perform at their highest levels because of opportunities that their teachers have made available'.

What appeared to emerge was a tension between students desire and motivation to engage and use the Echo Dots and teachers' pedagogical approach that appeared as a 'regulativity, which overlooked the potential of a novel and interesting device to positively affect students' engagement, motivation, albeit perhaps superficially via Alexa, and impact positively on learning more broadly.

5.1.1.4 Measurement and Assessment of Students' Performance

The Echo Dots may not have been fully explored because students' learning or measurement of their progress in learning could not be measured or assessed in the ways teachers were familiar with and were practiced at, using assessment methods that Taras (2005) has outlined. When two teachers used an Echo Dot in a lesson and asked students to work through a 'Skill'⁸ designed specifically for use in Hillview School, they remarked that the data produced was 'very interesting'. Alexa generated a 'score out of ten' when students had completed the 'revision test' and the teachers remarked that this data and the transcripts of the students' answers might be useful to assess students. Along with what was remarked as a 'time saver' by the automatic score from the test, it suggested that the Echo Dot was, at this point, considered to fit within the pedagogical approach of 'The Way'. It seemed plausible therefore that in this particular assessment scenario the Echo Dot's 'symbolic value', as defined by Bruner and Postman (1948. p.203), may have increased. The Echo Dots appeared to become useful to the teachers but perhaps only because they became an educational resource for performance measurement. This is perhaps because, as seemed to be the case, student 'outcomes', or performances in examinations, had arguably begun to define teaching and the education system more broadly (see Apple, 1993, 1995, 2013, 2014; Ball, 2003, 2007, 2016; Giroux, 2012a, 2012b) or as Biesta (2008, 2015) has explained, to result in an accordant pedagogical approach. It is possible that the teachers had therefore developed a perception of the 'symbolic value' of the Echo Dot as Bruner and Postman (1948, p.203) have defined it, by comparison to commonly used educational technologies such as worksheets, textbooks or examination papers or models or artefacts. As such, it appeared that teachers seemed to have possibly considered the Echo Dots as relatively 'low value' in terms of contributing to a student's academic performance in examinations or tests whereas other methods had proven benefits for academic performance in examinations and tests. In this way, the Echo Dots appeared to be ancillary rather than integral to pedagogy and usage seemed based upon the teachers' perception of their value in terms of outcomes for students and themselves (see Ertmer, 1999, 2005; Ertmer and Ottenbriet-Leftwich, 2010). This appeared likely in the classroom because the Echo Dots appeared to perform a supporting role with teachers taking the leading role in teaching and learning and the dissemination of information, as

⁸ Developers can produce 'Skills' which are computer applications (or 'apps') for the Echo Dot that have bespoke features or functionality. In this instance an 'Alexa skill' was written for a teacher and installed on the 6 Echo Dots for them to use. The 'skill' was a short quiz that tested students' knowledge of topics they had recently been taught and after completing it students received a score. The scores for all the tests were recorded as a text transcript which could be viewed by the teacher.

studies by both Welker (1991) and Turner-Bisset (2013) have outlined. For example, it was common to observe that the Echo Dots were deployed for students to revise answers to written questions or acquire answers to worksheets but teachers provided the delivery of curriculum ‘knowledge’ and used other teaching methods over the Echo Dots despite apparent enthusiasm and engagement of students in terms of question-asking.

Teachers appeared to be cautious about the Echo Dots and metered their use and this is understandable given that teachers remarked that the Echo Dots were ‘unknown’ and ‘unfamiliar’ and ‘slightly scary’ for some of the teacher participants. Alexa and the Echo Dots appeared to be regarded and controlled by teachers in a way that conveyed to students that knowledge from Alexa was not the ‘teacher’s knowledge’ and that the teacher should be perceived as the main source of knowledge or as Welker (1991) and Rodriguez (2012) have explained in their research, to support the notion of the teacher as an expert.

In the lessons that were observed, there appeared to be a disconnect between perceptions of what Alexa could do and could offer and what teachers expected the outcomes of teaching and learning to be, which has also been outlined in Mortimer’s (1999) study. It appeared that what occurred in the classroom and the accordant pedagogical approach, resulted from how learning was interpreted and what the process of learning was conceived as and what the outcomes of teaching and learning were perceived to be, as outlined in literature by Shulman, (1986) Mortimer (1999) and Rodriguez (2012).

A drawback of the Echo Dots therefore appeared to be that teachers did not seem to feel that pedagogically, the Echo Dots could positively contribute to students’ performance in a way that could be measured as other established methods such as worksheets or examination papers which gave scores and grades, currently used did. Davies and West (2014) found that when investigating the technology in terms of attainment, there was a positive impact of technology upon standardised tests

By limiting the students’ social interaction with Alexa during lessons, and by not capitalising on their enthusiasm and motivation to interact with Alexa, it is possible that opportunities for students to socially construct knowledge through dialogue with Alexa and involve other students aside from the teacher, were missed. By adopting a

pedagogical approach oriented towards measurement of performance and which regulated learning, opportunities to adapt or change teaching methods and strategies to meet the students' needs also seem likely to have been missed.

In this way the potential of the Echo Dots, as a voice technology that was 'social', to be used to create a classroom environment that facilitated a 'social construction' of knowledge and stimulated talk and developed students who were self-directed with a greater degree of autonomy and control over what knowledge they had access to and how they accessed it as Chin and Osborne (2008) have outlined and seemed to have been under-explored and overlooked. It is likely that this appeared to be in part due to the perceptions of the Echo Dots as not a viable and useful education technology that contributed to educational achievement, attainment and outcomes, a perception that was formed by, as Ertmer (1999, 2005) and Ertmer and Ottenbriet-Leftwich (2010) have explained, from the teacher's personal pedagogical belief.

5.1.1.5 Anxiety, Control and a Pedagogical Approach

There were technical problems associated with setting up and deploying Echo Dots in Hillview School's classrooms and these have been outlined in Chapter 3. Section 3.3.1. The data, presented in Section 4.3.3, showed that there were some technical barriers for teachers to overcome when using multiple Echo Dots and as was the case in Mortimer's (1999) study, there were some pedagogical complexities that arose using what was a 'new' technology. Using a single Echo Dot in lessons at Hillview School seemed to reduce teachers' anxieties about what might go wrong by allowing them to retain a degree of control of the pedagogical approach as has been discussed earlier. Concern and anxiety is a real concern for new and experienced teachers as Emmer (2001) Clunies-Ross, Little and Kienhuis (2008) and Frenzel et al. (2016) have explained. Anxiety and concern seemed evident when a teacher at Hillview School reported that trying new things, such as the Echo Dot in the classroom, was 'slightly scary'. From the data, a pedagogical pattern emerged for how the Echo Dots were used by teachers at Hillview School and this was that they usually began tentatively with a single Echo Dot and then progressed to more Echo Dots over time when it appeared that the 'class would be good' or when they reported that they felt less anxious and had grown in confidence from prior use of an Echo Dot.

It appeared that there were two ways in which teachers at Hillview School used the Echo Dots and this was as a 'multiple use' or a 'single use'. When using the multiple approach, an Echo Dot was placed individually on a table for small groups of students

to work whilst sitting around it. For example, six students would share one Echo Dot when working in the lesson. The single approach, which was usually the first pedagogical approach teachers tended to take, was where a single Echo Dot was placed at the front of the classroom as occurred in research by Hales et al. (2013). In both pedagogical approaches there appeared to be a degree of control exercised by the teacher regarding where in the classroom students could access the Echo Dots from, when they could access them during the lessons and how they could access them. For example, control was observed when teachers told students when they could speak to Alexa or when they could turn off the mute button or guidance about the type of request students should make to Alexa. The single approach appeared to provide the highest degree of control for teachers as students could not physically touch the Echo Dot by handling it to wake it or alter its volume because it was positioned distant to them. What appeared to emerge from the single use approach taken was that the classroom appeared to be 'regulated' by a particular pedagogical style as has been previously discussed.

In terms of supporting the notion of a 'regulativity', the single use approach to the Echo Dots seemed to provide pedagogical benefits for the teachers who taught using a specific approach, described earlier as 'The Way'. For example, the teachers who placed the Echo Dot alongside them at 'The Front' and used 'The Way' seemed to adjust their pedagogical approach very little and normal lessons seemed to occur. In this way, when at the front of the classroom, the single Echo Dot was used to supplement what the teacher said and support a familiar pedagogical approach. It appeared from observations of these types of lessons that the pattern was that teachers gave an explanation to the whole class about a topic being studied and asked Alexa for the same or similar information from the Echo Dot, to emphasise or corroborate what they had said. The single approach that was used therefore seemed to fit with what has been described so far as the pedagogical approach of 'The Way' and the pedagogical approach of the teacher at 'The Front'. The 'single' use pedagogical approach seemed to require very little adaptation or adjustment of what was commonly observed as the pattern of teaching, activities involved in learning or organisation of the classroom and students.

5.1.1.6 The Disruptive Effect of Alexa

As has been suggested earlier, teachers tended to control when and how students interacted with Alexa and in this way, they controlled the knowledge that Alexa provided and controlled. Also, in the single use approach, knowledge remained in the

physical area of 'The Front' and by association Alexa and the teacher were, it seems likely from observational data, regarded and thus were both conceptualised as the 'experts' (Welker, 1991; Rodriguez, 2012) located at the front of the classroom.

When students were able to work in groups with the Echo Dots in the multiple use approach, they were observed to become relatively more excited and more animated often picking the device up, using the buttons on it or turning and inspecting it. This suggests that the Echo Dot device was piquing students' curiosity which Dewey (1910, p.31) has referred to as a 'physical curiosity' where a student would handle an object to explore or investigate it. With the multiple use approach, the students in a group were observed to generally orient themselves towards the Echo Dot by sitting in a circle or semicircle around it. As such their attention then shifted, from facing towards the teacher and 'The Front', towards Alexa. This appeared to be a change in comparison to the normal pedagogical approach especially for teachers whose style of teaching appeared to be a 'formal authority teaching style' (Dilekli and Tezci, 2016). It was observed that the multiple use approach was challenging for those teachers who appeared to only use 'The Way'. The multiple approach disrupted the pedagogical approach somewhat. This appeared to be evident when, instead of remaining at the front of the classroom where they usually stood to explain to the whole class, with Alexa in the multiple approach, teachers were often observed to attend to a task such as 'checking email' at their desk while students used Alexa or they would walk around the classroom occasionally interjecting into students' conversations with Alexa. It seemed that in these instances of 'checking' from the teachers, students were somewhat oblivious or unaware of the teacher's presence and seemed engaged and immersed with Alexa.

Despite what looked likely to be the teachers perceived momentary loss or change to the level of control or influence, as students focused on and engaged with Alexa, teachers used their physical presence and questioning of students to establish authority and to present themselves to students as an expert and the 'source of knowledge' (Dilekli and Tezci, 2016) and in control. This seemed to be supported by the data, see Section 4.3.3, that showed when the teacher interrupted Alexa and by questioning students as to the validity or usefulness of Alexa's replies or asking Alexa a question themselves and then providing an alternate explanation and different interpretation as an answer.

Although data collected from Hillview School indicates that students appeared to find the Echo Dots engaging. In a study, Granito and Chernobilsky (2012) have described how some students, but not all, were interested in technology and responded positively to it and this positively affected their motivation. It seemed likely that for the majority of students, the Echo Dots were engaging, perhaps more engaging than the teacher, but this was not the case for all students all of the time. With regard to students' engagement with Alexa and disruption of 'The Way', by 'misusing' a device for social and entertainment purposes or to 'relieve boredom', as Eren and Coskun (2016) have outlined in a study, teachers may have adapted their pedagogical approach to move around the classroom to maintain order and the control that Wood and Wood (1988) identified in a study. Data collected and which has been presented in heatmaps earlier in Section 4.2.6, suggest that the disruptive effect of some students caused teachers to adopt different positions in the classroom. It seemed likely therefore that disruption by students or, with the Echo Dots, use and misuse of Alexa might cause the teachers' pedagogical approach to be adapted.

5.1.1.7 The Importance of Learning Talk

Observational data, see Section 4.3.4, and Section 5.1.1.5, suggest that teachers may have been anxious and concerned about how the Echo Dots were being used and the impact they might have had on students' learning and social and entertainment talk that might occur (see Section 4.4.5 and also Table 4 for data on numbers of interactions). Generally it was observed that classroom talk, whether about work or social and entertainment talk, appeared managed, or regulated, by teachers. Teachers were observed doing the majority of talking in the classrooms and students were guided to talk when asked to or were told to not talk when listening to explanations from the teacher was expected or when they worked on learning tasks and activities. However, in a study by Chin and Osborne (2008, p.3) it was found that there were benefits to be gained from general talk and discussions between students:

'When students engage socially in talk and activity about shared problems or tasks, their questions can stimulate not only themselves but, also, another group member to use the relevant thinking strategies and processes (e.g. hypothesising, predicting, explaining) in their search for an answer'.

As Chin and Osborne (2008) found, social talk, when oriented around an activity could benefit problem solving. It seems plausible that in classrooms where the general approach was to not talk, a device such as an Echo Dot which was shown to have

stimulated talk, could as Chin and Osborne (2008) suggested, cause talk to be of benefit to problem solving or generate a desire to seek a solution or find more information. In this way, rather than interpret social talk as entertainment and a disruption or distraction to learning, it might be construed instead as a potentially productive mechanism for learning. In this way, perceived as more than simply talk and instead as a social interaction that was part of a problem solving process of learning or a 'process of curiosity', as Beswick (1971, 2004, 2017) has described it, where students had a desire to find out more or to find an answer or further information and used talk to do so.

Interpreted in this way, talk is positioned as an important part of the social process of learning and social construction of knowledge (Vygotsky, 1978, 1986) and potentially part of a 'process of curiosity' (Beswick, 1971, 2004, 2017). Through this social process or 'learning talk' (Alexander, 2005) and social construction of knowledge that potentially occurs, the social talk of students with Alexa might also be interpreted as being a part of what Dewey (1910, p.32) referred to as a 'social curiosity', where individuals have learned that information can be gleaned from others. Social curiosity can be understood as an eagerness to indulge in talk with others to connect to the wider world through interactions with others whilst acquiring information and knowing that they then become sources of more knowledge. Although the data does not prove definitively that social talk was a form of 'social curiosity' (Dewey, 1910), it has been interpreted that social talk by students and talk with Alexa in all forms, was important and significant, despite much of the talk being perhaps for entertainment purposes, because it may be a form of 'learning talk' (Alexander, 2005) which might be part of a 'process of curiosity' (Beswick, 1971, 2004, 2017). What the data supports is that talk by students and talk by students with Alexa may hold possibilities for developing students' ability to engage in 'learning talk' (Alexander, 2005) even if the talk is regarded as social or for entertainment because talk is a social interaction that is part of a process of the social construction of knowledge. This suggests that students' talk, currently perhaps regarded or viewed as disrupting or contrary to learning, being simply social, might have been overlooked as a type of 'learning talk' (Alexander, 2005) and a symbol or sign of underlying processes of curiosity, the social construction of learning or 'epistemic activity' (Zenios, 2010).

This remains an area for further research and is discussed in more detail in Chapter 6, Conclusion and Recommendations. So far, the importance of moving talk from

performance to learning has been discussed in relation to the impact of the teacher and their pedagogical approach and perspective. The next section considers talk in terms of a digital more knowledgeable other as part of learning.

5.1.2 RO2: Discussion of Voice Technology as a Student's Digital More Knowledgeable Other in Lessons

This section discusses and critically analyses the Echo Dots and Alexa as a *digital* more knowledgeable other. Vygotsky's (1978) 'more knowledgeable other' has been described by Daniels (2008) and also by Moll (2014) as a culturally mediated and social form of learning whereby an individual's independent development is increased by help, hints or assistance from others. A *digital* more knowledgeable other, such as Alexa, could perform this role and support the development of an individual by providing hints and prompts, data, facts and information which are acquired through spoken interactions.

5.1.2.1 Talking to Develop Epistemic Behaviours

From the interpretations presented in Chapter 4, it was evident that the Echo Dots, by being present in the classroom for students to use, afforded them an additional opportunity alongside that of their peers and teacher, to engage in talk. It has been discussed earlier that the type and form that students' talk took suggested the potential notion of a form of 'learning talk' (Alexander, 2005). It has been suggested that talk by students was perhaps a significant part of a process of curiosity (Beswick, 2004), social construction of learning and indicated 'epistemic activity' (Zenios, 2010). This is a key notion because the importance of speech on intellectual development has been stated by Vygotsky (1987, p.114) who has explained that:

'A basic, indisputable, and decisive fact emerges here: thinking depends on speech, on the means of thinking, and on the child's socio-cultural experience. The development of inner speech is defined from the outside. As Piaget's research has shown, the development of the child's logic is a direct function of his socialized speech. This position can be formulated in the following way: the development of a child's thinking depends on his mastery of the social means of thinking, that is, on his mastery of speech'.

The importance of talk as a form of social interaction has been emphasised by Moll (2014, p.33) who explained that the social interactions required to talk with others also contributed towards being able to make meaning from talk:

‘however crucial language may be to the mediation and development of thinking, the construction of meaning is regulated (or mediated) by social relationships’.

What Moll (2014) and Vygotsky (1978) have indicated is that talk in the classroom provides a pivotal way in which students might, through any form of talk potentially, begin to develop their thinking processes and through spoken interactions with others, digital or human, generate meaning from talk. In this way, talk therefore becomes an important learning resource and this has been acknowledged by Dewey (1910) who identified the significance of talk for very young children for social adaptation and development and described it as ‘the keynote of mental life’ (Dewey (1910, p.170). It is possible therefore that talk in the classroom is important as a part of thinking and meaning making. Talk, understood as an action and behaviour, could therefore be interpreted by teachers as an integral part of learning. Silence on the other hand (Walkerdine, 1985) or a pedagogical approach that is oriented around silence might then be contrary to what is required for students to develop intellectually through ‘learning talk’ (Alexander, 2005) or to construct knowledge socially or to engage in ‘epistemic activity’ (Zenios, 2010). However, at this point it is only possible to say that the data suggested that students talked often and asked Alexa a lot of questions and the aim of the talk was often social but, importantly, was also often a search for more knowledge or was epistemic in essence.

5.1.2.2 Alexa: A Digital More Knowledgeable Other

The Echo Dots and Alexa, as was shown by the data, stimulated students’ talk and were used as a *digital* more knowledgeable other. Alexa engaged students in a form of what Vygotsky (1987) has called social speech. In a classroom without the Echo Dots there were less instances where talk might have occurred than when the Echo Dots were present and the data supports the notion that the Echo Dots stimulated talk and more talk occurred.

When Alexa was interpreted as a digital more knowledgeable other and having potential for talk to be encouraged, it seemed plausible that that thinking would occur, a connection that Dewey (1910) had also made. Dewey (1910, p.170) stated that ‘while language is not thought it is necessary for thinking as well as for its communication’ and that ‘speech has such a peculiarly intimate connection with thought as to require

special discussion' (Dewey, 1910, p.171). What becomes apparent from Dewey (1910) is both the importance of talk and a connection between talk and thinking.

The data revealed greater levels of talk and question-asking to Alexa by students and has revealed the need for talk to occur as part of teaching and learning so that opportunities are presented for students to perhaps become more like *thinkers*. Talk, therefore, considered broadly as a part of thinking, again appears to hold potential for more knowledgeable others and the social construction of knowledge simply through the act of engaging in talk. Alexa provided a way for students to talk and ask questions in contrast to the pedagogical approach that was observed in the classrooms and which appeared to regulate and restrict talk and orient talk around performance.

The observational data collected provided some indication that students were thinking because they were observed talking, discussing and asking questions to Alexa, so it seemed likely, could be assumed to have been 'thinking' (Tomasello, 2014) in order to form questions. It may follow then that it was possible that if a student was thinking more often because of their talk with Alexa, as well as with other students or the teacher, it seemed plausible that questions might arise in their mind and they may subsequently feel the desire or need to ask a question. A tentative connection begins to emerge between talk and thinking and some form of expression or outcome of thinking such as a question. A similar process was suggested, of becoming interested in problems, or thinking, then forming and asking questions, and was presented by Dewey (1910, p.33) who while identifying the importance of the teacher in fostering an inquiring mind, stated that:

'His [the teacher] task is rather to keep alive the sacred spark of wonder and to fan the flame that already glows. His problem is to protect the spirit of inquiry, to keep it from becoming blasé from overexcitement, wooden from routine, fossilized through dogmatic instruction, or dissipated by random exercise upon trivial things'.

In this respect, talk in the classroom could potentially therefore, in any form, but specifically with the Echo Dots used in the study, lead to or stimulate thinking which could, as has been suggested (Tomasello, 2014) lead to questions being asked. It is conceivable therefore that talk in the classroom with Alexa could likely lead to students' questions because they talked more, thought more and generated more questions because they were talking.

5.1.2.3 Alexa Encouraged Question-Asking and Talking

From the transcripts of interactions with Alexa and from observations of students' talk presented in Chapter 4, numerous questions were observed to occur when Alexa was used. For example, in one afternoon at Hillview School, there were 87 questions asked by students to the Echo Dots over a period of two hours (see Appendix 7). Vygotsky (1987, p.63) underlined the notion that questions might arise from talk and thinking, especially when the talk that occurred was between, for example, a student and an *other*, in contrast to egocentric talk to oneself, by stating that socialised speech:

‘has an entirely different function. In this speech, the child actually exchanges thoughts with others; he requests, orders, threatens, informs, criticises, or asks questions’.

When considering the importance of talk in relation to the aim of the research, it can be seen that socialized speech (Vygotsky, 1987) a broad form of talk with others, had the potential to lead to some types of talk that might not be so welcome in the classroom but also led to questions. Nonetheless, rather than encouraging students to be silent and not talk, as part of the ‘regulation’ of the classroom, emphasis could be placed upon encouraging students to talk more and about what is being learned, or to engage in ‘learning talk’, because as Hurst et al. (2013, p.377) have outlined:

‘The problem is not that students are unwilling to talk; many teachers say they spend the better part of their days trying to get their students to stop talking (whether in person or texting). The problem is getting the students to talk about the subject at hand’.

Teachers therefore, might wish to encourage talk but steer or choreograph students towards ‘learning talk’ (Alexander, 2005) because as has been shown, talk could lead to the formation of questions which has been suggested, inferred that thinking took place. It was discovered in the data that students talked frequently with Alexa, asked many questions to Alexa, many of which were epistemic, and students interacted more often with Alexa than the teacher. What emerged through the interpretations of the data therefore, was a relationship or connection between talk, thinking, question-asking and perhaps a form of epistemic activity (Zenios, 2010). It seems plausible that perhaps as part of this emerging relationship or connection, that the epistemic activity Zenios (2010) identifies is in fact Berlyne’s (1954) epistemic curiosity and was observable because students talked to Alexa and there was an emerging epistemic feeling or

motivation (Schmitt and Lahroodi, 2008; Costley, 2014; Jaber and Hammer, 2015, 2016).

5.1.2.4 Adapting to Alexa: Resilience and Persistence

When students were observed using the Echo Dots, they appeared to easily adapt their behaviours as Beneteau et al. (2019) also found, and students also accommodated Alexa into their learning activities and were able to rephrase questions, be persistent in their requests and make use of relatively short sentences to successfully acquire information as Underwood (2017) similarly found. Hales et al. (2019) found that students in their classes felt frustrated and a significant proportion disliked using Alexa when asked at the end of the action research project, but the data showed that although frustration was sometimes evident at times from certain students or during certain interactions at Hillview School, the data did not reveal frustration to be of any significant level or to have any negative impact upon conversations between students and Alexa. In fact, students displayed persistence when they were observed using the Echo Dots despite any issues or problems that arose. For example, over a period of two minutes in a lesson a small group of students were seen to ask Alexa twelve times for the same information because Alexa failed to understand what was being asked. It has been acknowledged that these devices cause frustration as Hales et al. (2019) found in their classroom study, but as Beneteau et al. (2019) found in the home study, use continued to increase and people could generally change their expectations of what the devices offer and then accommodate and adapt their behaviour to continue to interact with the devices.

In Chapter 4, the observations of students interacting with Alexa showed that any frustration that was observed seemed to occur subtly but then disappear quickly and was therefore temporary and momentary and use continued. Students did not seem to be dissuaded from using Alexa because of any technical or communication problems and were observed interacting favourably towards Alexa and to continue using the Echo Dot and move on to another request or to alternative classroom tasks and then return to the Echo Dot. Accommodating the failings and idiosyncrasies experienced when using prior technology was likely to have enabled students to keep using the Echo Dots and in doing so reduced their level of frustration. This appeared to be a type of persistence that included some degree of frustration but which was accommodated and learned to be a normal operating procedure of working with technology, that is, it can and does go wrong, but carry on. Beneteau et al. (2019) found breakdowns in communications with Alexa did occur and frustration could appear to be evident at times but that strategies

and techniques were used to repair breakdowns with Alexa such as adapting expectations and behaviours and using what (Beneteau et al., 2019, p.2) describe as ‘code switching’ techniques.

5.1.2.5 Alexa: Talkative and Silent Students

Using digital technology for enjoyment and gratification was found to be a motivating factor by Wu, Wang, and Tsai (2010) and Grellhesl and Punyaunt-Carter (2012). Talk with Alexa seemed to be a relatively enjoyable process it seemed that Alexa motivated students to talk because the data showed that talk to Alexa occurred often and frequently.

The motivational reasons for use of digital technology are evident in the literature, for example, ‘hedonic benefits’ as described by Wu, Wang, and Tsai (2010) and for ‘gratification’ as described by Grellhesl and Punyaunt-Carter (2012). However, not all individual students were keen to engage with the Echo Dots and research by Neiffer (2018) has suggested that voice technology, in particular Apple’s ‘Siri’, may not be impactful for all students and their engagement. The enjoyment found when using the Echo Dots was also reported by Terzopoulos and Satratzemi (2019) who identified that new technology intrigued and attracted children and positive motivational reasons for engagement were also outlined by Wu, Wang, and Tsai, (2010) and Grellhesl and Punyaunt-Carter (2012).

Some students appeared motivated, confident and willing to speak in public in front of peers and to use Alexa. There were also students who remained silent or only spoke to one or two other students, or when they were asked a direct question by the teacher, an issue that Hurst et al. (2013) identified in their research. It seemed plausible that these students may have wanted to avoid public speech or to ‘disappear’ (Chin and Osborne, 2008). It seemed possible that because Alexa required a student to speak in front of others and be heard, those who would prefer not to speak in front of others would likely wish to avoid using Alexa. The student who stated a preference for a textbook, according to the observational data collected, appeared to be a student who rarely spoke to other students or the teacher. Walkerdine (1985) has outlined a pedagogical regulation of speaking and conflict avoidance and at Hillview school therefore, it may have been that the student preferred or chose to be silent for these reasons. The student appeared to prefer to listen rather than talk or be verbally engaged in the lessons as Jaworski and Sachdev (2010) have also outlined in their research. What this seemed to

suggest, despite there being an Echo Dot that was generally perceived as engaging and intriguing and motivational (see Wu, Wang, and Tsai, 2010; Grellhesl and Punyaunt-Carter, 2012; Terzopoulos and Satratzemi, 2019), there were still some, but not many, students who did not use Alexa as a digital more knowledgeable other.

However, by teachers providing Alexa for students in their classrooms the data showed that more opportunities for talk were possible and instances of students' talk increased. For the silent students or those preferring not to talk, although not observed first-hand, a teacher reported that a student 'who never speaks to me, used headphones in the Echo Dot to talk happily with Alexa at their desk'. The data seemed to suggest that many students were motivated and confident users of Alexa but occasionally a student might choose not to engage with Alexa because, of the requirement to speak publicly.

However, the instance with headphones reported by a teacher demonstrated that less willing or motivated students might be more encouraged or motivated to use Alexa if their need for private talk could be facilitated. In relation to reaching and engaging more students, especially those who were silent students, there are pedagogical adjustments needed such as providing Echo Dots with headphones at a desk. Although not a guarantee for positively affecting learning, by providing opportunities for talk and encouraging and stimulating talk, silent students may benefit from Alexa, by making connections between talking, thinking and learning (see Dewey, 1910; Hurst et al. 2013; Moll, 2014; Tomasello, 2014).

5.1.2.6 Performance-Oriented Talk

Data from the classroom and from students' interactions with Alexa revealed a category of talk that was oriented around the subject being taught, what constituted 'good performance' or evidence of learning in that subject (see Section 4.2.6.). This type of talk by teachers, has been defined in this thesis as a 'performance-oriented talk'. This type of talk was observed to be initiated by teachers to students and usually involved some form of judgement or assessment of the students' learning similar to an approach to learning that Biesta's (2008) research has posited. Occasionally students were observed to ask a teacher for their score or mark and these instances of talk are regarded as 'performance-oriented talk' as it has been understood in this thesis. 'Performance-oriented talk' focused on metrics and appeared to restrict talk about knowledge more broadly, as Biesta (2015) has described knowledge. This suggested that learning was conceptualised as the acquisition or reproduction of data, facts and information related specifically to the content of the subject's curriculum which was quantifiable using

scores, marks and grades. An array of words for metrics were evident in the lexicon of ‘performance-oriented talk’ in Table 2, on page 103 and appeared to impinge upon opportunities for teachers to perform the role of a more knowledgeable other. With regard to the social construction of learning (Vygotsky, 1978, Moll, 2014) by assistance such as hints, tips, demonstrations or modelling, by focusing instead on the production, judgement and measurement of learning. This was because the emphasis was upon measuring learning or quantifying progress which oriented talk around metrics and formed a dialogue that judged and assessed outputs or evidence of students work as Biesta (2008, 2015) has outlined. Talk of this type meant that interactions between students and teachers were regulated because they were oriented around metrics. Dialogic interactions occurred involving the teacher as a more knowledgeable other (Vygotsky, 1978), where data, facts and information were part of the lexicon of knowledge development and learning, or Alexander’s (2005) ‘learning talk’, but these were limited.

Data revealed that worksheets were used commonly (see Section 4.2.2.), and as also identified by Krombaß and Harms (2008) in their study, a particular way of teaching and talking in the classroom facilitated and choreographed their use. However, Krombaß and Harms (2008, p.157) identified that worksheets can be beneficial in specific instances, but they also acknowledge that:

‘however, many teachers and museum educators have found that students often do not respond enthusiastically to worksheets. Filling them in can be viewed as a tiresome and obligatory chore which runs counter to the real museum experience and which should be finished as quickly as possible’.

In support of this when teachers used iPads to supplement teaching in mathematics, Haydon et al. (2012) found that the students with an emotional disturbance solved more problems in less time and that the iPads were found to be more engaging than a worksheet. However, worksheets were used frequently at Hillview School and appeared to be used as a method of generating evidence of learning. Conceptualised in this way, and with the performance orientation to the talk that occurred, both worksheets and talk conjoin to support the notion that ‘learning’ appeared to be understood as the attainment of metrics.

5.1.2.7 Metricalisation

In the classrooms, what was meant by the word ‘learning’ appeared hard to determine beyond a performance orientation. For instance, the emphasis upon achieving the correct answer as Ziff (2017) has also discussed, completion of tasks or worksheets and evidence of learning such as marks, scores or grades were emphasised as important. As such there appeared to be different perspectives about what learning entailed and often appeared to produce an approach that could be described as a ‘metricalisation’ of teaching and learning. ‘Metricalisation’ is defined as being part of a pedagogical approach that generated behaviours and actions oriented around measurement and assessment of students and which included a ‘performance-oriented talk’. When this occurred, because learning appeared to be interpreted by the individual as an individualised endeavour based on personal scores, marks and grades, which may have created different understandings of the purpose of teaching and learning, the opportunities for social or communal interactions with others or a digital more knowledgeable other appeared to occur less. It seemed that learning could be understood by students as the practice or experience of memorising, recalling and remembering facts and scoring high marks and the process of producing evidence of learning in the form of worksheets. Bruner (1996) has described a similar approach as a ‘folk pedagogy’ and Ziff (2017), discussing design school, has described how the search for correct answers has negative effects on teaching *and* learning. At Hillview School the data revealed the emergence of a pedagogical approach that seemed to include a ‘metricalisation’ of learning and ‘performance-oriented talk’ that limited opportunities for dialogue with a more knowledgeable other (Vygotsky, 1978). This pedagogical approach oriented towards performance suggested a specific understanding that was held about the purpose of teaching and learning and what knowledge was, which has similarly also been broadly suggested by Bereiter and Scardamalia (1987) Scardamalia and Bereiter (1993) Nyström et al. (2003) Alexander (2005) and Chen and Hong (2016).

5.1.2.8 Curating Knowledge from Alexa

Some information provided by Alexa was ignored by students, and this selectivity was similarly found by Beneteau et al. (2019) in their study. For example, when Alexa acquired data from long passages of text from internet web pages and read it out these were described by students as ‘too long’ or ‘too much’. As the information was audible only, students were possibly not able to engage, or process it as efficiently, as Osman and Sullivan (2014) and Magimairaj and Nagaraj (2018) have indicated in their studies,

and because it proved more difficult without accompanying visual information as Logie and Marchetti, (1991) have outlined. Observational data revealed that students tended to stop interacting with Alexa when longer recitations occurred which suggested that these interactions took longer and demanded students' attention for longer and perhaps thus required greater concentration and effort. Trying to remain attentive, along with curating data from long recitations, along with the general noise in a busy lesson, which has been described as 'multitalker babble noise' by Osman and Sullivan (2014, p.1506) may also have increased the effort required. It is possible therefore that these issues combined to produce an increased demand upon the 'cognitive load' of students (Feldon et al., 2019) and effort to assimilate and process the information (see Kalyuga, 2012; Osman and Sullivan, 2014; Magimairaj and Nagaraj, 2018).

In some instances where long recitations occurred, students were observed to have shrugged their shoulders or raised their arms in exasperation or were heard to say 'What?' and generally appeared 'overloaded' (Furnham, Gunter and Green, 1990; Magimairaj and Nagaraj, 2018) which often resulted in them asking Alexa to stop. For example, when Alexa read passages from Wikipedia webpages students asked Alexa to stop after the first few words or first sentence, and a similar interruption was also found by Hales et al. (2019) in their study. Shorter information appeared to be regarded as more easily processed and understood and so tended to be favoured by students particularly that which they regarded as *the* answer or which was the answer or solution to a question that had been given on a worksheet or practice examination paper. This approach was particularly evident when students were reading Alexa questions from a worksheet or examination paper where students often appeared to evaluate what they heard and then extract only what they needed or were curating knowledge. They appeared to listen for what they wanted and identify it as the answer suggesting that when they curated Alexa's information they were seeking to find what they already knew or had known but could not recollect or recall or that they knew the answer but sought confirmation which Scardamalia and Bereiter (2006, p.101) have described as knowledge about or 'declarative knowledge'. In this way, Alexa appeared to have performed a role of a digital more knowledgeable other, enabling students to request data, facts and information which they then curated to enable them to continue with their learning, tasks and activities.

In their interactions with Alexa, students tended to demonstrate a preference for acquiring *the* answer and appeared to not want to listen to additional information. Their

actions and behaviours were oriented towards answer acquisition which was similarly identified by Ziff's (2017, p.50) study, and who has explained that there is:

‘the existing orientation and increasing emphasis, in our society and in our educational institutions, on identifying “correct” from “incorrect” answers to all sorts of questions’.

Throughout the fieldwork at Hillview School there were no recorded instances where students stated that Alexa had been inaccurate, incorrect or untruthful. The issue that arises in this instance is firstly, that there is a perception created that there *is always* a correct answer. Ziff (2017, p.51) has also described that this can be concerning, stating:

‘the problematic notion that there is a “correct” answer to all questions’.

Secondly, the knowledge, or answers, provided by Alexa are considered by students as correct and that Alexa is not wrong or is not providing alternate perspectives, viewpoints or diverse or culturally influenced information. The issue here then is that Alexa is able to provide data, facts and information that students curate for correct answers, without considering that there may be alternate answers or even just more questions or conflicting or contrasting opinions. Here, from Ziff (2017) identifying a potential issue around the notion of there always being a correct answer, further questions of ‘What counts as knowledge?’ and ‘Whose knowledge is important?’ are raised.

5.1.2.9 Is There an Epistemicide?

From the questions ‘What counts as knowledge?’ and ‘Whose knowledge is important?’, an issue emerges from the research study which remains unresolvable due to a lack of data currently and is an interesting area for further study. The issue is whether an artificially intelligent device, such as the Echo Dot that performs the role of a digital more knowledgeable other, should do so for students who do not think critically as Ennis (1962, 1964) has outlined. This is because, for students who are not critical thinkers and cannot evaluate Alexa's knowledge or raise questions about what counts as knowledge or whose knowledge is important then a lack of critical thinking might contribute to a societal impact of what Sousa Santos (2006, 2007, 2014) and Paraskeva (2016) have described as an ‘epistemicide’. Epistemicide can be thought of as the suppression or replacement of one canon of knowledge via the promotion or favouritism of one other canon of knowledge. Regarding schools and the Echo Dots, the

canon of knowledge that Alexa accesses might be construed as being ‘favourited’ or promoted over other canons of knowledge. Further to this is the issue of whether devices with AI, that abridge states of not knowing and knowing and require students to curate data, facts and information, should be permitted to do so particularly where students may not be in the position to critically evaluate truth from untruth, fact from fiction or sense from nonsense. Where teachers are governed by a code of conduct and professional standards which frame their actions and behaviours (Shulman, 1986; Adoniou, 2014), digital technologies with AI, at time of writing, have no such ‘educational technology code of conduct’ or professional standard for their use by students which could act as a frame for their activity in relation to the transmission or acquisition of knowledge.

5.1.2.10 Stopping and Starting Students Talking

A pedagogical approach defined in this thesis as ‘The Way’, where teachers stood at ‘The Front’ and talked at students, was similarly by described Hurst et al. (2013, p.376), who outlined that this occurred despite teachers knowing that children were ‘naturally sociable’. Disconnecting students from each other through reducing talk and discussion might negatively affect learning because, as has been identified by Dewey, learning was known to be fundamentally a ‘social activity’ (Dewey, 1910; 1963). There may have been a negative impact of ‘The Way’ upon learning because it required students to reduce or cease talk and appeared to cause them to become relatively passive. This issue was also evident to Hurst et al. (2013, p.376) in their research who identified that:

‘Teachers expend a lot of energy preparing lectures... and then deliver the information to students who sit passively often thinking of everything but what the teacher is saying. Who is doing all of the work in this process? The teacher. The teacher is the one reading, writing, thinking, speaking, and therefore, the one who is learning.’

Within the approach described by Hurst et al. (2013) is how talk is overlooked as a means of engaging with learning. In order for students to learn instead of the teacher being the learner therefore, Hurst et al. (2013) have argued that a pedagogical shift and change in responsibility for learning should occur so that students could be placed in more control of their own learning by engaging, for instance, in more social interactions. So far, in this thesis, it has been argued that ‘learning talk’ (Alexander, 2005) might have a positive impact upon students’ learning. As has been presented, there appears to be potential benefits for students beyond acquiring knowledge by

listening passively, through talking and by being actively engaged in a social interaction with others because talking remains a key facet of learning and thinking, as Dewey (1910) has outlined.

With regard to becoming less passive, when students initiated an interaction with Alexa they did so on their terms because they started and stopped the interactions and also created the context of the interaction that took place. In this way students gained a degree of ‘control’ of a social interaction and were active as opposed to passive and only listening. The control observed by students over Alexa was not something that was observed during interactions involving a teacher in the research by Hurst et al. (2013). This appeared to be because teachers were in charge of the topic being studied, timings of the interactions and activities that occurred and methods used to learn in the classroom and usually controlled talk in the classroom, which has been defined in this thesis as a ‘performance-oriented talk’. Along with the need to retain order and control of the physical space and people within that space, it appeared that there was also a control over both the purpose and aim of teaching and learning and the outcomes of this, which has been defined in this thesis as a ‘regulativity’ and ‘metricalisation’.

The ability to have some control over the start, duration and end of a social interaction with Alexa may have been why some students might have preferred this method. Alongside the control, Alexa also appeared to have an advantage for students because of the immediacy of the Echo Dots, whereby they did not have to put their hand up or wait for the teacher to attend to them. In this way, Alexa appeared to offer benefits to students who were seeking information to get answers and quickly by being controllable and immediate. Students were less impacted by any ‘regulativity’, ‘metricalisation’ and were able to avoid the teachers’ performance-oriented talk.

5.1.2.11 Alexa is Fun: Starting Students Talking

There were a higher number of interactions with Alexa than with teachers which suggested that students used Alexa as something which was a more knowledgeable other, a preferred source of knowledge as well as an alternative source of knowledge to the teacher and was a digital more knowledgeable other. By being able to access information for classroom work quickly and easily and because Alexa offered students’ control over an interaction it seemed likely that Alexa was regarded by students as a digital more knowledgeable other. There was a slight differentiation that emerged therefore in how Alexa was used. If, as Daniels (2008) and Moll (2014) have explained,

a ‘more knowledgeable other’ (Vygotsky, 1978) was someone able to develop a less capable or less skilled person through social interaction then it seemed likely that Alexa did perform this role somewhat because of frequent and regular use of the Echo Dots by students to acquire data, facts and information for learning. For instance, although many different interactions and questions were recorded, the questions asked to Alexa tended not to be of the clarification or confirmation type (Chin and Osborne, 2008) because these were usually asked to the teacher only, but instead questions to Alexa were generally requests for data, facts and information related to the learning activities they had been set. Students wanted knowledge from Alexa, that is, data, facts and information to answer a question they had been given or in several cases, to provide knowledge that they did not have or uncertainty they needed to resolve. Alexa appeared to be used as a digital more knowledgeable other and the data revealed that students regarded Alexa as quick to reply, easy to interact with and although sometimes frustrating and not responsive, a good way to acquire information for classwork. Alongside this it might also have been that for students, Alexa was simply ‘fun’ (Frey and Wilhite, 2005) and a more enjoyable way to interact than other available methods in the classroom, including the teacher. Data from observations in lessons suggested that students appeared to enjoy using Alexa. If however, Alexa was fun and enjoyable for students, Tews et al. (2015) have outlined that the potential educational benefits of fun and enjoyment might be increased learner engagement.

5.1.3 RO3: Discussion of the Impact that Voice Technology Has on Students’ Epistemic Curiosity

The following section discusses the impact that the Echo Dots and Alexa had on students’ epistemic curiosity (Berlyne, 1954). At the time of writing, there appeared to be limited educational research literature regarding epistemic curiosity and students’ questions (see Arnone and Small, 1995; von Stumm, Hell and Charmorro-Premuzic, 2011; Jirout, 2011; Jirout and Klahr, 2012; Powell, Nettelbeck and Burns, 2016). In this section therefore, there is a discussion which argues that students asked epistemic questions to Alexa indicating they were epistemically curious. The relationship between students’ questions and epistemic curiosity has so far only been alluded to and suggested in the literature.

5.1.3.1 Asking Questions for Knowledge

A definition is not provided by Collins and Ferguson (1993) as to what epistemic questions are, but the example questions given suggest that epistemic questions are

questions intended to acquire knowledge, data, facts and information and thus *might* be evidence of epistemic curiosity. Berlyne (1954) defined epistemic curiosity as a desire or drive to know and as outlined earlier, the relationship between question-asking for knowledge and epistemic curiosity remains weak in the literature. Students' questions therefore remain significant for this thesis because Alexa, the recipient of students' questions, appeared to have increased the number of questions that students asked, for example, 87 during two lessons (see Appendix 7), and also seemed to generate more talk in the classrooms as a digital more knowledgeable other. The relationship between epistemic questions or students' questions to acquire data, facts and information needs further exploration into Alexa's role as a digital more knowledgeable other and the affect on epistemic curiosity.

The importance of students' questions, especially those which seek knowledge, or epistemic questions (Collins and Ferguson, 1993) and which are part of thinking and learning in the classroom are a crucial part of students' learning as Chin and Osborne, (2008, p.2) have explained arguing that:

‘It allows them to articulate their current understanding of a topic, to make connections with other ideas, and also to become aware of what they do or do not know’.

A relationship between question-asking and epistemic curiosity is also suggested by Ram (1991) who describes questions which are asked when there are ‘knowledge goals’. These questions emerge from thinking and have to be surfaced or asked (Ram, 1991) and might be regarded as expressions of curiosity or what Collins and Ferguson (1993) have suggested examples of and called ‘epistemic questions’. Reasons and motivations for ‘expressed curiosity’ such as epistemic questions (Collins and Ferguson, 1993) or questions asked for knowledge goals, is offered by Jaber and Hammer (2015, p.6) who have described ‘epistemic affect’ and ‘epistemic motivation’ in Science, as being:

‘the pleasure of abstracting ideas and building new theoretical connections, the desire to understand a puzzling phenomenon, and the thrill of a theoretical prediction borne out in an experiment’.

Here, Jaber and Hammer (2015, 2016) have identified what has been described as a drive or desire to know, or epistemic curiosity (Berlyne, 1954, p.187) which would likely see questions being raised and posed or give rise to ‘epistemic feelings to pursue

questions’ (Jaber, 2015, p.163) or produce Collins and Ferguson’s (1993) epistemic questions. This is supported by Chin and Osborne (2008, p.2) who state that:

‘questions may stem from curiosity about the world around us as well as events and interactions with real-world issues. Students’ questions may be triggered by unknown words or inconsistencies between the students’ knowledge and the new information’.

Graesser and Person (1994) expand the notion that ‘information-seeking’ questions are a particular type of question asked to acquire information to close a gap or resolve uncertainty and which could be interpreted as being an expression of a type of curiosity or an epistemic question (Collins and Ferguson, 1993). However, the link between the asking of a question that aimed to gain knowledge and epistemic curiosity remained weak in Graesser and Person’s (1994) study. The data from Hillview School revealed that certain questions could be considered as part of a process of becoming interested in knowledge and are similar to Graesser and Person’s (1994) ‘information seeking’ questions and those that are referred to as the ‘big questions’ Billingsley et al. (2018, p.1116) and are posited by Billingsley et al. (2018) as being a type of ‘epistemic insight’.

5.1.3.2 Asking a Question for an Answer

From Chapter 4, it could be seen that many of the questions that students asked to Alexa appeared to be, as Graesser and Person (1994) have described, ‘information-seeking’ questions. At Hillview School an example of an information seeking question was, for example, ‘What is the name of the most common polyester?’. However, a question such as this could be interpreted differently and be described as an identification or verification question, a question asked to secure an answer that might already be known. Given the context of learning a topic in the classroom, and alongside observational data and data from the Echo Dots it would seem that these questions were epistemic questions (Collins and Ferguson, 1993) driven by an epistemic curiosity (Berlyne, 1954). During lessons however, questions such as these that were epistemic questions (Collins and Ferguson, 1993) were often a question from a worksheet or practice examination paper that was read out by students word for word to Alexa. Rather than being unprompted, these questions were prompted and read from a worksheet or examination paper. Nonetheless, the question was asked by students who seemed desirous of data, facts or information suggesting a drive to know and therefore that the questions emanated from epistemic curiosity. Although these questions were read from

worksheets or examination papers and are regarded as epistemic, their purpose was to acquire answers to score marks and to finish the work set. Again, when exploring epistemic questions and epistemic curiosity, external factors such as ‘regulativity’ and ‘metricalisation’ are revealed.

The extent to which an interaction with Alexa such as this to acquire an answer facilitated learning that is temporary or permanent (Lachman, 2010) or whether it led to knowledge formation for the students remains unclear from the data collected through the study. It may have been that this approach enabled students to commit to memory data, facts and information that was specific to particular types of questions that they would likely be asked that could be recalled at a later date (Tan, 2011; Tan, 2020). In this way, given how knowledge seemed to be understood and how learning seemed to be perceived and in relation to examinations students might take, this approach may be effective and desirable (Kember, 1996). For the ‘outputs’ of teaching, consideration needs to be given to whether question-asking contributes towards the ‘moral cultivation and personal transformation of students’, as Tan (2020, p.10) has outlined, or remains focused on a process of ‘productional learning’ for evidence which can be measured and recorded that generates ‘outputs’.

Students asked Alexa questions such as, ‘What gas is given off when lithium reacts with water?’ and these appeared to emanate from an epistemic curiosity and these questions seemed to suggest that they were epistemic questions. The questions of this type were asked during an interaction with Alexa who appeared to be used as a digital more knowledgeable other. However, even epistemic questions appeared to be bounded by external factors such as a pedagogical approach which regarded learning as a method of producing evidence of learning or for use in future examinations.

5.1.3.3 Epistemic Activity with Alexa, Not Teachers

There appeared to be expressions of epistemic curiosity, or ‘epistemic questions’ (Collins and Ferguson, 1993), such as, ‘How many times does the moon travel around the world in one year?’ and ‘How many hearts does an octopus have?’ and ‘How long will it take to get to Mars?’ and ‘Can fish see water?’. These questions represent what has been regarded by Billingsley et al. (2018), as an ‘epistemic insight’ and are similar to the type described as ‘big questions’ by Billingsley et al. (2018). These questions suggest that there is a type of question that emanates from an epistemic curiosity because they come from a student’s desire to know or acquire information to resolve a

cognitive conflict or gap or remove uncertainty and seek knowledge. When discussing children's reading Yaden, Smolkin and Conlon (1989) explained that spontaneous questions, that have been called 'unprompted questions' in this thesis, are used to extract information and these questions are evidence of children's interest and that children were thinking at an 'epistemic level' or were engaged in what Zenios (2010) has defined as epistemic activity. At Hillview School, unprompted or spontaneous questions appeared to be 'epistemic questions' (Collins and Ferguson, 1993), and as seen from the examples above, were infrequently observed being asked to the teacher but more were more commonly found in the transcripts of students' interactions with Alexa. Where there was a low frequency of this type of question being asked to teachers, there may be additional reasons as Billingsley et al. (2018, p.1116) have indicated:

'that there are pedagogical pressures and barriers in secondary school science classrooms that negatively affect young people's expressed curiosity in big questions and their opportunities to build their understanding of the ways that science and religion relate'.

Here, Billingsley et al. (2018) connect what has appeared to be a problematic pedagogical approach with 'expressed curiosity' such as epistemic questions (Collins and Ferguson, 1993) or big questions (Billingsley et al., 2018) and argue that this negatively affects students' understanding. It is possible therefore, through Billingsley et al. (2018) to identify the beginning of a relationship between a pedagogical approach, epistemic curiosity, epistemic questions, and epistemic activity (Zenios, 2010) and knowledge and learning. Through the use of the Echo Dots a similar tentative relationship also began to emerge from the data that suggested that Alexa played a role as a digital more knowledgeable other in relation to epistemic curiosity (Berlyne, 1954) and epistemic questions (Collins and Ferguson, 1993), or a general epistemic activity (Zenios, 2010).

5.1.3.4 Fostering Epistemic Habits

By being present and available to students in the classroom, Alexa was a viable method of acquiring information quickly and easily and this appeared to foster and increase the use of Alexa by students. In comparison, when seeking information, students interacted with the teacher and generally began by raising their hand and waiting with it raised until the teacher became available and signalled for them to speak. When seeking information from an Echo Dot, Alexa provided more answers to more questions than the

teacher and this might have been the case for two possible reasons. Firstly, the ratio of approximately thirty students to one teacher meant that students appeared tired of waiting with their hand raised to ‘bid’ (Alexander, 2005) for the teacher’s attention and had decided or learned to turn to Alexa instead. Secondly, Alexa provided information to the student who asked for particular information related to the specific issue, problem or knowledge gap they had at that particular moment in time. In this way, Alexa may have appeared effective, efficient and viable as a digital more knowledgeable other. The long-term impact of this might have been that students would choose not to ask questions of the teacher and this might explain why there was a lower number of questions asked of teachers in comparison to Alexa. Another perspective is that, because students can see a ‘receiver’ for their questions that they know to be controllable and that *they* can control, this further increases the likelihood that they will ask a question to acquire or construct knowledge. What this might suggest is that Alexa simply by being in the classroom increased the likelihood that students will ask questions to acquire information. The potential of this for teachers is worth considering because if this is the case then once question-asking begins to occur it continues and eventually may become a habit more frequently observed with a wider audience including teachers, peers and Alexa. It is not too much of a stretch of the imagination to suggest that as the habit of question-asking continues and more questions are then asked to the teacher as students learn to seek information more readily and have more confidence to do so because of the positive outcomes of a ‘curiosity loop’ as they become more interested in inquiry more generally and are more interested and become intent on acquiring answers to their questions on their own terms. Or as Loewenstein (1994, p.93) explains:

‘Because curiosity is more likely to occur and will tend to be stronger as information is accumulated, interest, in effect, primes the pump of curiosity’.

It is possible that Alexa provided students with this ‘priming’ by developing students’ interest beyond just interest and further towards ‘epistemic activity’ (Zenios, 2010) such as asking an epistemic question (Collins and Ferguson, 1993). Alexa could potentially become a viable way to find information they were epistemically curious about. As such, Alexa had some effect upon students’ question-asking and also the type of questions asked by students in the short term when the Echo Dots were used but the data is unclear as to whether this would remain over the longer term.

5.1.3.5 Problems Caused Students to Think Curiously

Alexa was asked a large number of questions by students and Hales et al. (2019) similarly reported that students in their study were keen question askers to Alexa. Jirout (2011) found that children who were regarded as ‘high curious’ tended to ask more information seeking questions and were more discerning in their evaluation of questions. Although this does not suggest that information seeking questions are an expression of curiosity the data from Hillview School and from Yaden, Smolkin and Conlon (1989), Ram (1991), Graesser and Person (1994), Jirout (2011), Jaber and Hammer (2015, 2016) and Billingsley et al. (2018) strongly suggest that epistemic questions (Collins and Ferguson, 1993) are identifiable expressions of epistemic curiosity. A relationship between questions and curiosity in the literature sourced was not evident but from the data from Hillview School, provides support for particular types of questions as being suggestive of epistemic curiosity.

However, there remains issues empirically measuring epistemic curiosity (Loewenstein, 1994, p.87) and it remains problematic to identify exactly *how* someone is epistemically curious and subsequently what might constitute an expression of epistemic curiosity. However, evidence of epistemic questions (Collins and Ferguson, 1993) suggested students were possibly ‘thinking curiously’. In support of this, the process of ‘thinking curiously’ seemed evident in Steven who asked the question ‘Will diamonds burn?’. From Jirout (2011), Steven might be regarded as a ‘high curious’ student because he asked a high number of information seeking questions which then supports the argument for a relationship between question-asking and a form of curiosity. Steven was a keen user of Alexa and regularly asked questions that were ‘unprompted’ and were epistemic questions (Collins and Ferguson, 1993) or ‘big questions’ (Billingsley, 2018). Steven explained the process he went through prior to asking his questions:

‘So I’m sort of sat there, and then this thought just sort of comes into my head and then I think about it a bit, I think if I can work it out or answer it and then if I can’t... I ask it’.

Steven elaborated and explained that in some lessons the topic being taught made him interested and when he was interested, he often wanted to know more. There seemed to be a relationship between interest, being curious and asking a question which Steven had explained and which might be ‘thinking curiously’. When Steven found something perplexing or was unable to find an answer or solution his interest or curiosity formed

into a question that he then asked. Incongruity or uncertainty appeared to be part of an epistemic curiosity (Berlyne, 1954), a desire or drive to know more, or what Beswick (2004) has described as ‘creating, maintaining and resolving conceptual conflicts’ (Beswick, 1971, p.64) or in the ‘Zone of Curiosity’ or at a ‘tonus level’ (Day, 1982). Billingsley (2018) used a ‘Knot Problem’ as an example of this perplexing effect of some problems when presented to students and which then might lead to and students’ questions.

Upon entering the classroom, a teacher presented a ‘window cleaning problem’ that was perplexing to all and created incongruity. The teacher exclaimed, ‘I have to clean the windows this afternoon’ and several students subsequently asked the teacher questions which seemed to stem from their curiosity. Specifically, students were desirous of data and information related to the ‘problem’ that had perplexed them. Although the students’ questions were not curriculum focused, they suggested that perplexing or unusual problems had the effect of stimulating ‘thinking curiously’ which led to unprompted epistemic questions (Collins and Ferguson, 1993). As such, this is an interesting area for further study and consideration in terms of pedagogical approaches that might be taken by teachers to increase perplexing scenarios into teaching and learning. The ‘window cleaning problem’ therefore highlights the potential of perplexing problems for fostering interactions between the ‘less knowledgeable’ and ‘more knowledge’. Unfortunately, Alexa was not able to help students with their questions regarding the ‘window cleaning problem’ due the specific context of the problem as set by the individual teacher.

5.2 Summary of RO1, RO2 and RO3

The data has revealed that the Echo Dots challenged ‘The Way’ by disrupting the teachers’ pedagogical approach and this affected students’ question-asking and epistemic curiosity. For students, the Echo Dots appeared important because they presented an alternative and additional way to acquire data, facts and information to create their own knowledge without dependence on the teacher. This appeared to increase students’ independence and motivation to engage with information and be able to curate it themselves and begin to think and then ask questions.

The Echo Dots provided students with more opportunities to engage with information and through a device that they were interested in, were familiar with and enthusiastic to engage with (Granito and Chernobilsky, 2012). Benefits of this motivation and increase in engagement by students may extend more broadly (Costley, 2014). The Echo Dots

appeared to increase the level of talk and were a positive impact upon the number of interactions that took place in the classrooms. The links between talk, discussion, question-asking, inquiry and thinking and intellectual development emerged, as Dewey (1910), Schmitt and Lahroodi (2008), and Casey (2014) have outlined in their studies.

The overriding impression of the drawbacks and benefits of the Echo Dots in the classroom related to the understanding by students and teachers of the broader purpose of education in general, as Biesta (2015) has questioned previously.

This could be seen in the concerns from teachers related to both implementing and then using the Echo Dots more widely than occurred, across more classes and in more lessons. Reasons for not using the Echo Dots appeared to be that teachers focused on producing evidence of learning and focused talk around students' performance (Biesta, 2008) which suggested there was a 'performance orientation' to dialogue in the classrooms, which might form part of what Biesta (2015) has referred to as 'learnification'. It appeared that this then led to the judgement and evaluation of learning taking place to form a 'metricalisation' of teaching and learning, and this predominated the pedagogical approaches taken (Biesta, 2008, 2015). It was observed that particular actions and behaviours of students and teachers occurred which suggested there was a 'regulativity' of the classroom.

The Echo Dots in the classroom appeared to create a tension between two pedagogical approaches. The first approach focused upon specific outcomes, such as performances in tests or 'mock' examinations and worksheets. The second approach, in contrast, tended to orient around the students because they took ownership of acquiring knowledge and interactions to do so by engaging frequently with Alexa. In this way, the first approach appeared to align more with a 'behaviourist' pedagogical approach (Skinner, 1976) and the second, more with a constructivist or 'social constructivist' (Vygotsky, 1978) approach as students gathered data, facts and information to form their own knowledge through Alexa, that was arguably a more 'social' process.

It appeared that the Echo Dots were the change, because lessons took place with them where previously they had not, and simultaneously created a change because it meant that via Alexa, students talked more which appeared to lead to more interest (Billingsley et al., 2012; Billingsley et al., 2018) increased motivation (Granito and Chernobilsky, 2012; Eren and Coskun, 2016) and it seemed plausible, to further intellectual development (Dewey, 1910) as students created their own knowledge, that they had more control and autonomy over.

5.3 Part Two: The Research Aim

Part Two, is concerned with the central aim of the research study which was:

- To observe teaching, learning and pedagogy in secondary school classrooms to investigate how Amazon's Echo Dots were used as a more knowledgeable other and the extent to which they affected students' epistemic curiosity.

The discussion of the research objectives in Part One revealed the impact of a type of as yet unnamed pedagogy which could not be ignored. The pedagogy limited the extent to which students could engage with Alexa as a digital more knowledgeable other and be 'epistemically curious'. Part Two therefore provides a discussion of a type of pedagogy and defines it, and then presents the extent to which the research aim was achieved.

5.3.1 A Pedagogy of Performance

Discussing schools as part of a system of education, Ball (2003, 2007, 2016) and Ball, Maguire and Braun (2012) have described a process of education that influences schools and the external issues facing teachers. An educational 'A-C Economy' has been outlined by Kulz (2017, p.7) and Giroux (2012a) has suggested that within education there is an emphasis placed on evidence production. Giroux (2012a, 2012b) has also described many of the contextual and structural reasons for issues and challenges existing and Ball (2003, 2007, 2016) has described the outcomes of the education system upon teachers and identified resultant 'struggles' and 'resistance' that ensue. Personal experience gained from working in schools and knowledge developed from a role as teacher educator showed that schools were not 'silos', remote and disconnected from external factors and influences that acted upon them.

Therefore, the system and process and experience of education in 'neoliberal' (Ball, 2003, 2007, 2016; Giroux, 2012b) and technological times (Selwyn et al., 2019) present challenges around the function and purpose of education and pedagogy at a classroom level. It emerged from the data that what occurred in the classrooms was not free from external influence and this is also evident knowing that students, teachers and schools are assessed, measured and quantified, for example, through 'performance indicators' such as examination results. In regard to the function and purpose of a school, a perspective is presented by Scardamalia and Bereiter (2006, p.97) who have argued that the purpose of education might be to benefit society and culture and stated that:

‘the fundamental task of education is to enculturate youth into this knowledge-creating civilization and to help them find a place in it’.

However, Scardamalia and Bereiter (2006, p.97) when identifying the limitations of ‘modern’ pedagogical approaches, such as ‘constructivism’ that aims to have learners create their own knowledge, recognised that:

‘In light of this challenge, traditional educational practice – with its emphasis on knowledge transmission – as well as the newer constructivist methods both appear to be limited in scope if not entirely missing the point’.

An ‘external framework’ appeared to engender a particular traditional pedagogical approach (see Scardamalia and Bereiter, 2006; Ertmer, 1999, 2005) and this was observed at Hillview School as ‘The Way’. The resultant impact framed students as ‘valued’ for the evidence they might produce (Giroux, 2012a) and the outcomes they might generate, rather than as Scardamalia and Bereiter (2006, p.99) state, for ‘what they know and can contribute to the organisation’s or the community’s knowledge’. Teaching and learning appeared to be about production and performance rather than knowledge and learning.

In circumstances such as these the importance of inquiry or curiosity and students’ self-prompted questions and hypotheses or expressions of curiosity seemed to be overlooked in favour of what appeared to be an approach of memorising or learning ‘knowledge about other people’s knowledge’ or ‘knowledge reproduction’ (Scardamalia and Bereiter, 1993) or the acquisition of what Scardamalia and Bereiter (2006, p.101) have described as ‘declarative knowledge you can retrieve when prompted to state what you know’. Scardamalia and Bereiter (2006, p.99) have also explained that the ability to recollect, remember or recall information should not be a purpose or aim of education and that an aim for organisations should be that ‘people are not honored for what is in their minds’ because of the focus therein upon individualised or ‘siloed’ knowledge to the detriment of others and the organisation itself.

What seemed to be apparent from the use of the Echo Dots was a pedagogical approach that emerged from teachers’ understanding of what the purpose of ‘learning’ was which directly affected the need for students to move beyond individualised ‘declarative knowledge’ (Scardamalia and Bereiter, 2006, p.101). Time and energy spent pursuing goals such as ‘A-Cs’ (Kulz, 2017) and which was exemplified by the ‘performance-

oriented talk' that occurred, appeared to focus or orient teaching and learning away from the experiences of students in the classroom which fostered behaviours such as epistemic activity, epistemic question-asking and epistemic curiosity. Collectively, what has been described so far is suggestive of a possible form or type of pedagogy that was a *performance oriented* pedagogical approach taken by the teachers observed at Hillview School. As a working definition, before further discussion, this is suggested as and will be referred to as a 'pedagogy of performance'.

The Echo Dots primary advantage appeared to be for students not teachers and there were limited instances of teachers benefiting from their use in lessons. The Echo Dots, with regard to teachers, tended to offer support for a pedagogical approach, the suggested 'pedagogy of performance', which meant that students did not need to be epistemically curious.

Through the study of the Echo Dots, in relation to pedagogical approaches, a more knowledgeable other and epistemic curiosity, the interpretations of the data revealed a pedagogy that seemed to govern social behaviours and actions. Moving a discussion away from the suggested 'pedagogy of performance' therefore proved problematic because the aim and objectives of the research study were revealed to be tightly coupled or connected to it. As much as the study has revealed about more knowledgeable others and epistemic activity including question-asking and epistemic curiosity, it has also begun to reveal tentative notions such as 'performance-oriented talk', 'metricalisation', 'regulativity' and the '*digital* more knowledgeable other' along with a 'pedagogy of performance'.

The next section and subsequent sections of this chapter therefore discuss these in relation to the research aim and consider the pedagogy of performance as significantly influential.

5.3.2 Talking and Questioning for More Knowledge

Questions are primarily 'a form of social action, designed to seek information' (Heritage, 2002, p.1427) and according to Tracy and Nobles (2009, p.131) questioning is 'one of, if not the, central communicative practice of institutional encounters'. Dillon (2004) and Almeida (2010) have described the importance of students' questions in the classroom but it has also been shown that students' questions are often absent (Dillon, 2004; Wragg, 2001; Ness, 2015). An absence of questions or lack of students' epistemic

questions (Collins and Ferguson, 1993) in any classroom should be worrisome for educators. An absence of students' questions and lack of epistemic questions was evident at Hillview School and there were contextual reasons for this, but the primary reason appeared to be the pedagogical approach taken by teachers. Talk about and for learning in the classroom did not appear to be regarded as an authentic type of work in the same way that worksheets and other productional performance oriented activities were, as Alexander (2001, p.567) has explained, stating that:

‘there is an atavistic belief that written work is the only ‘real’ work’.

In the literature, it was apparent that the level of curiosity and number of students' questions differed between home and school and that teachers could affect the opportunities for inquiry, hypothesising and question-asking (see Kreidler, Zigler and Kreidler, 1975; Lowry and Johnson, 1981; Engel, 2009; Jirout, 2011; Jirout and Klahr, 2012). The literature supports the notion that schools and teachers can negatively impact students' questions, regarded as potential expressions of epistemic curiosity, and this also seemed to be the case at Hillview School.

In terms of pedagogy, when Alexa was present or absent, an educational framework meant that teaching and learning unfolded in a particular way in the classroom at Hillview School resulting in a lack of students' question-asking to teachers, and which Dillon (2004) Wragg (2001) and Ness (2015) have also highlighted in studies. The wider factors, in this instance external to a school, as described by Fullan's 'inside-outside' and 'outside-in' stories (Fullan, 2000), appeared to 'press in' on the school and teachers and students and influenced what took place internally in the school. This is an issue that Dillon (2004, p.7) has also described, stating that 'other powerful conditions and facts of life give students good reason not to ask [questions]'. The resultant outcome appeared to be a lack of students' epistemic questions (Collins and Ferguson, 1993) to the teacher, which was revealed at Hillview School.

The reason why students' questions are significant is because students' questions can be regarded as a signal or an observable and identifiable expression of epistemic activity (Zenios, 2010) and epistemic curiosity. This is especially the case when the question is posed to seek, acquire or engage with data, facts, information as part of the process of constructing knowledge or 'knowledge building' (Scardamalia and Bereiter, 1994, 2006, 2010). It can be assumed, that when epistemic activity (Zenios, 2010) leads to

epistemic questions (Collins and Ferguson, 1993), subsequently, there is evidence of an existence of epistemic curiosity.

Questions from students that are requests for knowledge (Loewenstein, 1994) or emerge from incongruity (Duffy, 1974) or that are information seeking (Chak, 2007) represent what has been described by Reio (2009, p.3) as ‘information seeking’ or cognitive curiosity’, or epistemic activity that Zenios (2010) has outlined. When students display or engage in epistemic activity (Zenios, 2010) it has been referred to as an ‘intellectual curiosity’ (von Stumm, Hell and Charmorro-Premuzic, 2011) which has been posited as being ‘the third facet alongside intelligence and effort’ of academic performance (von Stumm, Hell and Charmorro-Premuzic, 2011, p.583). It can be seen therefore, that questioning, epistemic curiosity and activity that is epistemic, contribute to knowledge acquisition and learning. This suite of behaviours can be described by von what Stumm, Hell and Charmorro-Premuzic (2011, p.583) call a ‘hungry mind’ and may contribute to what Bereiter and Scardamalia (2010) call ‘knowledge building’ or the process of deep learning from problem based learning opportunities in the classroom rather than context-general work (Bereiter and Scardamalia, 2010). The drive for knowledge or the desire to seek knowledge, as well as question-asking as a mechanism to achieve some form of knowledge building in the classroom, appears to be a desirable outcome. It seems that question-asking as part of knowledge building and epistemic activity or epistemic curiosity appear connected and this appeared to be the case at Hillview School. Alexa appeared to positively affect students’ desire and motivation to talk and ask questions and acquire data, facts and information as part of knowledge building endeavours and this was enacted via social interactions that took place communally with other students and also Alexa. It seemed that Alexa played a role in promoting students’ questions, gave rise to epistemic questions (Collins and Ferguson, 1993) and encouraged students to seek data, facts and information, and it seemed likely, to create or build knowledge by talking. In this way, as a more informative other or *digital* more knowledgeable other, Alexa played a positive role within students’ learning.

Interpretations of the data presented in Chapter 4 revealed how talk was prevalent between the students and Alexa and that this remained consistent over time due in part to what initially appeared to be the novelty of the Echo Dots. The data also appeared to show that teachers carried out the majority of the talk that took place. The data also showed that when the Echo Dots were present the teacher was still responsible for the majority of the talk, using ‘The Way’ from ‘The Front’, to students who were seated in

rows. There is a limitation of this pedagogical approach (see Kreitler, Zigler and Kreitler, 1975; Lowry and Johnson, 1981; Scardamalia and Bereiter 2006; Engel, 2009; Jirout, 2011, Jirout and Klahr, 2012), particularly for students, and this is a negative impact on deeper understanding and knowledge because it overlooks the importance of talking and thinking. Bereiter (2002, p.269) has described a similar form of instruction as a reductive pedagogy which is damaging for education, stating that:

‘If there is a reason for instruction focused on thinking itself, it is probably to repair the damage caused by poor education’.

It appeared that students did not ask questions in lessons to teachers unless they were for clarification or confirmation as Wang’s (2006) research has outlined or were a reply or response to the teacher who had asked them or the class a question. In other literature, epistemic questions (Collins and Ferguson, 1993) were infrequently observed being asked and this type of ‘information seeking’ question (Jirout, 2011) did not appear to be required because of the way in which teaching and learning took place, the pedagogical approach of the teacher, as suggested by Engel (2009) and the types of resources that were used in lessons. For example, the use of worksheets, as Engel (2009) highlighted, or examination papers and tests that were used at Hillview School, required written answers to be provided that could be assessed by the teacher. Students were observed to ask Alexa numerous questions in comparison to the teacher and appeared keen to interact with Alexa and the data showed that they asked numerous questions to the Echo Dots. As such, they appeared to engage in epistemic activity (Zenios, 2010) with Alexa and asked epistemic questions (Collins and Ferguson, 1993) suggesting that they were likely to have been epistemically curious in certain instances or scenarios.

However, although epistemic curiosity seemed likely because of the occurrence of epistemic questions, there appeared to be little opportunity or necessity for students to ask questions beyond those which enabled them to find out, for example, how long they had left to complete a task, where they should write an answer or whether the answer they had written down was correct, or ‘clarification and confirmation’ questions as Wang’s (2006) research has described them. Considering the factors influencing questions and epistemic activity, Scardamalia and Bereiter (2006, p.102) have explained how pedagogy impacts upon learning and knowledge acquisition:

‘the more that the curriculum calls for is often left to be conveyed by conventional instructional means. This raises concern that the deep knowledge that is most useful for transfer will not be connected with problems but will remain as knowledge about the relevant principles or laws’.

There were two questions asked to Alexa which symbolised Zenios’ (2010) concept of epistemic activity and were regarded as what Collins and Ferguson (1993) described as ‘epistemic questions’ and were thus representative of epistemic curiosity. The questions were, ‘Can fish see water?’ and ‘Would a diamond burn?’. When students asked Alexa an ‘epistemic question’ (Collins and Ferguson, 1993) or what Chak (2007) and Jirout (2011) defined as an ‘information seeking’ question such as ‘Can fish see water?’ students appeared to be attempting to acquire data, facts and information, which when interpreted in the context of the lessons, tasks and activities that took place, was the construction of knowledge or part of a ‘knowledge building’ activity that Scardamalia and Bereiter (2010) have described. Despite being driven by the need to complete a task or activity or to provide ‘correct’ answers (Wang, 2006) the students were ultimately seeking knowledge and thus engaged in what Zenios (2010) has described as epistemic activity that was manifested as an epistemic question such as ‘Would a diamond burn?’ which suggested that these were expressions of epistemic curiosity. In these instances an epistemic curiosity appeared to lead to an epistemic question being asked to Alexa, a digital more knowledgeable other or something which was considered by students to hold *more* data, facts and information than students held at that time.

Epistemic questions from students that were asked in classrooms, particularly those which were ‘information seeking’ or were epistemic in nature and an epistemic activity, had a dual benefit. Firstly, the question benefitted the individual student who asked the question because they gained knowledge, data, facts or information which could be used towards completion or resolution of their task or activity. Secondly, a question asked in a classroom by a student was public, for everyone present to hear and was a ‘communal question’. When a student posed a ‘communal question’ to the teacher it was asked in front of others who could hear and understand their attempt to seek knowledge and in doing so might possibly engage other students and promote information seeking or epistemic activity (Zenios, 2010) by them. The benefit of a communal question was that it was part of a social event that took place in the classroom between everyone who was present and might engage or motivate others to participate in a social interaction and contribute towards collective ‘knowledge building’ (Scardamalia and Bereiter, 2010) and the ‘knowledge discourse’ that occurred (Scardamalia and Bereiter, 2006).

Fundamentally, if students were talking, asking questions or engaged in discussions, other students were able to hear and potentially gain rather than siloed knowledge not being of benefit to the class and potentially the school as knowledge became built by groups of students or whole classes.

Alexa seemed to play a role in encouraging students to ask more questions and when students interacted with Alexa the questions they posed were ‘communal questions’ which they and others present were able to engage with and potentially benefit from as well. As such Alexa, when being used as a digital more knowledgeable other was able to promote ‘knowledge discourse’ (Scardamalia and Bereiter, 2006, p.102) which is defined as:

‘discourse whose aim is progress in the state of knowledge: idea improvement’

This is because students were able to pursue ideas and thoughts more easily and efficiently by asking Alexa. Knowledge or data, facts and information that were part of knowledge building, was able to be acquired ‘on-demand’ via a method that was communal, public, enjoyable and novel to facilitate learning because of an epistemic curiosity (Berlyne, 1954), epistemic questions (Collins and Ferguson, 1993) and epistemic activity (Zenios, 2010). Alexa appeared to be a way in which communal questions were asked which led to socially formed knowledge developing which originated from an epistemic curiosity. Communal questions enabled students and the school to build what Scardamalia and Bereiter (2010) have called ‘community knowledge’. Alexa played a role in students’ knowledge building because it built their intentionality which Scardamalia and Bereiter (2010, p.2) have defined as a behaviour that means ‘people engaged in Knowledge Building know they are doing it and advances are purposeful’.

When students interacted with Alexa, they did so more often than with the teacher and a higher number of questions were observed and recorded to occur during lessons. Considering Scardamalia and Bereiter’s (2006, 2010) knowledge building or Zenios’ (2010) epistemic activity, students’ interactions with Alexa may also have increased their ‘epistemic agency’ (Damşa et al., 2010; Zenios, 2010) or ‘epistemic fluency’ (Zenios, 2010) and epistemic curiosity. It seems plausible that the asking of questions to Alexa instead of the teacher may, over time, become a routine or habit and begin to lead students to understand that Alexa was a method for them to connect question-asking

with knowledge acquisition rather than fact or answer retrieval, as (Bereiter, 2010, p.10) has explained:

‘Participants recognize both a personal and a collective responsibility for success of knowledge building efforts. Individually, they set forth their ideas and negotiate a fit between personal ideas and ideas of others, using contrasts to spark and sustain knowledge advancement. Rather than depending on others to chart that course for them. Collectively they deal with problems of goals, motivation, evaluation, and long range planning that are normally left to teachers or managers.’

What was apparent with regard to the aim of the research study was that within an educational framework external to Hillview School that engendered a specific pedagogical approach which impacted upon students need to be epistemically curious and ask epistemic questions and engage in epistemic activity, Alexa appeared to cultivate talk and promote question-asking. In using Alexa as a digital more knowledgeable other, it appeared that students engaged in knowledge building through a knowledge discourse by asking communal questions that disrupted the effect of ‘The Way’, which seemed to have allowed them to develop epistemic agency and behaviours that indicated a higher level of autonomy from the teacher and which pointed towards a possible greater ownership of knowledge and its development and acquisition. Alexa encouraged students to talk and talk appeared to be a fundamental way for students to engage in knowledge building by asking questions to Alexa in greater numbers, many of which appeared to be expressions of epistemic curiosity.

Two disconnects have been revealed. Firstly, there appeared to be a disconnect between the teachers’ pedagogical approach or ‘pedagogy of performance’ and students’ needs in terms of learning. This appeared to be because students were receptive to the idea of using Alexa as part of their learning as a digital more knowledgeable other but opportunities and reasons to do so were limited and constrained. Secondly, there was a disconnect between teachers and students’ perceptions of the purpose and outcomes of learning and knowledge and the role of talk, question-asking and epistemic curiosity. This was suggested by the proportion and type of talk that occurred, ‘performance-oriented talk’ and who was involved in talk, what knowledge was understood to be and the means to create it.

5.3.3 Disconnects Between Pedagogy and Students' Needs and Talk

Epistemic behaviour (Berlyne, 1960) and epistemic activity (Zenios, 2010) with Alexa which manifested as epistemic questions (Collins and Ferguson, 1993) and epistemic curiosity (Berlyne, 1954; Jirout, 2011) appeared very little in the classrooms of Hillview School because of teachers' pedagogical approach and use of 'performance-oriented talk'.

The presence of the Echo Dots and observations of students' use of Alexa in lessons revealed two categories of talk: talk with teachers and talk with Alexa. The transcripts from the Echo Dots of students' interactions and talk with Alexa also revealed a contrast in the proportions of talk that occurred in terms of students and teachers. Students were shown to have talked more with Alexa than with the teacher. Teachers were shown to have talked more to students than to Alexa.

Regarding talk between teachers and students, Scardamalia and Bereiter (1993) and Scardamalia (2002) have described how the pedagogical approach in the classroom directly impacts upon what occurs in terms of the discourse that takes place. For instance, Scardamalia (2002, p.70) has described a 'centralized management structure' in the classroom which has been described previously in this thesis as 'The Way' and has outlined how this 'severely constrains the kind of discourse that can go on' (Scardamalia, 2002, p.70). The constrained talk that took place within the 'pedagogy of performance' and which appeared to be used at Hillview School has been discussed and defined in this thesis as a type of 'performance-oriented talk'. Considering 'The Way', the data showed that worksheets were used more often than the Echo Dots in lessons and that this form of learning required students to work silently and with limited opportunities for talk, in contrast to talk with the Echo Dots which was plentiful. The resultant effect of these methods of teaching, which reduced and restricted talk, was presented as a form of talk about marks, scores or grades or tests and examinations which has been defined in this thesis as a 'metricalisation' that included a type of 'performance-oriented talk'. Performance-oriented talk revealed that students did not need to ask questions unless they were about their own performance in tests, examinations or classroom tasks, activities and worksheets or were 'Yes/No' questions that could 'confirm and ratify topics' (Wang, 2006, p.533) or where students were 'requesting confirmation' (Wang, 2006, p.539) were sufficient. Questions were observed as mostly coming from the teachers and the following extracts of data collected at Hillview School characterise the type of talk from teachers with students

that was commonly observed in the lessons and is defined in this thesis as ‘performance-oriented talk’:

(Fieldnotes: 15th May, 2019)

‘The examiner wants to know you know about Health and Safety’.

‘On the [work]sheets I’ve given you make sure you get all three marks’.

‘It [the question] was worth 8 marks’.

‘Write down the key points and I will give you detailed notes next lesson... this type of question, slightly different to this, will be in a GCSE paper’.

The data revealed that ‘performance-oriented talk’ frequently occurred in lessons and suggested a way in which teachers prioritised what they talked about with students. Or, as Levinson’s (1979, p.368) research has described it, stating that it was a type of talk which had a priority or orientation towards performance because:

‘members are goal-defined, socially constituted, bounded, events with constraints on participants...’

In this way, as Levinson (1979) has outlined, the institution and its culture, goals and aims appear to form a setting-wide philosophy and modes of operation within which an individual’s beliefs are formed and resultant actions and behaviours occur. Hence why it appeared that teachers’ actions and behaviours at Hillview School revealed a type of ‘performance-oriented talk’ because, in the classroom at practice level and organisationally at school level, they were shaped and formed by their understanding and perceptions of what the purpose and outcomes of teaching needed to be as Biesta’s (2008, 2015) literature has also outlined.

Scardamalia and Bereiter (1993, p.37) have outlined how ‘question-asking in schools is not really dialogic’ and that the ‘transmission model’ of teaching only serves to populate students’ minds with ‘some kind of reproduction of knowledge’ (Scardamalia and Bereiter, 1993, p.37) rather than enabling them to construct their own knowledge. At Hillview School, talk and questions were observed to orient around marks, scores or grades when students interacted with the teacher, suggesting a ‘metricalisation’ and ‘regulativity’ and social interactions did not appear to be dialogic. Questions that were

asked to the teacher by students were limited and were usually clarification or confirmation questions (Wang, 2006) regarding the task or activity being worked on.

Wang's (2006) 'transmission model', has also been described by Scardamalia and Bereiter (1993, p.37) as a 'discourse model' and affects relationships in the classroom and as Wang (2006) has stated, 'reproduces, creates and challenges existing power relations' (Wang, 2006, p.531). At Hillview School this model emerged as 'performance-oriented talk' that choreographed actions and behaviours. Talk in the classrooms seemed to be a pedagogical approach that through an orientation towards marks, scores and grades, or a 'regulativity' and 'metricalisation', appeared to cast students into subordinate roles because they were not in control of talk with the teacher which Wang (2006, p.529) has argued occurs because:

'questions are a possible means for dominant participants to exert power over subordinate individuals, either in casual conversation or in institutional dialogue'.

In contrast to what Wang (2006) has suggested about the subjugation of students and what seemed possible from 'The Way', was that students appeared to like using Alexa perhaps because of a liberation they may have sensed from being able to control interactions. Control over talk and learning was observed as being held by teachers. It became increasingly problematic to ignore the impact of 'The Way' and its negative effect upon dialogue for learning and knowledge. Chen and Hong (2016) have described this approach to teaching and learning as an 'acquisition' model which is posited as a contrast to a 'participatory' model where knowledge is constructed by the learner. Further to this, Bereiter and Scardamalia (1987, p.10) have deconstructed the 'transmission' and 'acquisition' models and identified two types of idealized or types of teachers. They describe Teacher A and Teacher B whose pedagogical approaches are described as:

'...Teacher A typically assigns reading selections with little preparation and then has students answer oral or workbook questions about them...
...Teacher B is careful to select and sequence reading material so it builds gradually on students' existing knowledge...'

As was observed at Hillview School, worksheets, tests and examinations and a performance orientation to talk resulted in teaching and learning resembling Teacher A

with less resemblance to Teacher B's pedagogical approach. However, Bereiter and Scardamalia (1987, p.10) have described a third type of teacher:

‘...Teacher C's approach can best be described as taking all the things that Teacher B does and trying to teach students to do them for themselves...’

Here, Bereiter and Scardamalia (1987) describe a type of teacher that tried to reconstitute the ‘power’ hierarchy that Wang (2006) has identified and the ‘transmission’ and ‘acquisition’ (Bereiter and Scardamalia, 1987) pedagogical models. In doing so, Bereiter and Scardamalia (1987) have described what Chen and Hong (2016) outlined as a potential method:

‘to empower students to take over responsibilities normally reserved for the teacher’.

It is possible that Alexa led to or had the potential to lead to an empowerment of students and a disruption of the pedagogical approach of ‘The Way’ and this might subsequently prove to be able to have some reductive effect upon the influence of ‘performance-oriented talk’, ‘regulativity’ and ‘metricalisation’ on teaching and learning.

At Hillview School there appeared to be a pedagogical structuring and organisation of students’ learning that necessitated question-asking, epistemic activity, knowledge and learning being perceived as the acquisition of knowledge, data, facts and information. In this way there became little need for students to engage with the teacher as a more knowledgeable other in terms of the social construction of knowledge but instead required the teacher to engineer the transmission of knowledge to students where they were then able to comply and sit quietly to receive the knowledge. However, Alexa revealed that students do still ask questions and do still seek data, facts and information and engage with Alexa as a digital more knowledgeable other suggesting that the transmission model and ‘The Way’ contrasted with students’ needs and motivations. This appeared to be the case due to the relatively high number of questions and interactions involving Alexa. Also, occurrences of epistemic questions were observed such as ‘Can fish see water?’ and numerous questions were recorded in the students’ interactions that revealed ‘epistemic activity’ with Alexa suggesting that even if the pedagogical approach, priorities of the teacher and school and effect of ‘performance-oriented talk’, ‘metricalisation’ and ‘regulativity’ generated particular modes of social

interactions there were still epistemic questions and epistemic activity emanating from students but these were ignored or overlooked.

In summary, Alexa revealed the amount and type of talk that occurred at Hillview School and also revealed the contrast between talk of students and talk of teachers and also revealed the potential power relationship formed in the classroom by the pedagogical approach of the teachers. In this way, rather than perform solely as a digital more knowledgeable other Alexa also stimulated talk and worked upon power relationships by producing a ‘battleground’ where the control of talk could be challenged. The pedagogical approach currently observed at Hillview School unfortunately suggested that the benefits of a device such as the Echo Dot and Alexa, a digital more knowledgeable other, became overlooked despite students apparent enthusiasm and increased talk, epistemic questioning, epistemic activity and epistemic curiosity.

The previous two sections have described disconnects between pedagogical approaches, talk and question-asking as part of ‘epistemic activity’ and the socio-cultural creation of knowledge (Chen and Hong, 2016) and the impact of these upon how students’ learning and engagement with knowledge are enacted in the classroom. Although further data will be beneficial, from the tentative notions of ‘performance-oriented talk’, ‘metricalisation’ and ‘regulativity’ there is the suggestion that teachers’ pedagogical approaches could be interpreted as being evidence of a potential ‘pedagogy of performance’. However, this remains a tentative notion supported by three tentative notions which were revealed from the data collected from one research study. Nonetheless, the cumulative effect of the three tentative notions are suggestive that a ‘pedagogy of performance’ might have existed which may therefore be worthy of further discussion and consideration. This is a potential point of departure for a new research study. A diagram, below in Figure 24, presents the tentative notions that are hypothesised, to constitute a ‘pedagogy of performance’.

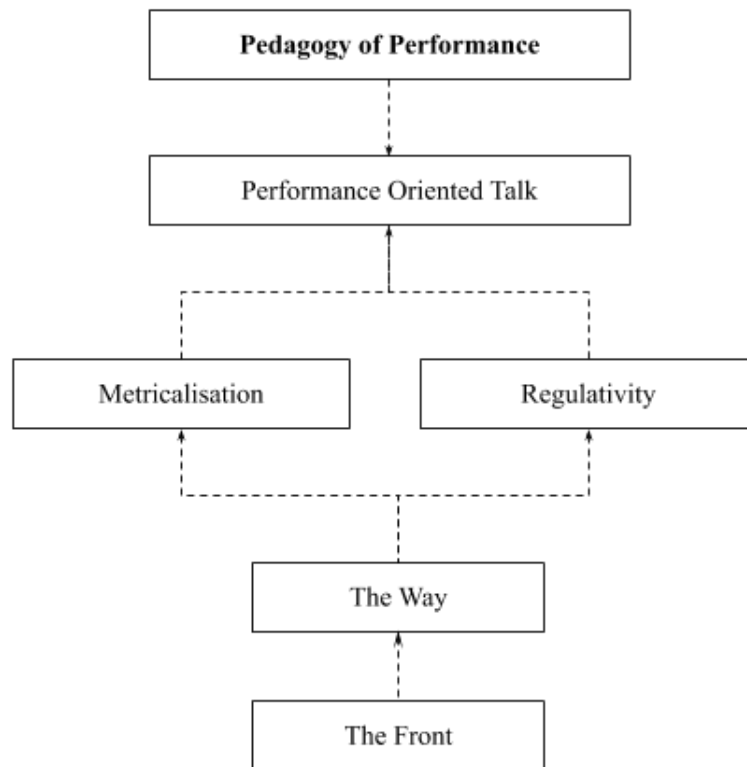


Figure 24: The tentative notions forming a pedagogy of performance

The tentative notions, as have been discussed, and shown above, contribute towards the tentative notion of a pedagogy of performance. To further visualise and understand the pedagogy of performance, and consider how each notion is related to others, a diagram is provided, below, in Figure 25.

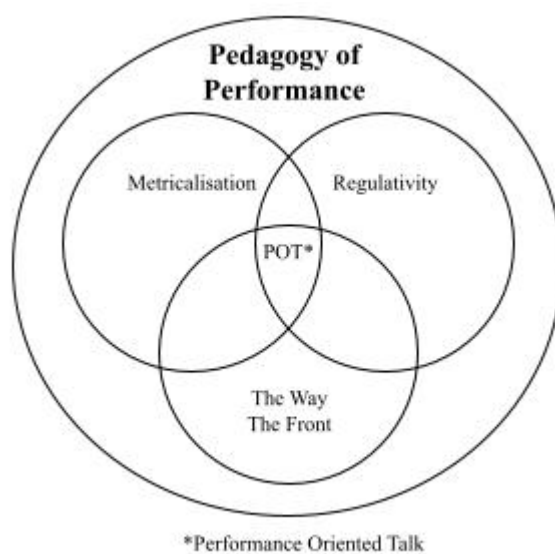


Figure 25: Visualisation of a pedagogy of performance

The next and final chapter concludes this thesis and the PhD research study at Hillview School, but importantly, also attempts to connect the dots to generate an answer for the burning question, ‘Why aren’t my students curious?’.

Chapter 6: Conclusion and Recommendations

This chapter has five parts. Part one revisits the purpose of the study. Part two presents the impact of a pedagogical approach. Part three outlines the limitations that were identified and part four presents the implications of the study and includes recommendations for further research and further questions. Part five presents the original contribution to knowledge that this thesis makes.

6.1 Revisiting the Purpose of the Study

The idea of a research study was conceived in late 2016 when I was a teacher in a secondary school. It became an attempt to provide an answer to a burning question of ‘Why aren’t my students curious?’. This question had emerged as I critically reflected on my own practice and thought about education more broadly. The aim of the research study was to observe teaching, learning and pedagogy in secondary school classrooms to investigate how Amazon’s Echo Dots were used as a more knowledgeable other and the extent to which they affected students’ epistemic curiosity.

Through an ethnographic approach, the study was designed to investigate the everyday teaching and learning at Hillview School through the methods of participant observation, informal interviews with teachers and data collected from the Echo Dots.

Although I had hoped that the data might reveal insights into the area of Vygotsky’s (1978) more knowledgeable other and epistemic curiosity (Berlyne, 1954). This occurred but the insights were overshadowed by what was additionally revealed regarding pedagogical approaches and their impact and affect. In trying to achieve the aim of the research study, several tentative notions were surfaced which could not be ignored and were pursued in terms of the research objectives.

6.2 The Restrictive Impact of a Pedagogical Approach

From as early as 1915, Dewey and Dewey (1915), Cubberley (1920), Postman and Weingartner (1971) and Cuban (1993) have described, but not named, a particular and persistent pedagogical approach. Similarly, a persistent pedagogical approach also emerged from the study at Hillview School. The pedagogical approach revealed at Hillview School was ‘The Way’ of teaching that was in line with the didactic approach

that Hurst et al. (2013) had described and the ‘formal authority teaching style’ described by Dilekli and Tezci (2016). Scardamalia and Bereiter (1993) and Ertmer (1999, 2005) have recognised that in terms of technology usage, the teacher influenced what took place in the classroom and that the type of pedagogical models employed and the pedagogical beliefs teachers might have also had an influence. The interpretations from Hillview School regarding use of the Echo Dots by teachers appeared to reveal broadly similar factors as Scardamalia and Bereiter (1993) and Ertmer (1999, 2005) have outlined. In this respect, the study at Hillview School is consistent with prior research regarding pedagogy and practice involving technology and perceptions and use of technology by teachers.

Students at Hillview School used Alexa to support their classwork and interacted with Alexa using short but frequent questions and requests and these occurred in large numbers. The insights regarding Alexa and students at Hillview School were in line with what Austerjost et al. (2018), Taken Smith (2018), Lopatovska et al. (2018) and Burbach et al. (2019) found in terms of spoken interactions and was consistent with the ways in which Sciuto et al. (2018), Lopatovska et al. (2018), Siddike et al. (2018) and Mclean and Osei-Frimpong (2019) who have also described these user interactions and behaviours with voice technology.

As Wragg (2001) Dillon (2004) and Ness (2015) have outlined, students did not appear to ask many questions to teachers in lessons and this appeared to be the case at Hillview School. When students occasionally asked a question in lessons to the teacher, as Wang’s (2006) research described, they were generally ‘Yes/No’ type questions and appeared to be asked for clarification and confirmation. Where the study at Hillview School makes some progress in this area is that Alexa revealed that students asked a lot of questions when presented with an Echo Dot during lessons especially when they were able to use it independently from the teacher as part of the work in the classroom. Question-asking from students increased and a significant number of questions to Alexa were not ‘Yes/No’ questions but epistemic questions. The reason why question-asking increased at Hillview School, was that students appeared excited at the prospect of using the Echo Dots and seemed more motivated to interact with Alexa possibly because they were simply regarded as ‘fun’ (Frey and Wilhite, 2005; Tews et al., 2015). Terzopoulos and Satratzemi (2019) and Granito and Chernobilsky (2012) similarly found that students were excited and motivated by technology.

Scardamalia and Bereiter (1993) have outlined teaching strategies that negatively affect students' understanding. Scardamalia (2002) has described how educational imperatives cause teachers to act and behave in specific pedagogical ways. Similarly, Ball (2003, 2007, 2016) Ball, Maguire and Braun (2012) and Giroux (2012a, 2012b) have collectively described what appears to be an external educational framework of imperatives that affect teaching. The notion that an external influence enacted a specific way of *doing* teaching and learning at Hillview School is supported by what appeared to be a focus on lesson worksheets, other pieces of evidence of learning and the lexicon of performance-oriented talk and the limited time the Echo Dots were used because of how they were valued and perceived by teachers. Hurst et al. (2013) and Dilekli and Tezci (2016) have indicated, without identifying specific teaching methods, that teachers might be conscious of the external aims and goals (see Ball, 2003, 2007, 2016; Giroux, 2012a, 2012b) beyond their individual classrooms which require them to orient their pedagogical approach in particular ways.

Beyond what the literature has revealed regarding the influence of an external framework and a pedagogical approach which Dewey and Dewey (1915), Cubberley (1920), Postman and Weingartner (1971) and Cuban (1993) described but did not name, the study at Hillview School suggests that the pedagogical approach might be a 'pedagogy of performance'. Within this pedagogy of performance the notions of 'performance-oriented talk', 'metricalisation' and 'regulativity' are integral (see Figure 24).

The literature by Walkerdine (1985), Scardamalia, (2002) and Jaworski and Sachdev (2010) has outlined that teachers controlled talk, students had specific roles in the classroom and were selected to speak when spoken to and listened silently taking a passive and receptive role. What emerged from Hillview School was broadly consistent with this notion as students were observed sitting in rows, having limited opportunities to talk about learning and knowledge, used worksheets frequently and were taught how to perform well either in the work at hand or in future assessments or examinations. It has been argued in this thesis that the context for this to occur was provided by the educational framework that schools operate within and a pedagogy of performance. Where the study at Hillview School is able to make a contribution to knowledge is that when Alexa was available for students to talk with, they talked in significantly greater quantities and they asked significantly more questions to Alexa than the teacher, many

of which were epistemic questions or requests and searches for data, facts and information or knowledge to help with their work in the classroom.

Jirout (2011) has identified a correlation between question-asking and curiosity but other literature remained inconclusive or unable to identify a relationship. For instance, Graesser and Person (1992) describe ‘information seeking’ questions and Yaden, Smolkin and Conlon (1989) describe ‘spontaneous questions’ and Loewenstein (1994) outlines the starting point for generating these types of questions and their importance for stimulating curiosity. The study at Hillview School is able to make a contribution to knowledge around question-asking and epistemic curiosity because the students at Hillview School asked Alexa a large number of questions many of which were regarded as epistemic questions (Collins and Ferguson, 1993) or epistemic insights (Billingsley et al., 2018) and which appeared to emerge from epistemic activity (Zenios, 2010) suggesting that they were engaged in epistemic behaviour (Berlyne, 1960). As such, it has been argued in this thesis, that Alexa stimulated talk, which led to questions, of which some were *epistemic* suggesting therefore that it is plausible that students were potentially epistemically curious at times when the Echo Dots were used in lessons and that these behaviours suggested that Alexa was used as a favoured digital more knowledgeable other.

6.3 Limitations

Chapter One has outlined my background and positionality and conveyed that the research study was an interest both professionally and personally. It is evident therefore, that the design of the methodology, the selection of the case to study and the participant observation and fieldwork were choices I made. I already had experience of why teachers did what they did and why students behaved as they did but this was not enough to provide *the* answer to the burning question of ‘Why aren’t my students curious?’. Herein lies a limitation of the research study. It presents a research study I designed and presents what I saw, when I was in Hillview School, when I participated in lessons with the Echo Dots that I elected to use and then, importantly, I interpreted. From the raw data through to the discussion, each phase of analysis moves further and further towards being one perspective from one researcher. To mitigate this during the fieldwork, when confronted with a potential insight or the emergence of a potential theme I talked, where possible, with participants to clarify, further understand or to gain their perspective. For example, in Section 4.2.5, the lesson with Surim, I spoke with the teacher about Surim’s curiosity which I felt was more than other students in the class.

The teacher reflecting on previous lessons, agreed that he did ask more unusual questions often seemingly unrelated to the subject being studied. In this way I was able to understand the data from their perspective and produce interpretations that were triangulated by 15 years of classroom practice and teacher education and school observations in forty-four schools, information from teachers at Hillview School and data from Alexa. I believe that although this thesis is the result of one person's endeavours and interpretations it considers the perspectives and information from many other sources.

When I started my PhD the broad scan of a wide range of literature demonstrated that at that time there were only one or two academic papers concerned with Amazon's Echo Dots and their use in schools had not yet been explored. The experimental and exploratory nature of the research project meant that it had potential to provide information that could contribute methodologically and to knowledge of an emerging area of voice technology in education. However, although I have made qualitative generalisations, the fact remains that the research study occurred in a single secondary school that was selected for reasons already provided. It involved participants that although self-selected and were representative of a wide range of teachers and subjects, it will not have been an account of actions and behaviours of all the teachers in all the subjects taught. However, regarding the range of teachers, there was a selection of experienced and early career teachers and in terms of the range of subjects, although not all subjects were represented, all subject faculties were.

The research study took place in a single secondary school, Hillview School. The fieldwork took place over two years and spanned one academic year and involved as many teachers as it was possible to recruit. Hillview School, as has been explained, was a school that was felt to have typified many secondary schools and this was based on my experience of working with forty-four schools in my role as teacher and teacher educator over 15 years. This was because, at a classroom, organisational and structural level, many similarities with other schools could be seen. For example, GCSE examinations and programmes of study at a structural level and features such as timetables, lessons and classrooms at organisational level are commonalities that can be observed from school to school. At classroom level, the students will be different from school to school and teachers will differ, but many commonalities still exist, for example, teacher's instructional strategies, resources used and topics taught. Within each school although these commonalities might look slightly different, qualitative

generalisations and a degree of transferability will be possible despite these differences. Therefore, where a school can be considered broadly similar to Hillview School, which is considered somewhat typical, then qualitative generalisations could be made in some areas. For example, at a classroom level, professional experience has shown that from Year 3 to Year 13 commonalities such as worksheets, teachers' questions and assessments of students are commonplace, albeit in a nuanced form.

The methods I selected to gather the data, upon reflection, I consider to have been broadly successful. In particular, the Echo Dots, as a novel data collection method, provided valuable data that otherwise would have been problematic to gather in a school classroom where students under the age of 18 were present. Participant observation and informal interview allowed me to work with students and talk with teachers and have a degree of separation from my normal role of teacher. In this way the methods that I selected to gather the data enabled me to see the classrooms from a perspective I had not seen before and they revealed data I had not seen before.

A limitation of the study is that the thoughts and feelings of students have not been sought formally but instead I have relied upon informal conversations with students during lessons, eavesdropping, observational data and information from the teachers to provide this. The reason for this was both pragmatic and professional. I did not know in advance where I would be working or with which students and teachers and as a result did not know which students would be participating and information on those students who could not be involved was not able to be shared with me. Prior professional experience of being a teacher and from research for a Masters in Educational Leadership, meant that I had interviewed students and sought their feedback previously which led me to believe that the hierarchical relationship between adult teacher and child student had presented issues when gathering data. However, during my participant observation where I worked as a teacher's assistant, I was able to occasionally talk with students about their experiences in the classroom with Alexa and when Alexa was not present, through informal conversations and through students' requests for help or assistance. Some of this data has been used to inform the interpretations I have generated but formal interviews may have generated a greater quantity of data. I may then have developed further confidence that I had gathered enough data about students and that no more data could be gathered.

In terms of what was revealed, ‘performance-oriented talk’, ‘metricalisation’ and ‘regulativity’ were notions that emerged as the data was analysed and interpreted. From these I have suggested that a ‘pedagogy of performance’ might have been evident but this requires further research. As such, because this occurred during the ‘inductive’ process of analysis and interpretation, after the fieldwork had concluded, the quantity of data to support these notions is smaller than I would have preferred. However, I have not claimed that these notions exist empirically, I have suggested that from the qualitative data, these themes emerged which suggested that they were possibly present at Hillview School during the time of the fieldwork. Had these notions been identified before or during the fieldwork I would have sought to investigate these in more depth and detail to gather more data specifically related to these and perhaps to have then provided a more ‘quantitative’ perspective on their occurrence. These notions remain intriguing areas for further consideration and study post-PhD.

I have not discussed in depth the external educational framework that impacted upon what took place by using data that was gathered but have used the extensive academic literature that supports that it exists and has an influence. I have outlined earlier that I would briefly consider it by way of contextualising the research study. I have suggested that because of what the literature describes along with professional experience of working in classrooms during ‘neoliberal’ times (Ball, 2003; Ball and Olmedo, 2013), it appears to be that Education Policy and various societal imperatives effect what takes place in schools and the outcomes can be seen and felt by teachers. As such, a limitation of the research study is that it does not provide empirical contextual evidence of the impact of external imperatives that acted upon Hillview School and effected the pedagogical approaches of teachers, although, I have presented that it appears to be so, because of what was observed. I have argued that notions like ‘performance-oriented talk’ only occur because of the resultant impact of an educational framework. In the data for instance, the emphasis by teachers was placed upon GCSE performance which was revealed in the way that teachers talked with students and the lexicon of ‘performance-oriented talk’ they used. The topics of teaching and learning, that were subject curricula based for students in Year 10 and 11, were examination specification materials which outlined what should be learnt. This suggested that the external assessments or performance indicators of the school by way of examinations influenced what occurred in the classroom by teachers either consciously or subconsciously. This is informed by the data that was collected from Hillview School along with 15 years of professional personal experience of teaching and working with forty-four secondary

schools, my role as a teacher educator and more recently from the school experience of my own children. This remains an interesting area for further study and a particular area of interest is the notion of a ‘pedagogy of performance’ and teachers’ understanding of ‘performance-oriented talk’.

The answer to whether Alexa affected students’ epistemic curiosity is that, when present in classrooms during the fieldwork, the Echo Dots caused students to ask more questions and that many of these signalled the possibility that they were epistemically curious because they asked epistemic questions. The answer to whether Alexa was a digital more knowledgeable other was that, at times, in certain instances, Alexa was used to assist students in their independent work and was a digital more knowledgeable other. However, the Echo Dots were not a Vygotskian more knowledgeable other (Vygotsky, 1978) capable of what Daniels (2008) and Moll (2014) have jointly described as a culturally mediated, socially oriented form of learning between people. The answer to whether Alexa was a more knowledgeable other remains problematic because of the way in which the literature defines a more knowledgeable other and the socially mediated way in which learning and knowledge unfolds. Alexa had limited capacity to act like a human and appeared social but could not produce evaluations of a student’s current knowledge or skills and determine a personalised route to further skill and knowledge. However, in the way that learning and knowledge seemed to be understood and perceived, Alexa performed as a digital more knowledgeable other when students wished to acquire data, facts and information as part of their work in lessons. What this study does not do is present insights into what is understood by the words ‘knowledge’ or ‘learning’ although I sensed that there were quite distinct implicit understandings of what they were and this related directly to what the purpose of the school was during the period of fieldwork. This remains an interesting area for further study because identifying what is meant by learning and knowledge is central to the pedagogical approaches that are then taken and the understanding of parents, students and teachers of what the broader purpose of education is, as Biesta’s (2008, 2015) research has outlined.

6.4 Implications of the Study

The research study offers suggestive evidence for the notion that Alexa, in certain scenarios can be used as a digital more knowledgeable other and can encourage students’ epistemic activity, epistemic questions and epistemic curiosity. In this way, it

lends support to the idea that voice technology in general has potential benefits for students.

The tentative conclusions, in relation to the pedagogical drawbacks and advantages of voice technology, suggest that Alexa has potential to disrupt pedagogical approaches that might be regarded as ‘traditional’ which has benefits for students’ engagement.

As discussed above, the Echo Dots seemed to make a positive contribution and with this in mind it is worth considering their longer term impact. No data was collected at Hillview School that suggested the Echo Dots could have a positive impact upon students’ attainment as currently defined, for example in GCSE examinations, by deploying them to Year 10 as they progress through Key Stage 4. As such, the contribution voice technology might make to attainment and achievement remains to be considered.

A significant notion to emerge from the research study was that of ‘performance-oriented talk’ which lends support for the development of a different form of dialogue in the classroom because of the current way that learning and knowledge are understood. Associated with this were the notions of ‘metricalisation’ and ‘regulativity’ that have been suggested as orienting learning towards certain axis, namely ‘productional learning’ and measurable, quantifiable evidence of learning. The use of Alexa in the classrooms of Hillview School has revealed that due to the notion of a ‘pedagogy of performance’ an argument can be made for the development of methods to mitigate the potential negative impact of performance-oriented talk upon dialogue, discussion, talk, question-asking and epistemic curiosity and it can be argued, thinking and knowledge. This will be discussed in the next section.

6.4.1 Recommendations for Further Research

In Chapter 5, in Section 5.1.1.7, ‘learning talk’ was discussed and an argument was made for encouraging students to engage more in a version of ‘learning talk’ (Alexander, 2005) because of the benefits they might gain. Along with a ‘pedagogy of performance’, ‘learning-oriented talk’ was presented as an area for further research to build on Alexander’s (2005) research and insights that emerged from Hillview School. This is also because Alexa revealed the hidden potential that appeared as students’ needs and desires to talk and ask questions for data, facts and information and knowledge. This might be more broadly interpreted as students needing to be more

‘epistemologically curious’ and as Freire (2001, p.37) has described it, to be more alive, stating that:

‘Curiosity as restless questioning, as movement toward the revelation of something hidden, as a question verbalized or not, as search for clarity, as a moment of attention, suggestion, and vigilance, constitutes an integral part of the phenomenon of being alive’.

‘Learning-oriented talk’ is therefore an area that appears significant and worth pursuing because of the educational benefits and the potential for broader social and spiritual benefits for students.

6.4.1.1 Learning-Oriented Talk

Learning-oriented talk remains a tentative notion that requires more data and further analysis. This section puts forward a recommendation for further research into learning-oriented talk.

Sedlacek and Sedova (2017, p.100) has argued with regard to the number of students and their level of engagement, that ‘increased student engagement in classroom communication will lead to better results.’ Regardless of outcomes, Sedlacek and Sedova (2017) have illustrated the importance of students’ communication, which has been identified in this thesis as increased student motivation and enthusiasm to talk to Alexa. Nystrand et al. (2003) have described a ‘transmission model’ of teaching and the relationship between teacher and students outlining roles of ‘evaluator and novice’ within which ‘official answers’ are sought, recalled or recited which has been described in this thesis as ‘The Way’. At Hillview School, what Nystrand et al. (2003) and Sedlacek and Sedova (2017) have jointly described above, negatively affected students’ talk for understanding, learning and knowledge. The resultant effect being that individual students in particular did not ‘contribute, [and] participate in the social construction of knowledge’ (Nystrand et al., 2003, p.140) and often listened silently to absorb knowledge, due to the pedagogical approach of teachers.

A verbal repertoire of students’ learning talk such as question-asking, speculating and discussing, has been described by Alexander (2005). Observations of students’ interactions with Alexa and pedagogical approaches at Hillview School, demonstrated that learning-oriented talk would encapsulate Alexander’s (2005) ‘learning talk’, because students needed and wanted to actively engage in activities oriented around the

acquisition of knowledge. Therefore, any talk, or questions by students or dialogic pedagogical approaches for example, in the classroom, that had an epistemic curiosity (Berlyne, 1954) as its driver would be a form of learning-oriented talk. In this way, learning-oriented talk would use the repertoire that Alexander (2005) has outlined but be broader because through an epistemic curiosity it would channel students and teachers' behaviours and actions towards the active acquisition of *new* knowledge, not just knowledge about knowledge (Bereiter, 2002). Learning-oriented talk could be both students and teachers' talk, social and verbal communication and expressions of epistemic curiosity or dialogic pedagogical approaches, that are epistemically motivated and has thinking and understanding as its goal. The aim could be considered similar to the 'knowledge building' outlined by Scardamalia and Bereiter (2006, 2010) and might cause a shift of purpose of talk in the classroom from performance to learning and change the ownership and control and type of talk from teachers to students, important as this is, as outlined by Wood and Wood (1988) and Chinn and Osborne (2008).

Before proceeding, three extracts below, set the scene for an argument that recommends greater emphasis is given to learning-oriented talk by students and teachers in the classroom:

'Because the teacher controls the talk, researchers tend to start and finish there, focusing on teacher questions, statements, instructions and evaluations and how children respond to them, rather than on the kinds of talk which children themselves need to encounter and engage in'.
(Alexander, 2005, p.13)

'[Dialogic teaching] is based on the conviction of a close relationship between speaking, thinking and learning'
(Sedova, 2017, p.279)'.

'Learning talk... repertoires such as this - and others are clearly possible, depending on how one conceives of human development on the one hand and the curriculum on the other - are often missing from discussion of classroom interaction'.
(Alexander, 2005, p.13)

As is revealed by the extracts above, the literature from Alexander (2005) and Sedova (2017) outline, that talk is controlled by teachers and ignores the need of students to talk, there are benefits of talk and there is a relationship between speaking and thinking and there is an impact from talk upon learning. Other literature (Dewey, 1910; Schmitt and Lahroodi, 2008; Hurst et al., 2013; Casey, 2014; Moll, 2014; Tomasello, 2014) has argued similarly and it is evident that students' talk has a significant role to play within

their learning. Alexander (2005) has suggested that ‘learning talk’ is possible and important and has outlined a repertoire of learning talk which includes ‘speculating, questioning, arguing and imagining’ by students. However, in relation to ‘performance-oriented talk’ and what has been argued in this thesis as its negative impact on students’ and on the repertoire of ‘learning talk’ (Alexander, 2005) as above, and students’ speaking, thinking and learning, further research and discussion regarding the suggested notion of ‘learning-oriented talk’, as this thesis has tentatively defined it, is required. In regard to talk for learning and the educational benefits that might be gained, Jirout (2020, p.22) has outlined that future work should explore question-asking and learning and how this relationship can be developed and nurtured. Regarding what further research might be carried out, in Chapter 5, Section 5.1.1.4, an Alexa ‘Skill’⁹ for ‘Science GCSE Revision’ was developed for and used by two teachers and a class of students (see Appendix 9, the code for the Skill). Although it was used by teachers in a performance oriented way to form a ‘score-out-of-ten’ judgement, an opportunity to develop a more *dialogic* Skill is revealed. A new Skill could be written which aims to remove and avoid the need for ‘performance-oriented talk’ and thus not use a pedagogical approach associated with a performance orientation. For example, a Skill could be developed that poses problems or hypotheses, perhaps about physical classroom artefacts related to the topic being studied, that require both students and teachers to work together to ask and answer questions related to not only knowledge about knowledge but in order to create new knowledge. A Skill such as this might draw on students’ epistemic curiosity, or engage it, by creating incongruity or conflict or to pose intriguing scenarios that create interest and wonder, as the ‘window cleaning problem’¹⁰ did. From this point both teacher and students, organised into discussion groups with an Echo Dot, could dialogically interact whereby both teacher and Alexa work as more knowledgeable others. This could engage students in dialogic learning-oriented talk so that students’ motivation and frequent question-asking to Alexa might be drawn upon and utilised for educational benefits. This might lead to a new lexicon of learning oriented talk, being developed in advance, to support the type of dialogic interactions between teachers and students that are desired. A Skill of this type might

⁹ A ‘Skill’ is an ‘app’ or software for the Echo Dot. Developers can use the Amazon Developer Interface to program and code ‘skills’ that perform specific speech interactions. In this way they can tailor how Alexa interacts with a user. For example, a ‘skill’ could be written to cause Alexa to ask students ‘Can fish see water?’. around which a guided knowledge building group event could occur involving students and teacher jointly.

¹⁰ The ‘Window cleaning problem’ was an event where a teacher entered a classroom and exclaimed that the windows needed cleaning. This perplexing statement generated immediate interest and curiosity that led to several unprompted questions from students.

allow a pedagogical approach to be formed, that can be planned for during lessons, which lessens the need for worksheets, row-based seating, teaching from ‘The Front’ and reduces reliance upon ‘the Way’ that was observed.

6.4.2 Summary of Findings

One of the tentative notions to emerge from the analysis of the data collected from the classrooms was that of a ‘performance orientation’ to talk that occurred in lessons. Another theme to emerge was a pedagogical approach defined as ‘The Way’ that seemed immutable but which Alexa was able to slightly disrupt, but only temporarily.

The analysis of the data from transcriptions of Alexa’s recordings of interactions with students was that students used Alexa to seek data, facts and information to support their classwork but interactions were generally short and students curated Alexa’s information for ‘correct’ or ‘right’ answers.

When students interacted with Alexa they asked large numbers of questions in relatively short time periods for as long as the Echo Dots were available. Many of the questions students asked Alexa were interpreted as epistemic questions, such as ‘Can fish see water?’ and which have been argued to be indicative of epistemic curiosity. This has also been regarded as an expression of epistemic curiosity.

It was discovered that Alexa increased the amount of students’ talk and there were a higher number of questions asked to Alexa than the teacher. This has been considered as Alexa performing the role of a digital more knowledgeable other.

Questions from students to the teacher were limited and there were questions from the teacher to the students, but the teachers tended to talk to students using performance-oriented talk.

Students asked epistemic questions in larger numbers to Alexa than they asked to the teacher. Students engaged with Alexa and were motivated to use the Echo Dots and did so to source data, facts and information from Alexa which in turn appeared to begin to liberate them from the orientation of talk about performance from the teacher.

In terms of pedagogical approaches, the Echo Dots revealed that pedagogical approaches appeared necessary because of wider external factors that required the

school to focus and prioritise a good performance in GCSE examinations. The pedagogical approaches that were required then appeared to restrict and constrain the use of the Echo Dots in lessons. This led to lesson activities which did not appear to require students to be epistemically curious or for teachers and students to use Alexa as a digital more knowledgeable other to any great extent.

6.4.3 Further Questions

Discussion of the study at Hillview School revealed several tentative notions. Some progress had been made by revealing them but beyond identifying and describing them, no further progress was made. This section attempts to provide a point of departure for future research by posing further questions to consider.

From the recommendation for further research made previously and despite research at Hillview School, a question still remains which is, ‘What is learning-oriented talk?’. Ultimately, this question problematises the ‘norms’ (Merton, 1938, p.673) of a ‘pedagogy of performance’ within which were observable ‘routines’ (Becker, 2004, 2005; Hockey, 2018) of teaching and learning at Hillview School. This question might allow research to consider if and how ‘learning-oriented talk’ could disrupt potentially entrenched pedagogical approaches, norms and routines and, through a ‘cause and effect’ or reflexive approach, reveal further insights into ‘learning-oriented talk’ in terms of teachers and students’ social behaviours and actions.

The research study revealed and posited the notion of ‘performance-oriented talk’ at Hillview School which was discovered through the use of Amazon’s Echo Dots in lessons when Alexa was presented as a digital more knowledgeable other. Learning as knowledge about knowledge was encouraged by teachers and was observed, during interactions with Alexa and the teacher, as the ability of students to recall, remember or recollect information and ‘knowledge’ was perceived as data, facts and information acquired to be able to achieve scores, marks or grades in future tests or examinations. As can be seen, the convergence of several factors at the point where teaching and learning occurred, appeared to demonstrate a belief of what the purpose of school was, and this appeared to be academic performance. From a pedagogical perspective and from classroom practices that occurred this illustrated the resultant student and teacher actions and behaviours. In this way, Alexa revealed the ‘norms’ (Merton, 1938, p.673) of Hillview School in relation to perceptions of appropriate pedagogical approaches, learning and knowledge.

Further norms (Merton, 1938) that emerged appeared to reveal that talk seemed to need to be about performance and that performance was valued, learning produced ways to measure learning and learning was performance. It also seemed that knowledge appeared to be thought of as learning if it allowed a performance to occur. If an entity such as the Echo Dots supported the norms of the school then they seemed to have an educational role but equally, worksheets, practice examination papers and tests also fulfilled this role but in ways which did not disrupt the ‘pedagogy of performance’ or disrupt any ‘power hierarchies’ (Alexander, 2005) or change norms (Merton, 1938, p.673).

Insights that emerged from the research study at Hillview School suggested that pedagogical approaches, or the pedagogy of performance, appeared to be driven by external imperatives (Apple, 2013) which subsequently led to the concepts of ‘learning’ and ‘knowledge’ being interpreted and understood by teachers and students in a specific performance oriented way. The notions of ‘metrics’ and ‘outputs of learning’ (Giroux, 2012a) and an ‘A-C economy’ (Kulz, 2017, p.7) supported a ‘blurring’ and merging of the concepts of pedagogy and the performance orientation which was also observable at Hillview School and has been defined in this thesis, tentatively, as a ‘pedagogy of performance’. Mortimore’s (1999, p.3) description of ‘pedagogy’ as ‘any conscious activity by one person designed to enhance learning in another’ suggests that it is plausible that if learning is oriented around scores, marks and grades, and that ‘performance-oriented talk’, ‘metricalisation’ and regulativity’ are evident, then a ‘pedagogy of performance’ may be defined, after Mortimer (1999, p.3) as:

‘Any conscious activity by one person designed to improve the quantifiable attainment of another’

Subsequently, a further question then remains which is ‘What is the definition of a ‘pedagogy of performance?’. Some suggestive evidence has been revealed from Hillview School but further research is required. Once defined, another question emerges regarding a pedagogy of performance which is, ‘What is the impact of a pedagogy of performance?’. This question presents an area for further research in terms of ‘performance-oriented talk’, ‘metricalisation’ and ‘regulativity’ and which may also require consideration of the potential of ‘learning-oriented talk’.

In terms of epistemic curiosity, students at Hillview School appeared to experience learning and knowledge as the acquisition of knowledge about others knowledge (Bereiter, 2002) or 'to report on what was already known' (Nystrand et al., 2003, p.139). Rather than be curious epistemically, to be desirous of knowledge, the study appeared to show that students needed to be passive listeners and silent or speak only for 'clarification or confirmation' (Wang, 2006). It was presented earlier in this thesis, that students' silence could be interpreted as a form of resistance or compliance to the teachers' instruction and pedagogical approach. In relation to how students resisted and complied and adopted passive or subordinate roles, Alexander (2005) explains that unequal power relationships give rise to covert or implicit classroom rules regarding actions and behaviours, meaning that students are 'dominated by listening, bidding for turns, spotting 'correct' answers, and other coping strategies' (Alexander, 2005, p.9). In relation to the participation or engagement in lessons or 'communication' (Nystrand et al., 2003), students' interactions with the teacher and Alexa at Hillview School were constrained and as was discussed earlier, resulted in short and brief occurrences of talk. This is described by Alexander (2005) as a pedagogical approach of 'Initiation-Response-Feedback' (IRF) methods or as was observed at Hillview School, an absence of prolonged dialogue or discussion or question-asking and epistemic activity. Even with Alexa, interactions were short, often less than ten words or a few seconds of talk and would often not be 'authentic questions' or were instead questions that were of a 'lower order' (Nystrand et al., 2003). For communication in the classroom there are additional factors such as silence, compliance, subordination, or coping strategies, as Alexander (2005) and Nystrand et al. (2003) have outlined and these may also be a facet of the notion of 'pedagogy of performance' that has been tentatively posited.

Having been driven by one burning question of 'Why aren't my students curious?', the PhD study has resulted in three further questions which collectively might indicate next steps for research. The three questions are:

1. What is learning-oriented talk?
2. What is the definition of a pedagogy of performance?
3. What is the impact of a pedagogy of performance?

6.5 Contribution to Knowledge

In this chapter so far, several contributions to knowledge have been briefly outlined and these are presented below in summary.

In Chapter 1, the study makes a contribution to knowledge by theorising the Echo Dots using Vygotsky's (1978) more knowledgeable other to reveal that Alexa provided more information to students and was a 'digital more knowledgeable other'.

In Chapter 3, heatmaps were developed in order to present data captured from observations of lessons and these remain a novel method of visualising classroom interactivity.

In Chapter 3, through a thematic analysis of the data and in the discussion in Chapter 5, a contribution to knowledge is made through the proposed tentative notions of performance oriented talk, metricalisation, regulativity and the pedagogy of performance. These are regarded as new educational research conceptual tools which may be used for future research.

In Chapter 3, it was shown that the Echo Dots were a focus *for* a research study but which also enabled these devices to become a method of data collection which, at Hillview School, was 'at scale', in 'live' lessons as part of everyday teaching and learning. This remains a contribution to knowledge because in the literature, at the time of writing, multiple Echo Dots have not been used in this way. A successful and novel method for deployment of Echo Dots in a school is outlined which overcomes technical problems that might stop further research occurring.

In Chapter 4, it was revealed that when the Echo Dots were used in classrooms, students' questioning increased in number, and they asked Alexa questions many of which were epistemic questions.

In Chapter 2 and Chapter 4, it was shown that there was no research available, at the time of writing, that demonstrated how Echo Dots might be used pedagogically. The study revealed that teachers controlled when and how they were used and this was primarily because of a pedagogical approach.

In Chapter 5, epistemic questions have been argued to have been observable expressions of epistemic curiosity. Also, because of the high number of epistemic questions and increased question-asking that was evident when Alexa was present, Alexa has been argued to have been a digital more knowledgeable.

In Chapter 6, it has been argued that a pedagogy of performance that encapsulates performance oriented talk, metricalisation and regulativity, causes a disconnect between students' talk and the pedagogical approach of teachers. The Echo Dots and Alexa appeared to have a disruptive effect upon this pedagogy and to stimulate students' talk and question asking and engagement with a digital more informative other.

As educators, a question remains: where do we go from here? A way forward needs to be found that challenges a potential 'pedagogy of performance' and which draws on students' desires to use voice technology and to talk for learning. In doing this it seems plausible that educational benefits might be gained *for students*. Herein lies the conundrum: whose need is the priority? Is it teachers' need to demonstrate their capability through their students' quantifiable academic performance or students' needs to engage in 'epistemic learning'.

From the contributions to knowledge summarised above and the disconnect that has been revealed between pedagogy and talk and the two questions regarding *need*, the next two sections move forward theoretically. Two models are proposed as contributions to knowledge and which could be used to foster epistemic curiosity through talk, develop a new pedagogical approach to voice technology integration and to promote adoption of voice technology in educational environments. The '*CUSP*' model (Figure 26, below) and '*PITEC*' model (Table 5, below) will be explained in more detail.

6.5.1 Curiosity Understood as a Signal/Problem (CUSP Model)

In Chapter 2, a lack of literature jointly regarding talk, epistemic curiosity and epistemic question-asking and dialogic pedagogical approaches in terms of voice technology was outlined. A gap regarding the role that voice technology could provide as a digital more knowledgeable other was also outlined.

This section proposes, as a contribution to knowledge, the 'Curiosity Understood as a Signal/Problem' (CUSP) model as a method for considering pedagogical approaches in terms of voice technology and students' epistemic curiosity in the classroom.

The study found data in the transcripts from the Echo Dots where, over two lessons, students at Hillview School asked Alexa 87 questions (see Appendix 7). This is a

significant finding based on what is known about a lack of questions by students in the classroom (Wragg, 2001; Dillon, 2004; Ness, 2015). For example, in a physical education lesson, when learning about the lungs, a student asked an unprompted question, ‘Can fish see water?’. In a science lesson, when learning about bonding, a student asked, ‘Would a diamond burn?’. These questions have been argued to be observable expressions of epistemic curiosity and were generated by ‘signals’, as Beswick (1971) has similarly described, that students had received. A signal can be understood in the classrooms of Hillview School as a statement, fact or question from the teacher that is asked and then heard by students or, for example, an artefact or object that is seen or handled by students. Another example of a signal occurred in an English lesson where, upon entering the classroom, a teacher exclaimed to students, ‘I have to clean the windows!’. Interactions such as these are considered a ‘signal’ and which begin a *process* that leads to epistemic curiosity and question asking. It is a form of engagement with a stimulus or, as Karpov (2014, p.186) suggests for Vygotskians, a ‘problem-situation’. For example, the artefact such as a plastic 3D model of human lungs or the question such as ‘What are diamonds made of?’ were ‘signals’ and a stimulus that engaged students. In the classroom, some signals that students received appeared to present them with a ‘knowledge problem’ in the form of an incongruity, an information gap or desire to know more. In this way, curiosity took the form of *signals understood as problems* that were then developed and acquired by students. From observations of lessons during fieldwork and from analysis of the transcripts from the Echo Dots it becomes possible to theorise a ‘Curiosity Understood as a Signal/Problem’ model (CUSP), below, in Figure 26. Karpov (2014), using research from American cognitive scientists, has suggested a ‘model of information processing’ that starts from data entering a ‘sensory register’ and in doing so begins to consider how signals begin to be processed. However, this model does not go beyond describing a process and provides no actionable or practical guidance for classroom teaching and learning. The ‘CUSP’ model begins to suggest not only *what* educators might do, but alongside the PITEC model outlined later, describe *how* educators might approach teaching and learning.

Through the ‘CUSP’ model it becomes possible for teachers to begin a conversation about teaching and consider and challenge the pedagogy of performance which constrains opportunities for students to engage with a digital more knowledgeable. For instance, the first step is to present a problem. In doing so, by trying to identify and formulate problems about the topic being taught instead of identifying what information

needs to be delivered to students, an alternate approach might emerge which could challenge a familiar pedagogical approach.

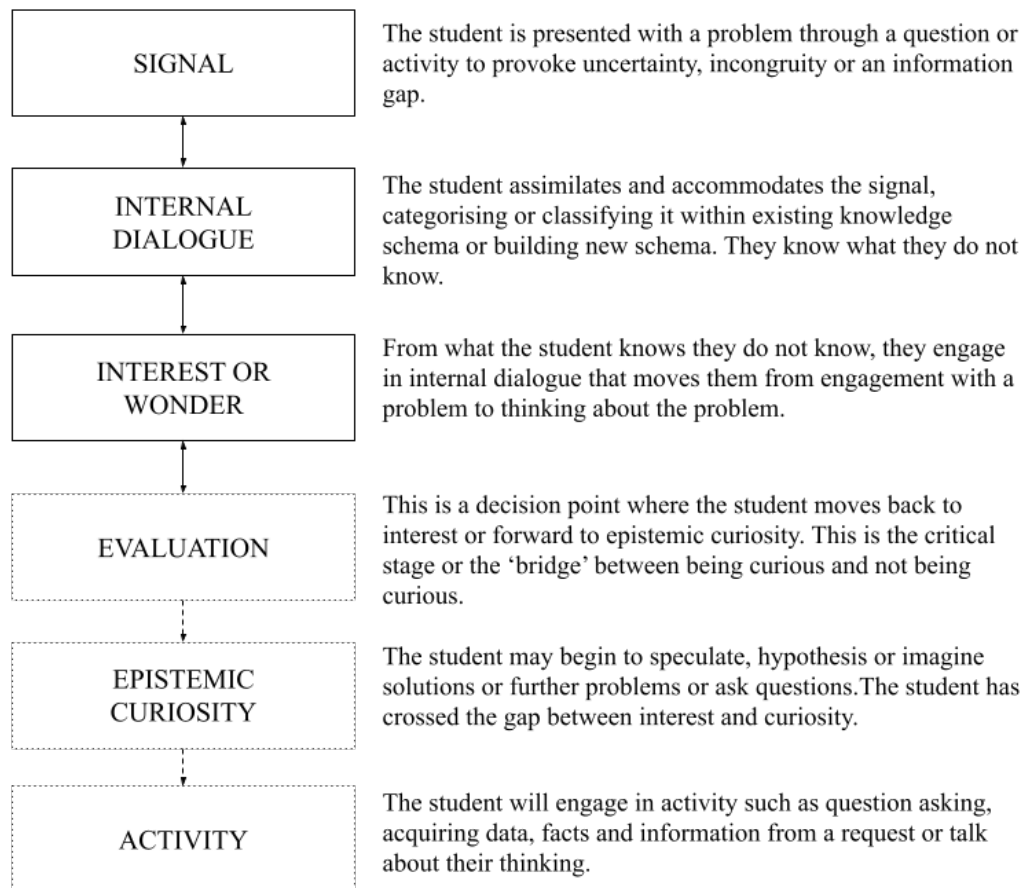


Figure 26: Curiosity Understood as a Signal/Problem (CUSP) Model

By conceptualising learning as beginning from a signal that then generates a 'knowledge problem' in the form of an information gap, incongruity or uncertainty, students might be moved towards a 'tip-of-the-tongue' state (Metcalf, Schwartz and Bloom, 2017), which with assistance from a digital more knowledgeable other, such as Alexa, might allow them to easily and efficiently engage with a device they perceive as 'fun' (see Frey and Wilhite, 2005; Tews et al., 2015) and useful (Davis, 1989) to acquire the data, facts and information to satisfy their epistemic curiosity and close information gaps, remove uncertainty or a misconception.

As recommended in Section 6.4.1.1, an Alexa 'Skill' could be created and be used in the classroom by students and teachers to create signals that generate knowledge problems, that is, present students with opportunities to talk and interact to develop and acquire 'knowledge problems' and thus be used in a pedagogical approach that is focused around learning oriented talk, discussions with Alexa or a teacher and to disrupt

a pedagogy of performance. The ‘Skill’ might be developed to include words, or signals, that form a new lexicon of learning talk that teachers and students could use.

However, the CUSP model does not provide actionable guidance on what next steps a teacher might take. In the next section, a model for voice technology adoption is presented which develops the idea of ‘knowledge problems’ into a model for integrating voice technology into the classroom to aim to foster students’ epistemic curiosity. It allows a focus to be drawn upon epistemic curiosity and epistemic activity which might then be used as educational resources to facilitate learning.

6.5.2 Five Stage ‘PITEC’ Model for Voice Technology Adoption

In Chapter 2, it was possible to identify through the literature a gap regarding perceptions, perceived ease of use of *voice* technology, *voice* technology adoption and affordances (Gibson, 1979).

This section proposes a Five Stage ‘PITEC’ Model for Voice Technology Adoption as a contribution to knowledge (see Table 5, below) which builds from the ‘CUSP’ model outlined previously in Figure 26, above. The model also builds on Wegerif’s (2004) idea of computer-supported learning conversations, Alexander’s (2005) notion of ‘learning talk’, and what has been proposed in this thesis as ‘learning oriented talk’.

The aim of the PITEC model is to provide *actionable guidance* and an initial starting point for educators who are considering using voice technology. The five stages provide a series of steps that could be used to frame pedagogical discussions about how teaching and learning might unfold and where voice technology could perform a role. The aim of the PITEC model is to promote and support pedagogical discussion and development.

It has been revealed by the study that students were keen and motivated to use the Echo Dots and had many interactions with Alexa. They also asked Alexa epistemic questions frequently which was posited as being suggestive of epistemic curiosity. It has been argued that Alexa was used as a more informative other or what has been theorised as a digital more knowledgeable other. It was discovered that teachers’ pedagogical approach of ‘The Way’ could be disrupted by the Echo Dots but this was temporary. The way in which Alexa was used has been presented in Section 6.2 as contributions to knowledge. From these, what was revealed was a disconnect between students’ talk and

the teachers' pedagogical approach that obscured a potential resource of epistemic curiosity that was hidden and dormant, suppressed by a focus on academic performance.

It was briefly discussed that students appeared excited to use the Echo Dots and were motivated to interact with Alexa, suggesting that this technology was 'fun' (see Frey and Wilhite, 2005; Tews et al., 2015). This type of benefit gained from user-interactions with technology have been discussed by other researchers (see Terzopoulos and Satratzemi, 2019; Granito and Chernobilsky, 2012). Other research has also found that technology might be used because it provides 'hedonic' benefits (Wu, Wang and Tsai, 2010), and provides 'gratification' (Grellhesl and Punyaunt-Carter, 2012) for users. User-interactions in terms of attitudes and perceptions of a technology is discussed below.

In the critical review of literature in Section 2.8.1, and earlier in Section 2.2.2, two Technology Acceptance Models (TAM) presented by Davis (1989) and Venkatesh et al. (2003) were presented. It was stated that both models were useful frameworks for assessing user adoption and engagement with technology but that they did not provide scope to evaluate factors such as natural language processing capacities or voice interactions, and perceptions of users of voice technology. Alongside this, Ma and Liu (2005, p.59) have explained that empirical tests of the TAM have 'produced mixed and inconclusive results'. Nonetheless, the TAM is focused on users' *attitudes* to technology and elements of the TAM provide a 'lens' with which to view what was revealed from the study at Hillview School in terms of the Echo Dots and Alexa.

In light of what was discovered and revealed about a pedagogy of performance, performance oriented talk, regulativity and metricalisation, alongside factors which constrained the use of the Echo Dots and restricted students' interactions with Alexa, a proposed model is presented below, in Table 5, that aims to contribute to knowledge of how voice technology such as the Echo Dots and Alexa may be deployed in school classrooms.

Although not an extension of the TAM, it considers elements of Davis' (1989) TAM and presents an approach to a type of technology that relies on voice as the only means of interaction. It is hoped that the PITEC model, alongside the CUSP model, provides a way to think pedagogically about epistemic curiosity and ways of placing devices such

as the Echo Dots and Alexa as more informative others or in roles of digital more knowledgeable others in classrooms.

The PITEC model might also be used to develop a communal perception, between both teacher and students, of the affordances (Gibson, 1979) of the Echo Dots and Alexa so that a shared understanding of their potential to augment teaching and learning might become possible and lead to adoption. For example, teachers might come to perceive Alexa as a valid teaching assistant able to assist students at ‘tip-of-the-tongue’ states (Metcalfe, Schwartz and Bloom, 2017) who require data, facts and information quickly to fuel their epistemic curiosity. The PITEC model therefore also makes it possible to potentially research the Echo Dots and Alexa, or other voice technology, in terms of affordances (Gibson, 1979).

It is expected that the model, presented in Table 5 below, begins at Stage 1 and proceeds forward to the next stage without missing a stage to complete one cycle. Upon reaching Stage 5 it is possible to return to Stage 1 and in an iterative way, proceed through the stages to complete another cycle. Multiple cycles may be completed so that adoption of voice technology and integration into a pedagogical approach may occur.

The PITEC Model		
Stage	Name	Description
1	Problematising (P)	Present students with a problem in the form of a gap in their knowledge related to the teaching topic which requires them to ask questions, seek data, facts and information
2	Identifying (I)	Identify opportunities where voice technology can support students to acquire data, facts and information independently that are related to the problem or possible solutions
3	Talking (T)	Plan and provide time when students can use voice technology to acquire data, facts and information independently and engage in talk about their discoveries to promote speculation, hypothesising, problem solving and solution suggesting
4	Evaluating (E)	Evaluate students’ talk using the transcripts from voice technology or discussion with students, to identify opportunities to advance knowledge, skills and understanding and provide opportunities to talk about knowledge gaps, incongruity, hypotheses, solutions or epistemic questions
5	Connecting (C)	Connect students’ talk, questions and data, facts and information requests to knowledge gaps, incongruity, misconceptions or an emerging epistemic curiosity to inform next steps in students’ learning.

Table 5: Five Stage ‘PITEC’ Model for Voice Technology Adoption

The CUSP and PITEC models, developed from research at Hillview School, could enable teachers who use them to provide practitioner perspectives that contribute to discussions regarding *if* and *how* voice technology is used in classrooms in the future.

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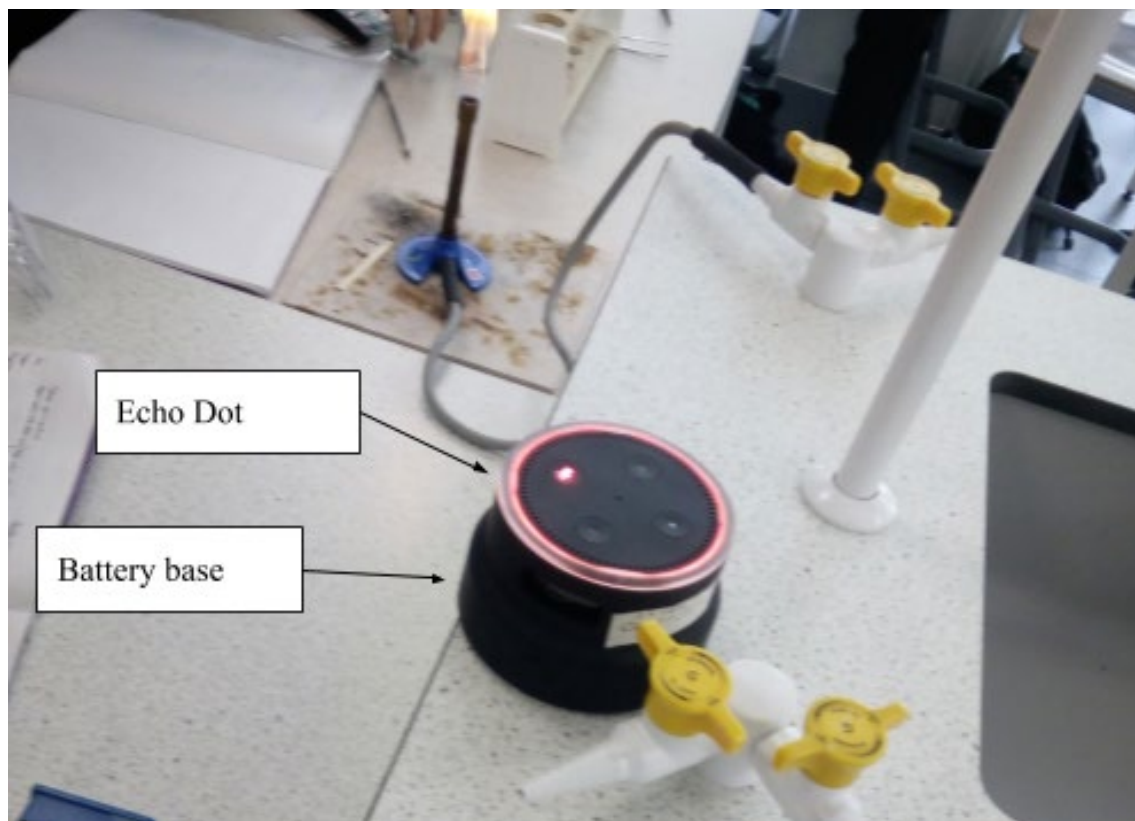
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Appendices

Appendix 1: The set of Echo Dots and Wi-Fi router used in lessons.



Appendix 2: Mobile Echo Dot placed in a battery base.



Appendix 3: Transcriptions are stored in a voice history section of the Amazon account and are available online.

Overview

Review Voice History

Manage Smart Home Devices History

Manage Skill Permissions

Manage Your Alexa Data

FAQs

Alexa and Your Privacy

Amazon Privacy Notice

Alexa Terms of Use

Review Voice History

Review and manage your voice recordings. [Learn more.](#)

Enable deletion by voice

Allows you to delete recordings by saying "Alexa, delete what I just said" or "Alexa, delete everything I said today".

Date Range

Start Date

End Date

Custom

01/02/2019

01/11/2019

Show

Delete All Recordings from 01/02/2019 to 01/11/2019

Filter by device

Delete Selected Recordings

☐

"who is pablo picasso"

On 23 October 2019 at 10:36 AM on Alexa

☐

"alexa"

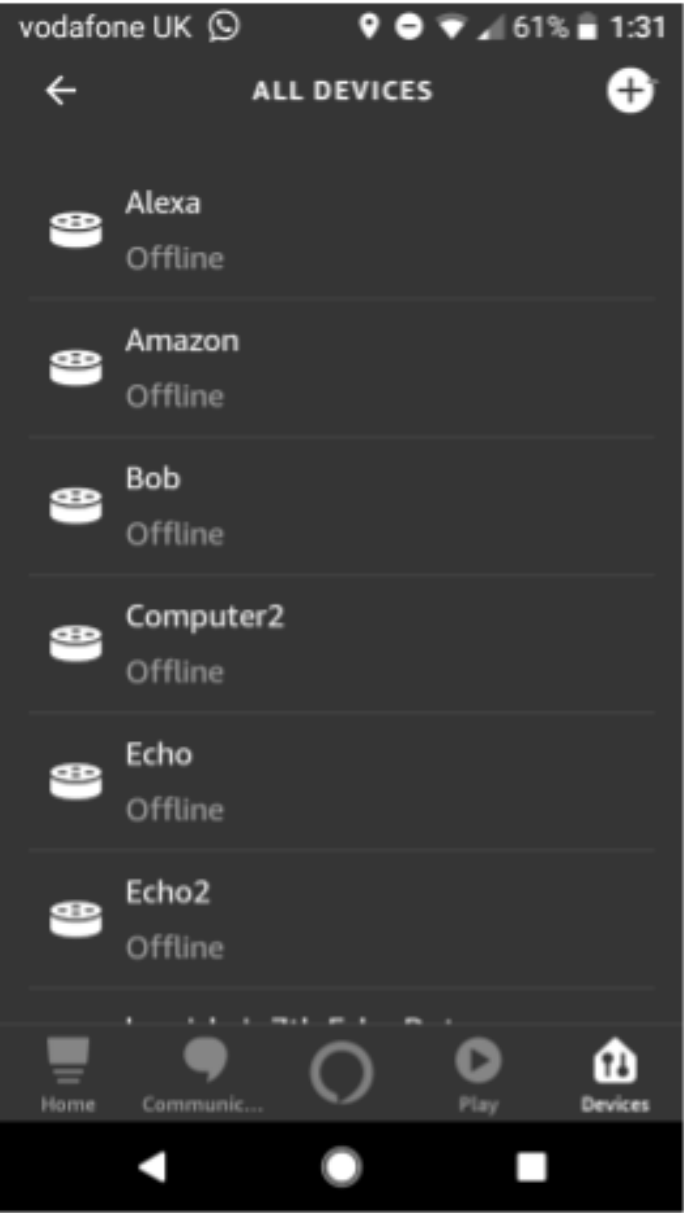
On 23 October 2019 at 10:36 AM on Alexa

☐

"alexa stop"

On 23 October 2019 at 10:36 AM on Alexa

Appendix 4: Echo Dots allocated different names



Appendix 5: Fieldnote diaries, 2017-2020



Appendix 6: Examples from the Thematic Analysis Process

The five images below are the first set of ‘codes’ that were developed and which were used to pursue themes throughout the dataset.

COMPLIANCE / RESISTANCE

- T: Lads [to M1 and M2] have we got our 3 marks yet?
- Another worksheet with more complex value calculations now. Asks S to do addition by long method. I am sat next to S who does the easier ones just but seems to lack confidence. TA placed me with him. He loses it with thousands - can do units and hundreds. T comes over and patronises him. He says it is to hard and he can't do it. T says you could do it last time. What can I do to make it easier for you to understand? He shuts down.
- They work on the worksheet. It's basically using a textbook to copy the answer into the worksheet 8 times. - This lesson was about filling in a sheet which they will use later to revise from. Im sure none will look at it again - probably better to simply use the textbook which was correct.
- so that in the lesson you could work in a group to collate the facts and produce a revision poster.
- T to class - get on with revision

CONTROL

- They are quiet when the T is talking but when they work they chat.
- T: No don't ask me, [points to wall] poster which is in the style of the 'Keep Calm Carry On' design but says Ask three before me] ask 3 before me.
- takes it around for them to sniff
- T loads up PPT on board. S sit silently. Eerily quiet!. No fidgeting or noise.
- T moves the slides on reading the instructions out. Plays a video of an avatar talking
- Once or twice she says X you need to not speak over me along with the mime.
- LE: What's the actual point of that? HB: We're trying to find a solution. LE: But what's does it actually do? HB: Can you write down the table neatly, LE: Why? It still works [he means if still drawn by him but untidily]
- I can hear a lot of back chat the sort of chat designed to play with the teacher for entertainment
- They turn rhetorical questions to literal and claim ignorance. T: "Do you want to move seat" S - "No".
- T - "Can you move to another seat". S - "I could easily move to another seat". T - "Will you move to another

TECHNOLOGY (ATTITUDE)

- following a short video clip
- She talks about G and say we can use it if we have sensible questions to ask it.
- [holds up worksheet which has red questions on]
- T loads up PPT on board. S sit silently. Eerily quiet!. No fidgeting or noise.
- T moves the slides on reading the instructions out. Plays a video of an avatar talking
- T: Oh well, technology lets us down - it does this doesn't it
- M1: Do we get to use Google?.
- M3 to M2: Are we going on the computers?
- M3: [quietly] How will we use Google?
- I spoke with T after lesson. She was asking about my research - I said I am looking at how the students use a G. She said she wasn't that technical. Says she has one at home [Alexa]
- T: Ask Google again Oscar... O: Ok Google, what do you react with carboxylic acid to make an ester?

ARTEFACTS

- T gets a bottle of ammonia
- T goes to get the human body model technician has put on my desk
- [As nylon is wound onto the glass rod student asks]
- I gather it means the metal weights acting down on the ruler
- They perk up when it is a practical
- M2 to T You've got a gold tooth - M2 Is it real? - T yes or it would react? - T Yes, but you can't know me out and steal it

MKO

- T picks up on each point and explains the students thinking is correct
- T: S2 ask Google. S2: Hey Google, what is the name of the most common polyester T leads a Q and A without Google T: what actually is nylon? S3: it's a polyester [reading from sheet]
- [Another TA comes in - sits next to S to start work with the student on the paper]
- T1: Why aren't you doing this? [addresses S and points to place on paper then sits back leaving S to begin work]
- Two TA in this class who sit one to one
- Not much discussion - only with TA for those who have one come to them.
- This group are chatting about anything but work. I can hear snippets but not enough to state what. I hear names, days, a few laughs / giggles etc. I know it's social chatter. T
- Talking about who spent certain (largish) amounts on in game items (Phin (£600) M4 has his phone out on the desk (T still out room)
- M2 - How many people can you have in your clan?
- T takes M5 to display on wall next to IWB (left side in corner)
- T demoing an example on the DW to F4 and F5. Arrangement of electrons.

The two images, below, show two codes that were finalised. These were then used to collate data within the dataset that was considered to fit within the theme of the code. This process was repeated several times to confirm the code and theme and to connect data with the theme.

REGULATIVITY A teacher's pedagogy involving methods that control, adjust or maintain a particular 'productional' approach to learning, or perception of what learning is or what counts as knowledge, that might be oriented around attainment.

- "Don't use 'stuff' use its name" then "...and what else Hannah?" ... "What word should we use instead of 'more' David?" ... "Don't say that in an exam or we'll fall out Harry!" said jokingly.
- T: let's not think about an exam answer,
- [holds up worksheet which has red questions on]
- I saw new seating/table arrangement.
- The teacher related the topic to GCSE
- T says we need the textbooks
- Ok we need to do some writing
- Worksheet - work out the total value of the coins.
- We carry out - print out of shapes (see attached) Measure sides and find similarities
- Worksheet given out
- S has a photocopied sheet which has 4 pictures of trees on it and 4 text boxes of text.
- P picks up on this. Draws a diagram on the board of a seesaw on a pivot with two cubes on each end. She asks a S where the force is acting - in what direction? S says up? She says no it's down. She says look at the direction it is down it is at right angles to the ruler. It is perpendicular. That's why it is called perpendicular force - we will need to know that in GCSE
- T says we are learning a new topic

PERFORMANCE ORIENTED TALK Talk that takes place in schools about education processes and systems involving teachers and students that is bounded by the content of a subject's curriculum and which is focused upon its evidencing and measurement

- F1: "Did I get more than zero Madam?"
- T: Everyone got more than zero.
- T: Lads [to M1 and M2] have we got our 3 marks yet?
- She mentions this type of question - slightly different to this - will be in a GCSE paper.
- T: yes - write down the key points and I will give you detailed notes next lesson and we can do the sticking in then.
- This class was quiet. Most of the talk was in the form of the teacher telling the S what the correct answers were and how the method worked
- M7 can you look at the higher on the triple?
- says examiner wants to know you know about health and safety
- Don't stop if you get stuck as other questions might be answerable
- ~~Wasn't going because the answers were not harder. Each question done~~

The image, below, shows how the dataset was pursued for ideas that could be further worked into a ‘code’. This was to confirm the chosen codes and to ensure that as much data as possible was analysed using the codes. It allowed data to fit into codes and themes to be generated.

conversation the whole lesson and doesn't distract [redacted] and cause her to intervene. It isn't surprising that he in referral. A noticeable thing today, M1 is talking to others proximal to him. He has been one of the students who has not been observed talking previously - most lessons he sits in silence. Is this because others are absent or something else. M6 has spoken to him a few times today before M1 started talking with others. He doesn't start conversation but will participate this lesson.

I spoke with [redacted] at the end briefly. The blue paper slip students are given when they have been kept back or sign in late. [redacted] M3 arrives with a blue slip. [redacted] tells me that M10 was taken by [redacted] for a pastoral meeting - I ask if it is a positive or negative meeting, she says it could be either. I agree with [redacted] to place the GHA on to a table at the back with F6, 7, x, 8 and 9 on the 23rd of May and also a Dot with M10, F10, 1112 and M9. We will see if these students coalesce and talk, discuss, question either each other or [redacted] a bit more in the short term or the longer term.

9.49am|

Class enter quietly in a controlled way. [redacted] says quiet please. T says test is next Tuesday.

Class come in an assemble into their seats and the T moves behind the desk to the computer and brings up a slide (that she will refer to) displaying it on the IWB.

[redacted] needs the S to make notes, bullet points on revision topics. Reference to the two types of Science, namely the Trilogy (triple) and the Synergy (combined).

9.55am

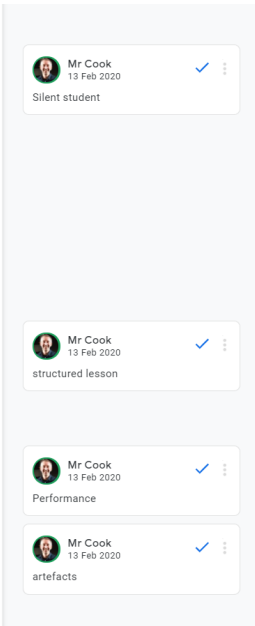
T gives some revision advice - revise things you don't know. All the talk so far has been about GCSE/examinations.

T to M6 Can you hand out sheets please. Makes mention of Y9 exams starting shortly. It's too easy to forget that this is a Y9 class and they have three years of GCSE study.

9.57am

[redacted] arrives with a blue slip of paper in his hand and a green card (green card is pocketed) Blue card given to T. M6 is sent by the T to referral room with books for M8.

9.58am



Appendix 7: 87 Questions: questions from students during the period from 12.20pm until 3.10pm. (Other requests, duplications and similarities removed)

Time	No.	Question asked of the Dot(s)
	1	What happens to current in a parallel circuit?
	2	How do you spell ...? VOLTMETER
15.00	3	What are the fossil fuels?
	4	What are the units of heat energy?
	5	What is sound energy?
	6	What does renewable stand for?
	7	Is light a energy?
	8	What are the three fossil fuels?
	9	What type of what type of energies are there?
	10	What are the sources of renewable energy?
	11	What are the units of heat?
14.47	12	What what are the eight types of energy?
	13	What is electricity?
	14	What is static electricity?
14.24	15	Why does a balloon stick to you when you rub it on yourself?
	16	How does a balloon stick to a wall?
	17	What is polythene?
	18	What's the mass of hydrogen?
13.01	19	What is polystyrene?
	20	What is the mass of chlorine?
	21	What is a catalyst?
	22	What is equilibrium?
	23	What is crude oil?
	24	What is fractional distillation?
	25	What is the mass of iron?
	26	What is an alcohol?
	27	Can you tell me the order of the planets?
	28	How do you calculate kinetic energy?
	29	How long does it take to get to space?
	30	How many times does the moon travel around the world?
	31	How long does it take to get to the moon in a plane?

	32	How long will it take me to get to mars?
	33	What is three thousand two hundred and seventy four divided by seventeen?
	34	How many times does the moon travel around the world in a year?
	35	How big is the moon?
	36	How many elements are in the periodic table?
	37	What's a sperm cell?
	38	How many chromosomes do i have?
	39	What is the proton number of gallium?
	40	How far is the earth from the Sun?
	41	Explain photosynthesis to me
	42	What is the difference between an animal and a plant cell?
	43	What does voltage mean?
	44	What does current mean?
	45	What is an ammeter?
	46	What is the strongest element?
	47	What's the mass of hydrogen?
	48	How many electrons does Oxygen have?
	49	What does electricity do?
	50	What is the equation for acceleration?
	51	What is a cell?
	52	What is the largest planet in the solar system?
	53	What is an alcohol?
	54	What does a cell do?
	55	How do you calculate kinetic energy?
	56	What's University in French?
	57	What does fiber do?
	58	What is the acid in your stomach?
	59	What is saliva?
	60	What's the longest word in the dictionary?
	61	What's the longest word in Chemistry?
	62	What is a good example of protein?
	63	What does the what is a good source of fat?
	64	What does a small intestine do?
	65	What's your favourite element?
	66	How many legs does a spider have?

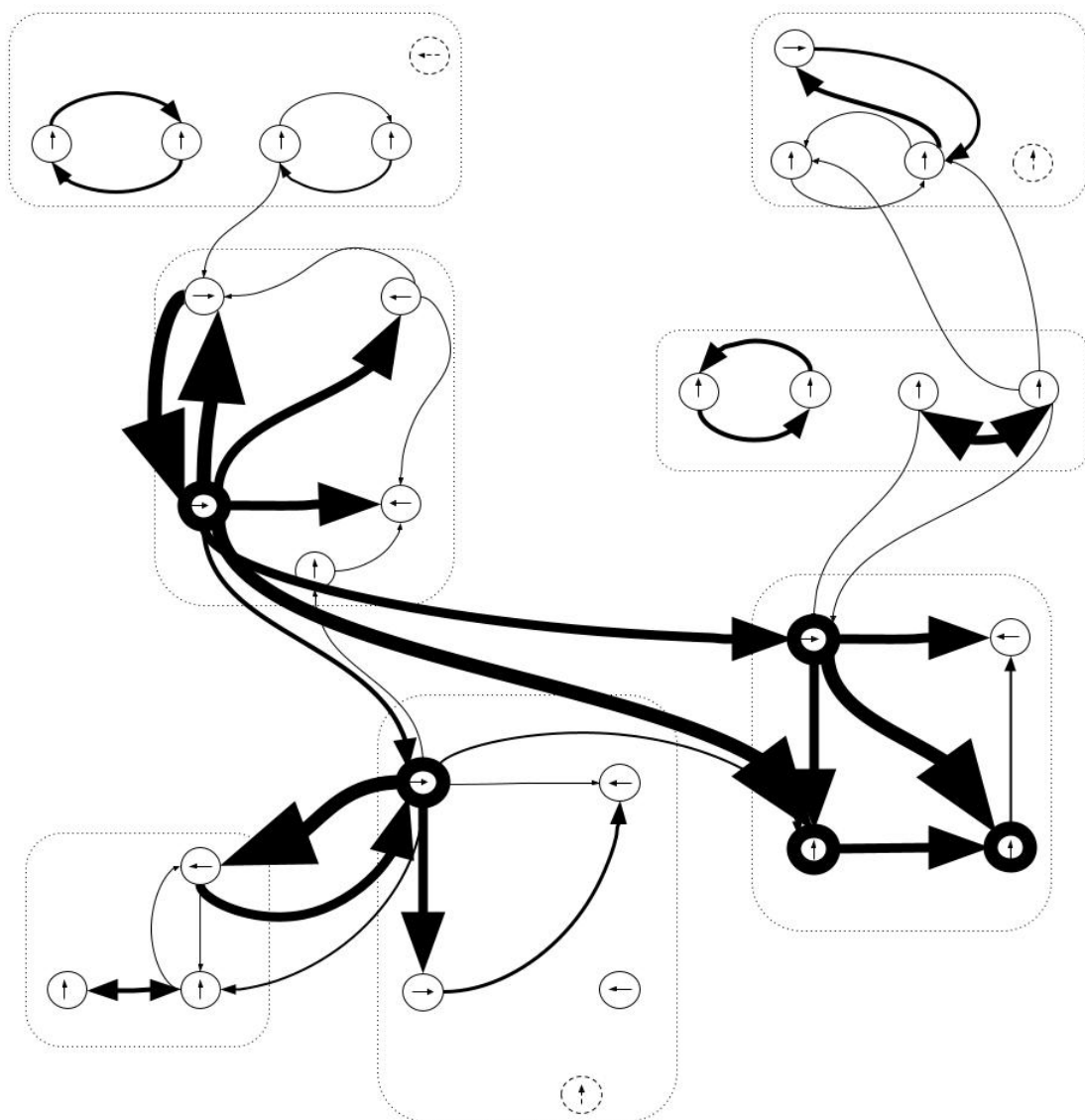
	67	What happens if you eat too much sugar?
	68	What are enzymes?
	69	What am I reading?
	70	What does anus do?
	71	What is carbohydrates?
	72	What does the stomach do?
	73	What is the function of protein?
	74	What's an amylase?
	75	What does the mouth do?
	76	What does the large intestine do?
	77	What is the function of the small intestine?
	78	What is the function of carbohydrates?
	79	What is energy?
	80	What are the kidneys?
	81	What does the esophagus do?
	82	What's the human digestive system?
	83	How many people are there in the world?
	84	What's four hundred and fifty times two times naught point two?
	85	How do you calculate gravitational potential energy?
	86	What is the difference between a physical change and a chemical reaction?
	87	What's the liquid?

Appendix 8: Heatmaps

Heatmaps produced a large quantity of additional work. I was in several lessons for sometimes two days per week over many months. I made notes continually through every lesson and these were converted into digital versions of heatmaps at the end of the day. I usually had at least five heatmaps to draw each week and because of the level of detail required to draw the lines and circles and create text box labels, each heatmap could take 3-4 hours each.

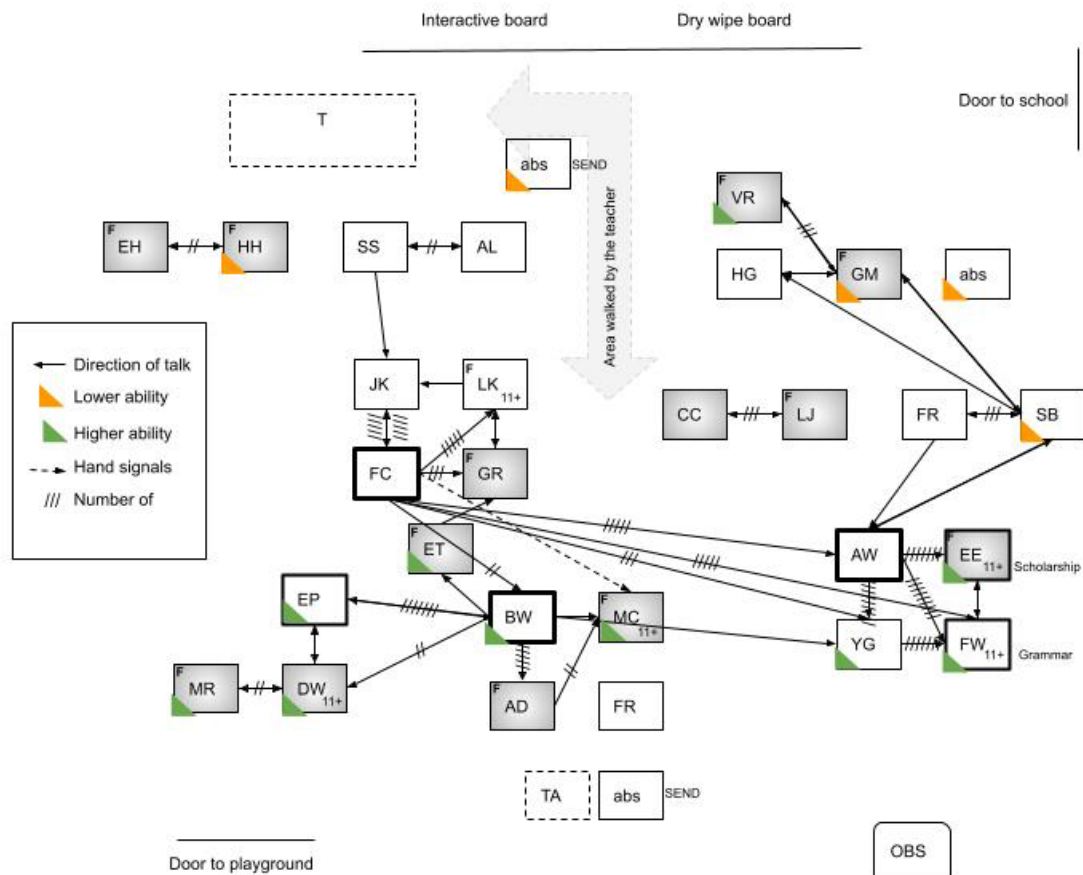
Heatmap A – The first attempt

During fieldwork as a participant observer I made a record of which students were in lessons, where they sat along with other contextual information. The main purpose was to capture who talked and who they talked to and to record talk from and with the teacher. A ‘tally-chart’ and hand drawn diagram was made during every lesson. The first version of a heatmap is shown below. Arrows were drawn indicating the direction of talk and thickness was used to portray quantity of talk.



Heatmap B – Too much data

A second version of a heatmap evolved and is shown below. These captured more data including teacher rating of ‘ability’ and any hand gestures or signals students made to other students. Desks, windows and significant equipment that was present in the classroom was also mapped onto the heatmap.



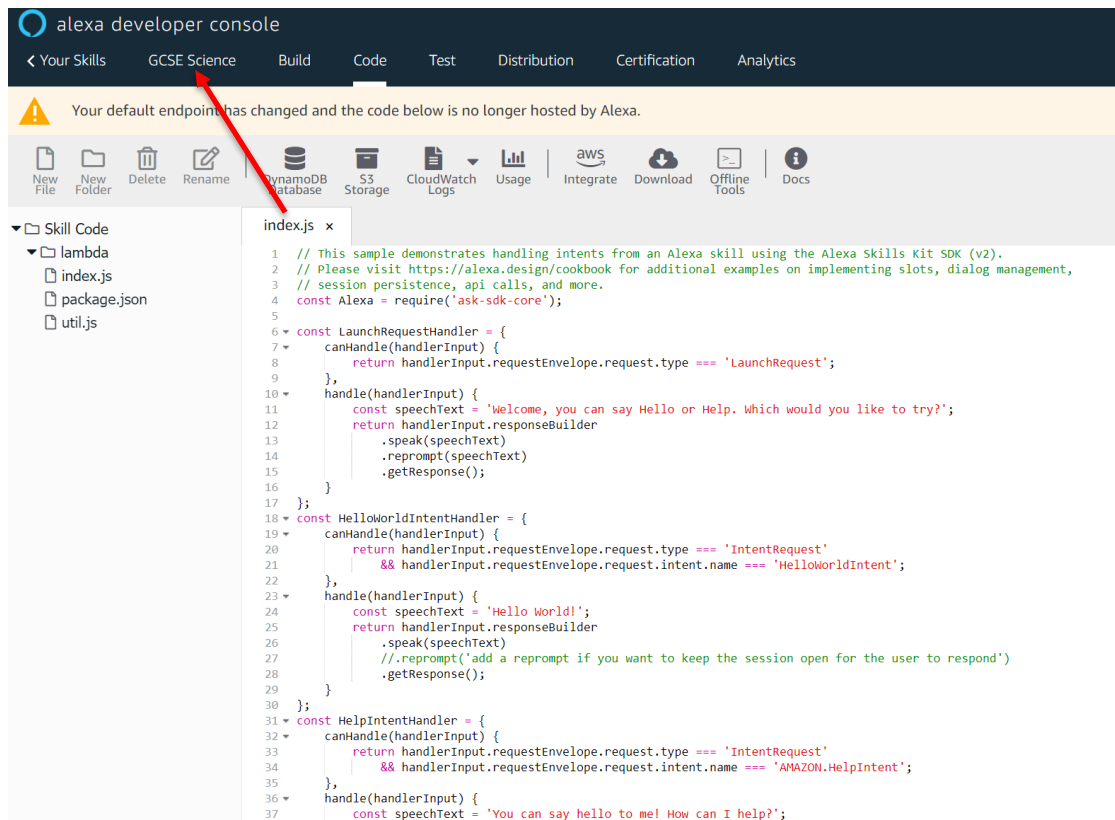
Heatmap C – Did not work

A third version was developed to produce data based on different phases of the lesson. For example, in most lessons there would be a ‘starter’ phase where the teacher carried out an explanation or talk and a ‘main’ phase where students worked on activities.

Appendix 9: Alexa ‘GCSE Science’ revision ‘Skill’.

Prior to using the Echo Dots and Alexa I had experimented with several other voice assistants including Google’s Home Assistant and an Open Source version. During this time I had become aware of the potential within Amazon’s Web Services to code and deploy custom ‘Skills’ to Amazon’s Echo Dots. It was the potential to code Skills that had some influence on my decision to use the Echo Dots for the fieldwork. Along with developing the solution for connecting the Echo Dots, I spent a total of approximately 3 months working on technical solutions separately to the fieldwork.

Following a conversation with two teachers we felt it would be interesting and useful to explore ‘Alexa Skills’. I spent one week researching and investigating how this could be achieved. I spent a week learning how to use ‘Blueprints’ and ‘Routines’. I then spent three weeks learning how to code using JSON/Javascript and the Amazon Development Console. It took a further two weeks to learn how to write a Skill. A further week was taken to write the Skill that would be used and another week of learning how to publish it and then test it at the school on several Echo Dots. An extract from the ADC of the code is below along with the ‘blueprint’ for the Skill that was created and used in a lesson.



The screenshot shows the Alexa Developer Console interface. The top navigation bar includes tabs for 'Your Skills', 'GCSE Science', 'Build', 'Code', 'Test', 'Distribution', 'Certification', and 'Analytics'. A red arrow points to the 'GCSE Science' tab. Below the navigation bar, a message states: 'Your default endpoint has changed and the code below is no longer hosted by Alexa.' The main area displays the 'Skill Code' for the 'GCSE Science' skill, showing a file tree on the left with 'index.js' selected. The code in 'index.js' is as follows:

```
1 // This sample demonstrates handling intents from an Alexa skill using the Alexa Skills Kit SDK (v2).
2 // Please visit https://alexa.design/cookbook for additional examples on implementing slots, dialog management,
3 // session persistence, api calls, and more.
4 const Alexa = require('ask-sdk-core');
5
6 const LaunchRequestHandler = {
7   canHandle(handlerInput) {
8     return handlerInput.requestEnvelope.request.type === 'LaunchRequest';
9   },
10  handle(handlerInput) {
11    const speechText = 'Welcome, you can say Hello or Help. Which would you like to try?';
12    return handlerInput.responseBuilder
13      .speak(speechText)
14      .reprompt(speechText)
15      .getResponse();
16  }
17 };
18 const HelloWorldIntentHandler = {
19   canHandle(handlerInput) {
20     return handlerInput.requestEnvelope.request.type === 'IntentRequest'
21       && handlerInput.requestEnvelope.request.intent.name === 'HelloWorldIntent';
22   },
23   handle(handlerInput) {
24     const speechText = 'Hello World!';
25     return handlerInput.responseBuilder
26       .speak(speechText)
27       .reprompt('add a reprompt if you want to keep the session open for the user to respond')
28       .getResponse();
29   }
30 };
31 const HelpIntentHandler = {
32   canHandle(handlerInput) {
33     return handlerInput.requestEnvelope.request.type === 'IntentRequest'
34       && handlerInput.requestEnvelope.request.intent.name === 'AMAZON.HelpIntent';
35   },
36   handle(handlerInput) {
37     const speechText = 'You can say hello to me! How can I help?';
```

score.

Write your questions, add 2-4 answers, and check the correct choice. (Optional: follow-up facts.)

Question:

What does the symbol I stand for in the periodic table

✓ Iron

⊖

✓ Iodine

⊖

✓ Indium

⊖

+ ADD ANSWER

Follow-up fact:

Follow up fact, Did you know that Iodine has the number 53 and is a solid at room temperature but is best known perhaps as a gas.

Question:

Can you name an expensive pure form of carbon?

✓ Led

⊖

✓ Glass

⊖

✓ Diamond

⊖

Appendix 10: Letters

Letter 1: Extract Showing Permission to Conduct a Research Study

Thank you for agreeing to the research taking place in your school. I also wish to thank you and your staff in advance for helping me with my PhD.

Approved by Headteacher of

<hr/>	<hr/>	<hr/>
Print your name here	Signature	Date

cc: Dr. Colin Forster
cc: Prof. Kamal Bechkoum

Letter 2: Email to Staff

Staff information

Would you like to try using an Amazon Echo Dot in your classroom?

I am investigating **how artificial intelligence devices such as Amazon's Echo might be used in the classroom by teachers.**

I will provide you with an Echo Dot (and a mobile phone) with which you can experiment and teach. How you use it and when you use it is up to your professional judgement. You are under no obligation to try it out for any longer than you want. You can hand it back at any time or keep it all year.

What I need from you if you do take part, are your thoughts about what happened when you used it. This can be done face to face or via email, text message or Whatsapp.

I'll show you how to set it up if you take part and can be in lessons to support you if you want. I can also be an extra pair of hands in the lessons when you use it.

If you're interested please email:

As with all research, everyone is anonymised (e.g. the location, the school, the subjects and of course teachers) and all notes etc are confidential and stored securely.

More information on the research project can be found here: <http://www.r-cook.co.uk/>

An overview of the ethical arrangements for the research can be found here: <http://www.rcook.co.uk/ethics.pdf>

My contact details are:

My research has been approved by both the Project Approval Committee and the Ethics Committee at the University of Gloucestershire, 2018.

Letter 3: Parent Letter



LETTER OF INFORMED CONSENT TO PARENTS

[School Logo]

[DATE]

[ParentName]

[Address]

Research Study in

Dear [ParentName]

The school will be hosting an Education/Computing research project throughout the academic year 2018-19 during Terms 2, 3 and 5 which involves the use of speech activated digital assistant devices that respond to questions. A researcher from the University of Gloucestershire will be in school during this time and may be in some of your child's lessons observing teachers who choose to use a device.

The research will **not directly involve any interviews with students** but in order to comply with ethical research procedures I am writing to inform you the research is taking place. If you wish for the research to not include your child(ren) please email

If you are interested in finding out more about the research please contact the school who will put you in contact with the researcher directly.

If you have any further queries please contact the school.

Headteacher