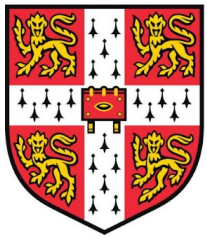


UNIVERSITY OF CAMBRIDGE

Designs and affordances for dialogue in Google Classroom: a design-based research study

This thesis is submitted for the degree of Doctor of Education (Ed.D) by

Tristan John Igglesden

Homerton College

October 2021

Word Count: 67443

Designs and affordances for dialogue in Google Classroom: a design-based research study

Table of Contents

List of Figures

List of Tables

Preface

Abstract

This project identifies means by which Google Classroom, a digital learning management system (LMS), can support dialogic pedagogy; the ways in which teachers and students explore and generate ideas together through dialogue. Perceptions of convenience and the demand for remote learning solutions, accelerated by the Covid-19 pandemic, have led to the introduction of this suite of digital tools into the lives of millions of students. It is therefore timely for educators to evaluate the potential of this disruptive technology for dialogue, in order to support, develop and potentially transform their practice.

A mixed-methods approach was applied to this study, conducted within a participatory design-based research (DBR) framework. The aims were to both identify affordances of Google Classroom, and generate designs, that promote dialogue within it. Practitioners from an independent preparatory school, representing a range of curriculum subjects, were invited to participate as *co-researchers* in the project. Audiovisual data was collected from 18 lessons with Year 7 (11-12 year old) students between 2017 and 2020. This was analysed using the Cam-UNAM Scheme for Educational Dialogue Analysis (SEDA). 9 student and 7 teacher interviews were also conducted and thematically coded.

Affordances of the LMS to support classroom dialogue in the setting included the ability to promote awareness of different perspectives between participants and to foster collaboration and community. Google Classroom also afforded dialogic practitioners the opportunity to further their students' meta-cognition and inter-subjectivity. The project also identified new spaces within the LMS in which engagement with multiple perspectives, a characteristic of reflective dialogue, can occur. Shared digital artifacts within the LMS represent new spaces in which dialogic space-time can be accessed; their accessibility, immediacy, co-construction and provisionality were the means through which this is possible.

Design principles emerged from the DBR process that describe how teachers can design tasks to leverage the digital tools of the LMS to promote a dialogic approach to learning. Whilst context specific, these have user-generalisability and could be modified and applied by practitioners with an interest in promoting dialogue in their own settings, so long as limited numbers of digital devices are available to their students. The joint planning meetings between practitioners in which these heuristics were generated represent a novel model of teacher professional development that might be applied to develop context-specific designs for dialogue within a LMS in similar settings.

Acknowledgments

I would like to acknowledge the support of my school, not least those colleagues and students who have directly participated in this project. Thanks also go to my supervisors, Prof. Sara Hennessy and Dr. Louis Major, and my advisor, Dr. Paul Warwick, for providing such wise counsel. I have also benefited from the support and critical friendship of my EdD cohort, the Cambridge Educational Dialogue Research (CEDiR) group and the efforts of my inter-coder reliability volunteer, Patricia Brooks in particular.

I am eternally grateful to my wonderful wife Anna; it is thanks to her love and friendship that this journey was possible.

Declaration

This thesis is the result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the preface and specified in the text.

It is not substantially the same as any work that has already been submitted before for any degree or other qualification except as declared in the preface and specified in the text.

*It does not exceed the prescribed word limit for the Education Degree Committe*e.

Part I: Introduction

I.1 Research imperative

Learning Management Systems (LMS) aid the delivery and storage of written work and digital media in educational settings. Typical of the social tools of Web 2.0 applications (O'Reilly, 2005), LMS also allow for the co-construction and sharing of digital artifacts between users (Lee & McLoughlin, 2010); *objects* that are of cultural interest or importance to the context in which they are produced. The Google Classroom LMS (see Fig. 1.1 for illustrative example) and its associated applications (eg. Google Docs, Google Sheets and Google Slides) are free and open to all (at classroom.google.com), providing an inexpensive, flexible and far reaching mechanism for the creation and distribution of open educational resources (OERs). By February 2021, the number of users of this platform had risen to "more than 150 million" (Google, 2021a) but whilst these digital tools have been introduced into the lives of millions of students, perceptions of convenience and the demand for remote learning solutions, accelerated by the Covid-19 pandemic, are likely to be the reason for their introduction. It is therefore essential that practitioners begin to evaluate the potential of this disruptive technology to support and develop pedagogy that they culturally value; in the case of this practitioner-researcher, one that promotes educationally valuable dialogue (Mercer, 2000).

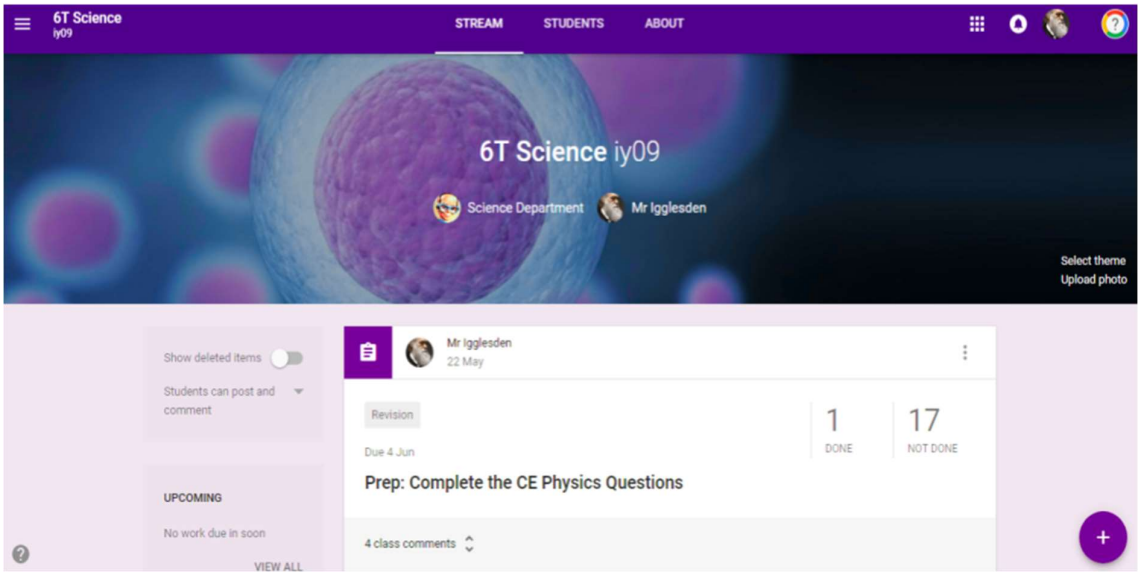


Figure 1.1: Example of a Google Classroom home screen.

In 2014, the independent preparatory school in which I worked as the head of science, began to trial the use of Chromebooks in lessons and Google Drive as a means of curating student work. Soon after, the Google Classroom LMS was made available to teachers at the school. Initially, I introduced this to my own department as a means of trialing a *paperless* approach and to reduce the organisational demands placed upon the children. However, it soon became apparent that the LMS also allowed for greater collaboration between the students to take place that might in turn, support reflective classroom dialogue (Alexander, 2008a). This exciting potential stimulated my interest in exploring new dialogic approaches that might leverage this disruptive technology. In this project, I have used professional dialogues to develop my own practice and that of fellow dialogic, and Google Classroom, educators at my school. In so doing, design principles, and a novel professional development process, emerged that could be modified and applied by practitioners with an interest in promoting dialogue in their own settings. The affordances of Google Classroom, the perceived and actual properties of the LMS that determine how it could possibly be used (Norman, 1988) to support dialogue, will be of interest to fellow researchers in the fields of educational technology and dialogue and the developers of such systems.

Google Classroom allows users to interact in a number of different ways and of particular interest are the *Comment* and *Share* functions found within all G Suite for Education applications (see Fig 1.2 for illustrative example).

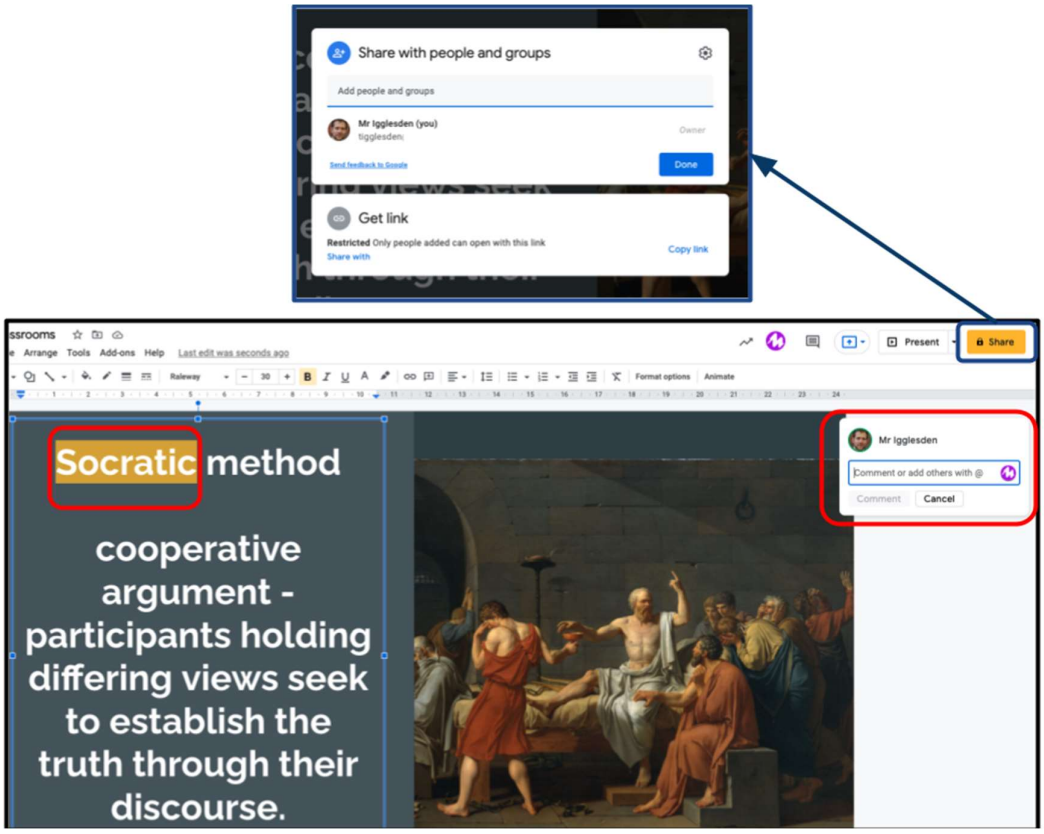


Figure 1.2: Example of a Google Slide presentation with *Comment* and *Share* functionality highlighted.

Comment and *Share* functions allow both students and teachers to interact with written comments based on and around documents whilst avoiding some of the pitfalls of typical threaded discussion forums. Within these applications, comments remain anchored to a specific digital artifact (e.g. documents, videos etc.) and remain contextualised. The sharing of artifacts can be achieved on an *ad hoc* basis by using the *Share* button displayed on all documents or arranged in advance by teachers using the *Assignments* function of the LMS (see Fig. 1.3 for illustrative example).

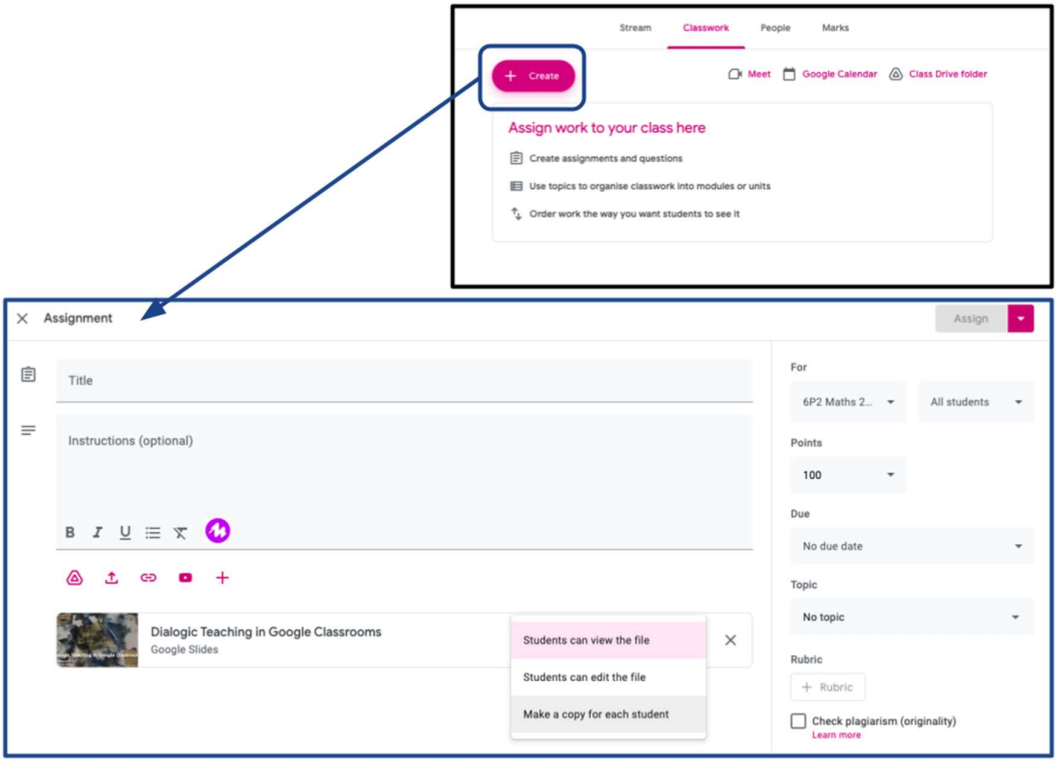


Figure 1.3: Options available to teachers when setting assignments within Google Classroom.

This allows for resources to be copied and distributed to each individual student or for all members of the class to work on a central, shared copy. By distributing resources in this way, Google Classroom also has the potential to reduce the secretarial demands placed upon the students, and may provide greater opportunity for real-world face to face dialogue, the frequency and nature of which was of interest in this study.

I.2 Research questions

This study aimed to address the following research questions (RQs).

> **RQ 1. What affordances do LMS (specifically Google Classroom) provide for the teacher mediation of dialogic learning?**

This first line of enquiry is significant as it addresses the potential Google Classroom has to support dialogic pedagogy, for which there is a growing body of supportive educational research (Haneda, 2017), discussed further in Part II of this report. This means of instruction is culturally valued at the setting of this project and in light of the potential disruption that the introduction of Google Classroom might bring about to both the content and delivery of curricula, identifying and designing means to promote dialogue within the platform is of value. Consequently, a design-based research (Brown, 1992) (DBR) approach, incorporating joint planning activities (Kiemer et al., 2015) with fellow practitioners was developed (see Part III for details) in order to identify the affordances of the LMS that can support dialogic pedagogy and to generate design principles which can be applied, with modification, to similar settings.

RQ 2. Do LMS open up new spaces for dialogue?

Meaning arises from the tension in the gap between different perspectives (Bakhtin, 1981) and Google Classroom would appear to offer new gaps across which this tension can be held. Users of the LMS generate a large number of digital artifacts that can be revisited at a later date, offering dialogic practitioners the potential to expand dialogues and learning over extended time periods. These artifacts are multimodal and have the potential to highlight the differences in perspectives between individuals, facilitating dialogue during shared enquiry (Hennessy, 2011). However, the use of digital spaces within LMS as forums for productive classroom dialogue has yet to be documented elsewhere in the literature.

RQ 3. What is the nature of interaction within a LMS?

The frequency and types of dialogic moves that occur between students in a classroom when the digital tools of a LMS are at play were of particular interest to this study; to determine if the disruptive nature of the technology had in fact promoted or constrained productive dialogue. Documenting the nature of the interactions between students and their teachers was also of interest, to determine if

those practitioners with dialogic intentions (Warwick et al., 2020) had been able to cede some control of the classroom discourse to their students and emancipate them from a more monologic discourse (Shor & Freire, 1987).

These research questions are explored in the five parts that follow this introduction. In Part II (Literature Review), the research landscape that the project is situated in is outlined. This includes the establishment of the operational definition of dialogue used in this project and an exploration of its role in learning and the social construction of knowledge. The means through which teachers can mediate learning with technology are then discussed before the affordances for Web 2.0 technologies to support dialogic pedagogy are considered.

In Part III (Methodology) a rationale for the design-based research structure used for this study is put forward. The data collection instruments that were selected for this mixed methods project are then detailed, as are the means of data analysis. The limitations of these methods and the ethical considerations that were made are also discussed.

In Part IV, the preliminary findings from the exploratory phase of the project are reported, as are the implications they had for the main study. In Part V, findings from each of the three phases of data collection in the main study are then reported. Provisional theories explaining the findings of each phase are postulated and refinements for subsequent phases of the project are described.

In Part VI (Conclusions), the design principles that emerged from the study are reported, as are the affordances of the Learning Management System to support classroom dialogue. Longitudinal changes in practice at the school, in and around Google Classroom, are also reported in this final part and the use of the DBR framework as a model for teacher professional development at the setting is appraised. Finally, my personal reflections on this project's impact on my practice as both a practitioner and researcher are presented.

Part II: Literature Review

The literature outlined in this review establishes the research landscape that this design-based research (DBR) project into the *affordances of a Learning Management System (LMS) that support dialogue* is situated in. There are a rising number of educational institutions that use LMS technology to deliver, create and curate the vast majority of their teaching materials. For example, Google Classroom (the LMS under scrutiny in this project) now has more than 150 million students regularly making use of the platform (Google, 2021a) following its launch in 2014. This project focuses on the ways that LMS such as Google Classroom can support dialogic pedagogy; the way in which teachers and students explore and generate ideas and questions together (Alexander, 2008a). Classroom talk is an important tool for learning and if we accept Alexander's assertion that the spoken word is central to human learning and collective identity (Alexander, 2001), any technology that promotes or disrupts this process warrants appraisal by practitioners with dialogic intentions (Warwick et al., 2020).

In Chapters 1 and 2 of this review, relevant literature is provided to define dialogue and establish its role in learning and the social construction of knowledge. In Chapter 3, the means through which teachers might mediate learning with technology are discussed. Finally, in Chapter 4, the affordances for Web 2.0 technology, and LMS specifically, to support dialogic learning is considered.

In addition to reviewing extant theoretical literature, systematic trawls were conducted on an annual basis between 2015 and 2021 to identify contemporary studies that aligned with this project. A protocol was devised for the manual search of three key journals (British Journal of Educational Technology, Journal of Computer Assisted Learning and British Educational Research Journal) and the Google Scholar search engine. Using Boolean logic, one of four technology (LMS, Google, digital, mobile) and four pedagogic (argument, scaffold, social, dialogic) key words were combined (eg. Google AND dialogic) to form search terms used to query each of the electronic depositories. These search terms were selected after

analysing the titles and keywords of papers which had previously been identified as potentially relevant (eg. Hennessy, 2011, Higgins et al., 2012, Rojas-Drummond, et al., 2013). Relevant information from these papers has been embedded within this review and the overarching themes discussed in Section II.4.4. This literature informed the research questions and methodology (see Part III) of this investigation and allowed for the interpretation of the data and provisional theories generated in the main study (see Part V) and findings (see Part VI) to be grounded by relevant theory.

Chapter 1: Introduction to dialogue

II.1.1 Definitions of dialogue

There is a growing interest in the potential of dialogue to transform education and this field of research draws on a variety of traditions (Major et al., 2018a). Consequently, the terms *dialogue* and *dialogic* have been used to convey a range of different meanings in discussions concerning education (Littleton & Howe, 2010), although these do tend to share certain characteristics: the open exchange of ideas, collaborative inquiry, reasoning, engagement with different perspectives and mutual respect (Haneda, 2017). Most commonly the literature refers to dialogue in the sense of the Socratic method, a form of cooperative argument where participants holding differing views seek to establish the 'truth' through their discourse. This results in a dialogic circularity or "attunement to the attunement of the other" (Rommetveit, 1998, p.359) and a shared understanding. An additional meaning of dialogic is its use in direct opposition to "monologic" (Wegerif, 2007). The most common medium through which knowledge is transmitted in the traditional classroom is through direct teacher instruction or that of the printed word. Here, the authoritative, monologic voice remains unchanged and unchallenged, preventing any shared meaning from being constructed. In contrast, dialogic pedagogy demands that all parties have the potential to be affected by their interactions, that teachers and students construct understanding together for mutual benefit.

Some authors use the term dialogue synonymously with talk while others take a theoretical approach, considering dialogue to be an epistemological paradigm. This is built upon the premise that all thought is dialogic in nature (Mercer & Littleton, 2007). To distinguish between this and the operational use of the word *dialogue*, Per Linell (2002) describes this epistemological framework as *Dialogism* in which knowledge is dynamic, socially negotiated and (re)contextualised. From this social constructivist standpoint, it is impossible to separate the cultural and psychological functions of dialogue. Communication and thinking may in fact be considered two sides of the same coin; what Lev Vygotsky described as “Inter-mental” and “Intra-mental” thinking (Mercer & Littleton, 2007). Vygotsky (1978) claimed that an important way in which children learn to think individually is through learning to reason with others. The individual later acquires an ability to develop an internal dialogue of their own, introducing ‘virtual others’ to their thinking. Jean Piaget (1965) also proposed that when ‘Transactive Dialogue’ takes place, participants become aware of the gaps between their perspectives. For Piaget and Vygotsky, it is in the resolution of these socio-cognitive conflicts that learning takes place.

The meaning of *dialogue* can also be taken beyond epistemology to describe a *social ontology* of its own (Markova, 2003). This is based on the ideas of Mikhail Bakhtin who used the term *inter-animation* to indicate that meaning is not found in the intention of the speaker or the response of the addressee but emerges between the two (Bakhtin, 1981). Bakhtin established that there is a need to create meaning in a dialogic way and this concept of dialogism has an increasing number of proponents. Bakhtin concludes that the world is dialogic and his school of thought would insist that any reported incident of monologic discourse is in fact an illusion; even within a seemingly silent printed text, a multitude of voices are at play. The power of written discourse is the result of conflict between the internal voice of the reader, the voices of the characters and the author themselves ergo, monologism does not exist. This argument stems from Bakhtin’s concept of “Heteroglossia” within texts (Bakhtin, 1935); that there are no static knowledge artifacts and it is the differences between voices that create meaning (Wegerif, 2008). Bakhtin’s *dialogue* does not require perspectives to be unified, it avoids consensus and thus an infinite

dialogic space of potential meanings is preserved (Wegerif 2011). It is the impossibility of consensus that is the basis of all dialogue (Markova, 2003), an artform in which the debate surrounding a subject is never exhausted (Nikulin, 2010).

Having considered the complex needs of learners in contemporary educational settings, there is an appetite among many practitioners to improve the quality of dialogue in their classrooms and in turn; the communication, collaboration and critical thinking skills of their students (Teo, 2019). However, despite increasing support for dialogic pedagogies within educational research, large-scale studies suggest that system-wide change is yet to occur (Haneda, 2017). Where teacher-pupil talk does exist, it is more often than not asymmetrical, consisting of closed questions and only the briefest of opportunities for students to respond (Mercer & Dawes, 2008), it is dominated by closed questioning conducted at pace set by teachers (Hennessy, 2011). Classroom discussion is often *univocal* (Segal et al., 2017) since most student contributions tend to closely align with those of the teacher whose evaluative comments tend to direct the flow of inquiry along a pre-ordained path. In contrast to traditional teaching as compliance, learning via a truly expanded dialogue can empower participants to co-construct new knowledge (Wegerif, 2013). Google Classroom would seem to represent a space where transactive dialogue and reflection can occur at a pace controlled by the learners themselves as the LMS offers them longer, even infinite time to respond to one another.

II.1.2 Operational definition

When proposing that the affordances of a Learning Management System (LMS) to support dialogue be the subject of this EdD study, I initially referred to Robin Alexander's definition of dialogic pedagogy; the way in which teachers and students explore and generate ideas and questions together (Alexander, 2008a). However, whilst completing this literature review, a context specific operational definition of dialogue for this project began to emerge. Human dialogue may be defined as an interaction between two or more co-present participants using a system of signs (Marková & Linell, 1996). This definition can, in part, be applied to this project as the

interactions that are to be observed in and around Google Classroom are not only mediated by language but multimodal digital artifacts as well. However, interactions within this LMS are not necessarily between *co-present participants*, as interactions may be separated by both space and time. This definition also fails to describe the reflective space that dialogue provides and the impact it has on the thinking of participants.

The premise of this project is that dialogic teaching (within and around a LMS) can increase a participant's capacity for reflective thought as well as developing subject knowledge (Mercer et al., 2017). This is in keeping with the initial findings of an ESRC-funded study of classroom dialogue (Howe et al., 2019) that three aspects of dialogue strongly predicted performance on National Curriculum Standard Assessment Tests (SATs). Elaboration, querying and student participation were features of teacher-student talk that in combination, were found to improve educational outcomes. All three of these key features require participants to engage in reflective dialogue, justifying their positions whilst maintaining a dialogic space between their perspectives. This liberatory pedagogy (Shor & Freire, 1987) is democratic, responsive and holds the potential for creativity and the emergence of new knowledge. Google Classroom users generate a large number of digital artifacts that might be revisited at a later date, potentially allowing educational dialogues to take place over much greater timescales. Co-constructed artefacts are also multimodal and serve to highlight the differences in perspectives between individuals, thus facilitating reflective dialogue during shared enquiry (Mercer et al., 2017).

Schwarz and Baker (2016) summarised *dialogue* according to Wegerif as 'not mediated by an adult', having an 'infinalisability', 'creativity' and 'interthinkingness' (Littleton & Mercer, 2013). The premise of this project is that dialogic teaching (within and around a LMS) has affordances to increase children's capacity for reflective thought as well as developing subject knowledge (Mercer et al., 2017). For these reasons, the term *Reflective Dialogue* (Wegerif, 2013) is prefered to *Exploratory Talk* (Mercer & Wegerif, 1999) in the context of this work. This *dialogic* term is

characterised by gaps between perspectives remaining open, an essential condition for productive discourse. The ancient Greek word ‘διάλογος’ (*dialogos*) means *across or through* rather than ‘two’ (Schwarz & Baker, 2016). Wishing to emphasise the infinalisability of dialogue, the final operational definition for this project is, ***“a* sign-based interaction that promotes intersubjectivity between participants”**. This definition is bound by the context of this project and is by no means a universal description of dialogue. It is a working definition that acts as a heuristic device, enabling incidents of reflective dialogue to be better identified within the confines of this project. This definition also allowed for the multimodal and extended interactions within Google Classroom to be accounted for. In practical terms, this meant that both real world and digital communications were sampled in order to establish the practices that promote dialogic learning. As pedagogy was developed during this practitioner-researcher project, the affordances of Google Classroom to support dialogue became apparent (Major et al., 2018b).

Chapter 2: The role of dialogue in learning

II.2.1 Social constructivism

Sociocultural theory has an emphasis on mediation through speech (Daniels, 2001) and accounts for all levels of human interaction. These include the cultural, psychological and social, the latter being the level at which dialogue occurs and at which social action takes place. Mikhail Bakhtin (1981) established that there is a need to create meaning in a dialogic way and this concept of dialogism is widely accepted as a means to engender learning. Intellectual development “cannot be understood without reference to the situated, social experience of the individuals in question” (Mercer & Littleton, 2007, p.18); it has been demonstrated that collaboration leads to greater learning (Azmitia, 1988) as Vygotsky’s and Bakhtin’s constructivist theories would suggest. Bakhtin described concrete speech units as utterances, the study of which he called ‘translinguistics’. All utterances have addressivity and are therefore associated with at least two voices. For instance, parody contains both a concrete utterance and the voice of the parodied (Wertsch, 1991). Even when considering the written word, Bakhtin identifies multiple voices

that prevent the “persuasive” voice from being isolated from others (Bakhtin, 1981, p.343). He argues that monologism can not exist and that there is no “first nor a last word” and no limits to any dialogue (Bakhtin, 1986, p.170).

Linell (1998) and Rommetveit (1992) also reject the concept of monologic on the basis that a communicative act is always interdependent. Meanings are molded by their context and even an authoritative voice is responding to previous utterances and anticipating future responses (Bakhtin, 1986). Even when the voice of the other is silenced or removed, deep traces of it remain and can be acted upon. Dialogue requires the acknowledgement of the other; there is always a plurality. Furthermore, meaning does not exist before dialogues are engaged with; it is instead constructed within the framework of a dialogue. Sequential context is vital to meaning (Lefstein et al., 2015) and it is through talking in turn that meanings may be negotiated (Fernández-Cárdenas, 2015).

Social constructivism and the ideas of Bakhtin in particular, have created an agenda of interaction in education (Fernández-Cárdenas, 2015) where participants (including teachers) must position themselves within a cacophony of voices without silencing the other. A conversational plurality is the only way to ensure all voices can coexist and create new meanings. Unfortunately, teacher-pupil talk is often asymmetrical (Mercer & Dawes, 2008), consisting of closed questions and brief answers, reducing a choir of voices to a single unit. Bakhtin described this form of discourse as authoritative, demanding unconditional allegiance from the other. Alexander (2001) identified five categories of talk; rote, recitation, instruction, discussion and dialogue with the latter two singled out for their cognitive potential. Dialogue implies that a horizontal, rather than the more common vertical transmission of knowledge is the route to lasting cognitive change in participants. Piaget’s cognitive development theory (1965) proposes that when ‘Transactive Dialogue’ takes place (where an individual’s reasoning operates the thinking of another), participants become aware of the gaps between their perspectives. It is the resolution of these socio-cognitive conflicts that results in cognitive restructuring, a change that may take place a long time after the dialogue has taken place. “Every function in the child’s cultural

development takes place twice: first on the social level, and later, on the individual level" (Vygotsky, 1978, p.57).

II.2.2 Argumentation and dialogue

Argumentation underlies any activity in which there are opposing points of view, including within an individual (Larrain et al., 2014) and it plays an important role in learning through dialogue. It is a discursive practice aimed at increasing (or decreasing) the acceptability of controversial positions and therefore permeates all dialogic classroom practices. Coffin and O'Halloran (2008) define argumentation as the process and an argument as the product of negotiating ideas and perspectives. It should not be considered to be competitive and there is no winner or loser during the discourse but argumentative discourse styles may be disputive or deliberative (Asterhan, 2013). In the former, self-promotion or devaluation of another's contributions may occur and interpersonal conflict is exacerbated. This has been demonstrated by research into the rhetorical styles used on social media (Asterhan & Hever, 2015). Other than threatening the stability of a group and raising uncertainty both within and amongst members, disputational statements lead to consensus too quickly. Agreement is then the result of the power imbalance within the group rather than from the co-construction of some new knowledge or viewpoint. Disputational statements have the effect of promoting the ego of some whilst devaluing the contributions of others in the group.

"Argument literacy is the ability to formulate and comprehend arguments when speaking, listening, reading, and writing." (Reznitskaya et. al., 2015, p.1). Effective argumentation contains deliberative dialogue, emphasises a shared goal and promotes a positive atmosphere. This is achieved through signs that emphasise a shared purpose and serve to maintain positive relationships. These are noble goals for any dialogue but persuading others of an understanding requires social interactions that are often inhibited by traditional classroom dynamics (Berland & Reiser, 2009), particularly between the teacher and students. These interactions are often described as Initiation-Response-Feedback (or IRF) sequences (Sinclair &

Coulthard, 1975) which are under the jurisdiction of the teacher and tend to allow only the briefest of responses from students before feedback is given. More often than not, feedback is restricted to meet the narrow aims of the curriculum and to steer future interactions in a way that fits a predetermined narrative. Even between peers, researchers highlight the fact that for the majority of students, valid argument does not come naturally and requires practice (Kuhn, 1991). According to Toulmin et al. (1979), key components of an argument are claims, grounds, warrants, and backing. Claims are assertions about a topic and grounds, the factors or data on which these claims are founded. Warrants justify the connections between the grounds and the claim whilst backing justifies particular warrants. These components must then be organised into a persuasive narrative in order to make some statement about a 'truth'.

The dilemma for teachers is that argumentative dialogue redresses the power structures in the classroom (Wolfe & Alexander, 2008). Many practitioners would find engaging in true dialogue with students, as partners in the exploration of knowledge, nerve-wracking and at odds with the expert-disciple dynamic they are used to. Furthermore, there is a cultural imperative to introduce students to existing knowledge and norms of thinking. Conducting dialogue in ways that recognise alternative perspectives and build on the experiences of individuals is a challenge for the dialogic practitioner. This is especially problematic when teachers are faced by bizarre or incorrect responses whilst attempting to maintain the lines of enquiry (Alexander, 2008b). Dialogue is not always comfortable (Lefstein, 2006) and power relations in a classroom can not be overlooked due to the inevitable age and status differences of the participants. Attunement to the other is difficult to achieve in schools due to this. Students with the ability to co-construct knowledge within such a framework must exercise a healthy skepticism and think critically. This is a central tenet of the Philosophy for Children (P4C) program which promotes the idea that students should 'doubt methodically' and internalise the 'truth' they construct for themselves (Daniel & Auriac, 2011).

Classroom argumentation has primarily been researched in the context of science education and Leitão (2008) identified three dimensions that effective arguments have in common when studying science lessons. They should be pragmatic (setting up conditions for argument to occur), epistemic (defining the content to be covered) and semiotic (with mechanisms that allow the argument to proceed). Leitão found that only 46% of dialogue involved justification, but where it does exist, it is predominantly in discourse between students. In a similar study, Berland and Reiser (2009) identified three goals to any argument; sensemaking, articulating and persuading. It is the latter which depends upon the ability to convince a neutral audience but students are rarely given the dialogic time and space to do so. This particular study focused on the written explanations prepared by students of a biology module. Whilst these written arguments may well be the form in which their understanding will be later assessed by an exam board, it is likely that there was also verbal argumentation during the lessons that was not analysed. Nonetheless, the evidence suggests that persuasion requires interactions that are inhibited in the traditional science classroom, a space which is not structured to promote epistemic discourse (Christodoulou & Osborne, 2014). Furthermore, there is little reason to engage in argument when the audience (particularly of any written statements) is primarily the teacher who, in all likelihood, provided the evidence and conclusions that the student is expected to repeat. Students must be given the opportunity to construct and share their own understanding of the phenomena they observe if they are to be stakeholders in knowledge. This feature of dialogue is particularly salient to the scientific method.

Argumentation with a peer can produce cognitive change but only if the tensions between their viewpoints are given a forum in which to become explicit. Even when argumentation is promoted by practitioners, greater success is not assured amongst students. Osborne et al. (2013) found that there were no significant changes in outcomes over 2 years and across four schools when lead practitioners embedded argumentation activities into their science schemes of work. Given the complexity of the task, it seems probable that successful co-construction of knowledge can only

occur when such practices are widely adopted by an institution and practiced regularly by teachers and students of all subjects alike.

Vygotsky (1978) claims that an important way in which children learn to think individually is through learning to reason with others. The individual later acquires an ability to develop an internal dialogue of their own, introducing 'virtual others' to their thinking. Jean Piaget (1965) also proposed that when 'Transactive Dialogue' takes place, participants become aware of the gaps between their perspectives. Piaget supposed that young children benefit from peer-based learning because a natural egocentrism is challenged (Crook, 1998). For Piaget and Vygotsky, it is in the resolution of these socio-cognitive conflicts that learning takes place and it is therefore valuable to consider argumentation theory when contemplating the *Dialogic* educational paradigm. Argumentation is a "means for attempting to make claims or discourses more acceptable to people than they were initially" (Schwarz & Baker, 2016, p.67). It is a challenging interaction through which knowledge artifacts are illuminated (Freire, 1970). Operationally speaking, *argumentation* is generally meant as an exchange between people in order to handle a disagreement (Schwarz & Baker, 2016). Dialectic arguments typically follow the three stages of thesis, antithesis and resolution. In the 19th Century, G.W.F. Hegel proposed that an *absolute realism* could be achieved through this form of discourse as the resolution of arguments moves participants towards a single ideal (Schwarz & Baker, 2016, p.27). As subjects get closer to intersubjective understanding they retreat towards the silence of a single consciousness, what Hegel described as *The Absolute Idea* (Hegel, 1975, p.292). In dialectics, language is used to make reasoning explicit and to build a shared model of the world by overcoming the contradictions between viewpoints and Vygotsky considered the dialectic between an adult and child essential to the development of higher mental functions (Vygotsky, 1978).

Whilst this discourse has been conflated with Bakhtin's dialogical perspective, Wegerif (2008) points out a conflict between the assumptions on which these concepts are based. Vygotsky's *dialectical* integrates voices into a single knowledge artifact. Meanwhile, Bakhtin's *dialogue* does not require perspectives to be unified; it

avoids consensus and thus an infinite dialogic space of potential meanings is preserved (Wegerif 2011). Vygotsky is not dialogic in Bakhtin's sense of the word since this refers to the inter-animation of real voices where there is no overcoming or synthesis. "Take a dialogue and remove the voices (the partitioning of voices), remove the intonations (emotional and individualizing ones), carve out abstract concepts and judgements from living words and responses, cram everything into one abstract consciousness - and that's how you get dialectics." (Bakhtin, 1986, p.147). *Alterity* (Markova, 2003) in which the other has a disruptive influence and introduces dialogic tensions is an essential feature of dialogic interplay.

II.2.3 Tool mediated action

From a biological reductionist standpoint, sociocultural phenomena can be explained by the underlying psychological processes of individuals (Wertsch, 1985). A common theme in Vygotsky's work is genetic analysis (Wertsch, 1991); a study of the origin and change in mental functions. Vygotsky contended that natural and cultural factors were intertwined to produce a phenotype, that a phenomena can only be explained in light of all of the processes leading to it. This approach avoids the pitfalls of biological reductionism and Vygotsky was influenced by the work of Charles Darwin when studying the human ability to use sign systems (language) as a means to overcome problems. Vygotsky made a distinction between elementary (i.e. natural) and higher (i.e. social or cultural) mental functions. Natural development produces functions in their elementary forms, such as memory. Cultural factors then convert these to higher skills, such as internal speech, through the use of signs and tools. Vygotsky described this as 'tool mediated action' and it is considered to be one of his most important ideas (Edwards, 2005). Often, a novice will use a potential concept word before they have full understanding of the semantics but this may still lead to reason and scientific thought. When new ideas are encountered that fit our existing means of understanding the world, they can be easily assimilated. However, other ideas force us to accommodate them, literally changing our minds.

In a 'sign system' participants can say more than they understand or intend. Vygotsky offers examples from Tolstoy to illustrate this, where communication is possible between characters who provide one another with only minimal signs. A similar example can be found in HBO's the Wire (2002); In one scene, two detectives survey and analyse a murder scene using only a single expletive. The word conveys no useful information in itself but acts as a shared focusing device that understanding can hinge upon. During ventriloquation (Wertsch, 1991), where learners speak with the voice of others, the learner may have no concept of what a sign means to others. However, experimenting with novel words plays an important role in the development and internalisation of what was once a foreign voice. This process is even evident in the pre-language development of infants whose mirror neurons mean that there is no discernible separation between the acts of being smiled at and smiling themselves (Wegerif, 2013). Here they are clearly experimenting with signs that they have no knowledge of but will come to internalise into their own lexicon. Indeed, learning in school may be considered to be a semiotic apprenticeship, enabling culture to be transmitted and new knowledge to be generated (Wells, 1999).

II.2.4 Knowledge construction in the ZPD

The social constructivist idea of *scaffolding* occurs within what Vygotsky called the *zone of proximal development* or ZPD (Vygotsky, 1978 p.86) where "adult guidance" is adjusted to the needs of the learner. This is the gap between the independent problem solving and potential development of a learner, as measured by the ability to solve problems with and without adult assistance. The ZPD is a dialogic space where the learner and teacher see a task from each other's perspective, allowing the co-construction of knowledge to occur. Despite the implicit hierarchy in this relationship, there is a movement towards a shared meaning and homogeneity.

However, it may be argued that as this process is leading towards an established truth (that of the guide) it is in fact monologic (Wegerif, 2013). From a Bakhtinian perspective, this is not dialogic discourse as it is closely associated with the

transmission of fixed ideas and reliant upon the inequalities of status between the participants. The asymmetrical power (and knowledge) in the relationship makes the utterances monologic (O'Connor & Michaels, 2007). Cognitive change in the teacher is unlikely, ergo; no new knowledge is co-constructed. But this is not to say the ZPD does not provide an effective tool for the vertical transmission of culturally important ideas; the authoritative voice does play a central role in many, established classroom activities. Gordon Wells (2007) argues that both monologic and dialogic talk can be valuable but that dialogue has affordances for learning that are not present in monologic transmission; in particular the possibility of creative thought. Dialogue itself is a form of semiotic mediation (Wells, 2007) that provides a framework for the learning and thinking of individuals and members of their cultural groups. However, this meaning-making framework tends to be acquired during monologic interactions with expert members of a child's home culture (O'Connor & Michaels, 2007) within the ZPD. During scaffolding of this nature, expert cognitive support is sensitively adjusted to account for the expertise of the novice before it is faded and responsibility is finally transferred to the student (Van de Pol et al., 2010). The intended outcome is the internalisation of culturally valued knowledge in the less experienced individual. This goal focused approach to learning limits the possible actions of the student (Wertsch et. al 1993) and is somewhat at odds with the idea of dialogue as a means to co-construct knowledge given that the learning outcome is preordained by the teacher. Wegerif considers this teacher mediation as a kind of *domestication* of children to the interpretations of the world (Wegerif, 2011), which puts limits on children's imagination and creativity.

However, scaffolding can be employed by teachers as a means of transferring dialogic skills themselves to their less experienced students (Rojas-Drummond et al., 2013). One strategy to scaffold the dialogue of students is to employ spontaneous enquiry questions (Rop, 2003). These questions are asked in order to expand understanding rather than to assess it. It is essential that the questions used originate from student curiosity but are still related to the content of the curriculum. In this way, the expected curriculum may still be delivered but also expanded upon in a direction that is guided by the learners. Neil Mercer (1995) has also shown how

some teachers make effective use of Initiation-Response-Feedback (IRF) exchanges to scaffold learners' understanding. Typically, these involve closed, quiz style questions to which the teacher has an expected response. However, Mercer described an enhanced version of this interaction whereby teachers, in the feedback phase, ask further questions to expand the scope of the interaction into an area that is not necessarily preordained or part of a prescribed curriculum. In these *spiral IRFs* (Rojas-Drummond et al., 2013), the line of enquiry is somewhat student-led and the more common IRF loop is broken. For this kind of activity to be productive, teachers need to encourage their students to develop their own thinking. This can be achieved in a number of ways. For example, by engineering time for students to think and by encouraging them to rephrase their ideas (Mercer et al., 2017). *Exploratory talk* (Mercer & Dawes, 2008) places an onus on explicit reasoning that is dialectic in structure. As such, Wegerif stresses that the essence of successful exploratory talk is in fact the ability of each participant to think empathetically and to focus on 'the other'. Wegerif is now a proponent of *Reflective Dialogue* (rather than *Exploratory Talk* (Mercer & Wegerif, 1999) as the most productive form of discourse for learning (Schwarz & Baker, 2016). This dialogue is characterised by an *infinalisability* where the gap between perspectives remains open. Reflective dialogue shows *creativity,* is not mediated by an adult and demonstrates *interthinking* (Littleton & Mercer, 2013). Wegerif argues that reflective dialogue opens up spaces for learning to take place in, especially within and around digital technologies. He opposes the finalisability implicit in Mercer's definition of exploratory talk; which involves the seeking of agreement between participants. This is in contrast with the Bakhtinian idea of the 'infinalisability' of dialogue (Bakhtin 1986).

Dialectics will continue to play a role in the modern classroom and it is certain that only a fraction of digital communication that occurs within a LMS will be dialogic. Authoritative voices can play an important role in the classroom, not least in the scaffolding of learning by teachers within the ZPD of their students. Although *co-construction* of new knowledge in the ZPD is unlikely to occur due to the inherent power imbalance, adult scaffolding is still an important means of transmitting culturally important knowledge to children. However, this form of apprenticeship

need not exclusively lead to the acquisition of preordained “truths”. It is also a means by which children can be inducted into a cultural conversation, where they can learn to use dialogic tools for themselves (Rojas-Drummond et al., 2013). These can later be used to co-construct knowledge by engaging with, maintaining and reflecting upon different perspectives.

Chapter 3: Teacher mediation of learning with technology

II.3.1 Talk as a tool

“People do not only use talk to interact, they interthink” (Littleton & Mercer, 2013, p.1). Talk mediates actions between individuals and like any useful tool, allows the user to manipulate their surroundings and in this instance, other people. During infancy, speech begins as an egocentric act. Once the transactive potential of this is discovered it takes on a communicative role. Finally, this becomes inner speech during the later stages of childhood (Wegerif, 2013). Vygotsky made a distinction between everyday and scientific speech and thought (Scott, 2008). Scientific speech is often considered to have greater authority and to be more worthy than other modes of talk. However, everyday speech should not be dismissed; it is the form of talk, and therefore thinking, that is first mastered by children. It is the prevailing method for communicating with and making sense of our surroundings. In learning everyday speech, children lay the foundations for learning itself (Halliday, 1993). Learning is a matter of constructing models of the world; these are then reshaped according to what works as and when new information is encountered (Barnes, 2008). Talk is an effective tool for learning when it extends the logic or reasoning of any debate (Mercer, 2000). Talk that acts to promote social cohesion is less effective due to its cumulative nature and emphasis on maintaining a rapport between individuals. When participants are merely seeking agreement, the gap between perspectives is closed, preventing any cognitive change from taking place.

Like any tool, users must be shown how to make effective use of the technology to mediate their actions and teachers should not assume that students know how to be

productive when talking to one another. For most, argumentation does not come naturally, it is a tool that can only be acquired through practice and therefore must be explicitly taught (Kuhn, 1991). When engaged in appropriate activities, students not only achieve cognitive change and greater subject knowledge but social cohesion is also promoted. Teacher professional development (TPD) is essential if such skills are to be appropriated by students. Simon et al. (2006) demonstrated, albeit on a relatively small scale (12 teachers were provided access to 6 half-day sessions), that argumentation workshops for teachers led to change in their classroom practice within a year. The study made use of a coding scheme that focused on teacher inputs, such as encouraging listening and justification – acts that help not only to maintain the focus of a dialogue but also themselves, model effective practice to the students.

In the majority of classrooms, talk is asymmetrical and monologic; in fact “the potential power of spoken language is underexploited in most classrooms, in most of the world, most of the time.” (Mercer & Dawes, 2008, p.57). Teachers tend to act as expert guides to their students, disseminating the established knowledge of a culture in piecemeal fashion to their learners. Where there is student participation, a familiar triadic pattern of discourse is established by closed questions from the teacher. This is followed by brief answers from selected students and evaluative comments from teachers. This initiation-response-feedback (IRF) device (Coulthard & Sinclair, 1975) is asymmetrical in its nature due to the power imbalance amongst participants. Teachers are in control of the discourse at all points; from selecting the subject to be explored to determining which voice(s) may be heard. In order for a response to be accepted a student must typically put their hand up as quickly as possible, often before they can give the question due consideration. The rapid nature of this phase of an IRF sequence is unlikely to support the learning of the majority and will not increase the understanding of those whose ideas are actually heard. At best, rapid question and answer exchanges will elicit what the students already know. Students may perceive that their queries are either dismissed or met with anger and there is significant social pressure (from both peers and teachers) not to ask questions that are open-ended or off task (Rop, 2003). As stated in the previous chapter, Alexander

(2001) identified 5 categories of talk but identified dialogue and discussion as having the potential to create lasting cognitive change. Dialogue offers space for reflection that is lacking in a typical IRF exchange.

The feedback given at the end of the IRF sequence serves to reset the status quo and allows a teacher to move the discourse along a path of their choosing. Whilst a teacher may be satisfied that the interaction has exposed the students to the prescribed ideas of a curriculum, it is unlikely that the students will have constructed knowledge for themselves. The most likely reason this discourse is embarked upon is to informally assess the current knowledge of the students as opposed to generating any new cognitive change. Talk between students is more symmetrical; although a power imbalance between peers is inevitable (thanks to social status, age etc.) these are less pronounced than those between teachers and their students. If promoted by teachers, this talk is far more likely to result in the co-construction of knowledge and thus lasting cognitive change. “What ultimately counts is the extent to which instruction requires students to think, not just to report or repeat someone else’s thinking.” (Nystrand et al., 1997, p.72).

The ground rules for teacher-student interactions are implicit in most settings and are quickly identified and adhered to by students. These tend to cement the authority of the teacher who alone has the power to nominate who can speak, to ask questions without permission and to evaluate comments. For their part, students must ensure that their answers are as succinct as possible and should raise their hand to be nominated rather than speaking freely. Similar rules help govern other human interactions such as chat shows and religious services (Mercer & Dawes, 2008). But in the modern world, where people of all ages are given forums to share their ideas and interact, these established rules for talk seem outdated and worse, ill suited to help participants create new insights. As the ways in which knowledge is distributed changes, static teaching materials and methods will no longer suffice; instead we need “continually renewable, flexible adaptive materials and practices” (Pea, 1993, p.48). Mercer & Dawes (2008) have also compared educational talk and social talk between students. Social talk, which has the ability to promote group cohesion is the

most common form of discourse between students. Educational talk between students is far less likely and needs to be promoted by teachers. In order to do so, ground rules must be agreed upon, made explicit and observed. This code of conduct helps to ensure that all students are included and that the discourse is productive. They create an intersubjective space where ideas can compete and be tested against one another without jeopardizing the cohesion of a group or social standing of any individual. Alexander (2001) described 5 principles for such discourse; it should be collective, reciprocal, supportive, cumulative and purposeful. Where ground rules for productive dialogues are explicitly referenced, they increase participation and facilitate students' exploration of one anothers' thinking (Frøytlog & Rasmussen, 2020), particularly in the context of disruptive digital technologies which increase the demands on students' attention (Rasmussen et al., 2019).

In order to enhance learning with talk, practitioners must improve their own teaching repertoires. Mercer & Dawes (2008) have curated a list of potential strategies such as allowing multiple responses without evaluation, asking students to justify their ideas, prompting short group discussions and asking students to nominate speakers. The exploratory talk promoted by dialogic pedagogy is complicated by the social complexity of the classrooms in which it takes place. Students who are willing to offer their thoughts before anyone else may well risk more than they stand to gain. It is for this reason that ground rules should be established which both teachers and students should adhere to when interacting. Mortimer & Scott (2003) analysed the communicative approach of science teachers and identified two dimensions, interactive-non-interactive and dialogic-authoritative. Non-interactive and authoritative approaches are commonplace and involve the teacher presenting a specific point of view whilst lecturing the students. Where authoritative talk is interactive, the familiar IRF sequence is established with the aim of consolidating the single, correct point of view amongst students via a question and answer routine. Dialogic talk is for the most part interactive. In this mode, teachers and students consider a range of ideas and construct an understanding together. However, some dialogic classroom talk can be non-interactive. By broadly considering any instance where more than one point of view is expressed, it is possible that a teacher may

provide students with the chance to hear different voices by reviewing different ideas on behalf of contributors whilst maintaining authority over the discourse. Interactive-dialogic pedagogy may represent an ideal of teaching for many but it is at odds with teaching as compliance. It is the mode of learning that most educators and students are used to, often employed as a consequence of there being a fixed body of knowledge to recall; usually for the purposes of a summative examination over which learners have no individual responsibility (McFarlane, 2003). Dialogic pedagogy is at odds with this, as all participants are given the opportunity to contribute knowledge and are expected to enhance the learning of others.

Cultural differences in the organisation of classrooms also have a profound effect on the type and frequency of dialogue that takes place and group work is less likely to be seen in certain countries and contexts. Where small group tasks are prevalent, they are not necessarily created with student-student dialogue in mind. Instead, they may well be the product of a lack of resources in subjects such as computing and science where practical experiences are considered essential. Wherever the opportunities for dialogue between students exists, evidence suggests that small group work allows high level cognitive activity to take place. This can be further engendered if teachers provide guidance to students as to how best to conduct the tasks collaboratively (Galton et al., 2009).

II.3.2 Scaffolding

Human life is intrinsically social and consequently, dialogue and development are intertwined (Rojas-Drummond et al., 2013). Scaffolding occurs within the zone of proximal development or ZPD (Vygotsky, 1978 p.86) described in the previous chapter. When scaffolding, the expert's cognitive support is sensitively adjusted to account for the expertise of the novice before it is faded and responsibility is finally transferred to the student (Van de Pol, 2010). Scaffolding may take the form of participatory appropriation, guided participation or apprenticeship (Rogoff, 1995). Regardless, the outcome is the internalisation of culturally valued knowledge and practices in the less experienced individual. However, identifying and resolving

differences between the desired outcomes of teachers and students is difficult and may prevent this guided construction of knowledge. If the teacher does not attune to the understanding of the learner, the complexity of their talk will be too great for an effective ZPD to be established.

Scaffolding limits and shapes the possible actions of the student (Wertsch et al., 1993). Students must be supported, guided and challenged before the support is gradually withdrawn. Learning management systems have affordances that allow for the teacher mediation of learning, particularly in the form of scaffolding but teachers must continue to be discerning in their selection of resources and tasks in order to meet the needs of their students. Hennessy et al. (2005) identified the need for the expert structuring of classroom activities when analysing the "Technology-integrated Instructional Conversations" of 15 teacher-researchers . Across 6 curriculum areas, positive outcomes occurred when teachers judiciously chose activities that "encouraged pupil collaboration, experimentation, reflection and analysis" (Hennessy et. al, 2005, p.265) and remained focused on the subject at hand. One strategy to scaffold the dialogue of students is to employ spontaneous enquiry questions (Rop, 2003). These questions are asked in order to expand understanding rather than to assess it. It is essential that the questions used originate from student curiosity but are still related to the content of the curriculum. In this way the expected curriculum may still be delivered but also expanded upon in a way that is guided by the learners.

II.3.3 Digital technology as a cultural tool

> *None of the new technology media was developed as a response to a pedagogical imperative, and it shows* (Laurillard, 2004, p.27).

70% of students globally use computers in school and since 2009, there has been an increase in the amount of time spent on these machines (OECD, 2015). In the recent past, devices such as interactive whiteboards (IWB) and digital microscopes have been introduced into classrooms without regard to the needs of learners (Hennessy,

2006). Between 2007 and 2012, British schools invested over £1bn in digital technology with little or no measurable impact on educational outcomes (Nesta, 2012). Digital, social, and mobile technologies (DSMTs) have been shown to support a wide range of self-directed learning activities (Curran et al., 2017) and present ideas in novel and exciting ways. However, it remains the job of the teacher to help students internalise this information into lasting knowledge. The volume of information available online places a great demand on learners to evaluate and discern between sources (McFarlane, 2003). “If we want students to be smarter than smartphones we need to think harder about the pedagogies we are using to teach them” (OECD, 2015, p.6). The development of argumentation skills may well provide a solution to this problem.

Argumentation is the process and argument the product of negotiating ideas and perspectives (Coffin & O’Halloran, 2008). Based on Toulmin’s (1958) work, argumentation skills and in particular, confrontation, have become influential in the design of computer-supported collaborative learning (CSCL) environments such as discussion boards, simulations and Learning Management Systems (Feyzi Behnagh, & Yasrebi, 2020). These applications are built upon a sociocultural model (Wegerif, 2007) and enforce collaboration through their task design. CSCL environments afford learners the opportunity to engage in joint tasks and to co-construct knowledge and artifacts through communication and the sharing of resources (Jeong & Hmelo-Silver, 2016). Learning with others in this way requires collaboration, networking, participation and dissemination of ideas between group members; enduring skills that mimic those required in many modern workplaces. Each of these aspects can be supported by digital technology (Nesta, 2012), such as Google Classroom, but this must be planned for by educators with dialogic intentions. To increase the efficacy of dialogues in the context of digital technology use, educators should make their dialogic intentions explicit; through the use of ground rules for talk for example (Warwick et al., 2020).

II.3.4 Digital artifacts

Education can be considered to be the transmission and appropriation of cultural tools, such as language, in order to generate further knowledge; a process which is formally mediated by educators. Any new knowledge constructed through this process becomes an 'artifact' that can in turn be passed on. Thanks to digital technology, there has been a proliferation of such artifacts (videos, documents, web pages, blogs etc.) that can be shared with increasing speed. These new artifacts and meanings certainly represent an increase in human knowledge, although this does not necessarily equate to deeper insights (Wegerif, 2013). For instance, British schools spent £487 million on ICT equipment and services in 2009-2010 (Nesta, 2012), but this investment failed to result in radical improvements to learning experiences or attainment. Much of this money was spent on Interactive Whiteboards (IWB) which have been demonstrated to provide teachers with the opportunity to remotely mediate the work and thoughts of learners (Warwick et al. 2010) and to better critique their ideas (Hennessy, 2011). Like other digital platforms, they allow artifacts to be generated that can be revisited and amended over great periods of time, extending dialogues indefinitely. Digital representations of knowledge may be endlessly augmented and enriched and enable the products of a dialogue to accumulate ad infinitum. This gives teachers the opportunity to mediate their students' own lines of inquiry and to discover and co-construct new knowledge for themselves. However, too often this technology is monopolised by teachers, used only to display information rather than to promote or extend dialogue (Hennessy & London, 2013).

II.3.5 Dialogic space-time

Wegerif (2013) contends that the internet is a disruptive technology to education, as it is incompatible with the established monologic interactions that widely take place. He has compared this to the advent of print technology that moved education away from an oral tradition and into one where written knowledge became more tangible,

reproducible and fixed. The drawback to the transmission of knowledge in this way is that information becomes unsituated and decontextualised, unable to be shaped by its surroundings as they change with time. The Web 2.0 has some of the same affordances of print media, allowing meaning to stretch via text and other means across space and time. However, the social features of Web 2.0 tools add the fluidity of Socratic oracy to the information, as artifacts are endlessly augmented and edited whilst being transmitted.

To increase the impact of dialogue between students, the time and space over which they are engaged should be as expansive as possible. Learning Management Systems offer teachers the chance to mediate their students' access to such space-time, giving them the option of dipping in and out of a conversation as and when they feel able to contribute. In contrast to real world dialogue, participants do not need to take the floor in real time (a daunting prospect for some) and can address multiple lines of inquiry simultaneously. These utterances may be as enduring as physical print media, but modern communication is also “immediately dialogic and communal” (Wegerif, 2007, p.174). Indeed texting, blogging and maintaining an online presence on social media means that many learners are already engaged in a great deal of writing and dialogue that deepens their sense of inner life and space (Ong, 1982). In effect, their inner space becomes collective, relational and eternal (McGregor, 2003). The read-write technologies of the Web 2.0 not only enable teachers to mediate collaborative enterprise but also promote the self-regulation of learning (Nesta, 2012). In a small-scale study of two A-level classes, Enriquez et al. (2008) demonstrated that the creation of online text encourages greater thought prior to communication and where an IRF exchange is still employed by a teacher, digital forums allow the response to be better considered and multiple voices to be heard.

In a real world classroom, collaborative activities tend to be dominated by more confident language users (Downes, 2015) who feel able to contribute to traditional, synchronous, oral classroom dialogues in a timely manner. Learning Management Systems can provide tools for teachers to mediate non-synchronous dialogue and reduce the time pressures placed upon students. The expanded space-time of the

digital world reduces anxiety and increases the motivation to collaborate. Even in situations where teachers design tasks that mirror the traditional IRF sequence in virtual environments, the response phase can become interminably long and can invite the voices of many to be heard. Computers are infinitely patient and so long as the framework of a task promotes it, students may engage in discussion to prepare their responses. This leads to a new initiation-*dialogue*-response-feedback (I*D*RF) sequence (Wegerif, 2013) which has greater cognitive benefits than standard IRF exchanges. Hardware and software have an ambivalence that helps to promote dialogue between students, this is in contrast to teachers who are likely to add their judgments when mediating a discourse. It also reduces time pressures that practitioners may feel when delivering curriculum content, allowing students to engage with material at a pace that better serves their needs. In the modern networked society, the industrial metaphor of knowledge as something which is produced by a series of steps is no longer relevant (Wegerif, 2007). Instead, the endeavour of constructing meaning can be considered to take place over an ever-expanding dialogic space-time.

The idea that utterances, particularly in the form of text, have a “chronotype” (Bakhtin, 1981, p250) that denotes the time and context in which they were created is nothing new. According to social constructivism, all learning takes place across dialogic space; talk is situated in long conversations between protagonists and is shaped by all previous utterances and interactions (Mercer, 1995). Technology has the capacity to further open up these gaps and the internet gives an almost concrete form to dialogic space-time. In order to interact with this environment, students will need to possess greater dialogic skills and it has been demonstrated that those who are taught such strategies perform better in critical thinking and problem solving tasks (Howe & Abedin, 2013). Dialogue can also positively impact the quality of learning in English, mathematics and science (Alexander, 2012). Technology can be used by teachers to enhance learning through dialogue and can help students to better transfer skills and knowledge from one context to another (Nesta, 2012).

Chapter 4: The potential for a Learning Management System to support dialogue

II.4.1 What is technological affordance?

The term *affordance* was coined by James Gibson (Gibson, 1979) as a means of describing the possibilities that an environment offers an animal, “what it *provides* or *furnishes*, either for good or for ill” (Gibson, 1979, p.56). According to Gibson’s definition, some offerings of the environment are beneficial and others injurious. Donald Norman later introduced this term to the design community (You & Chen, 2007), describing affordances as “the perceived and actual properties of a thing, primarily those functional properties that determine just how the thing could possibly be used” (Norman, 1988).

The concept of *affordance* has since been applied to digital technology in educational contexts. Conole & Dyke (2004a) have described a taxonomy of the affordances of digital technology to support learning that includes *Communication and Collaboration.* However, these affordances can be considered to have both positive and negative connotations for teaching and learning. An affordance of the technology does not simply refer to the intended use but also to the unintended consequences. *Affordance* can also account for the ways in which technologies are adapted by people in novel circumstances (Conole & Dyke, 2004b).

This is in contrast to *functionality* which refers only to the intended or designed usage of an object. As Norman (1988) points out, many objects restrict the actions available to users in order to improve their functionality but in doing so, restrict their possible applications and thus their affordances. This is certainly true of many digital technologies, including Learning Management Systems (LMS) such as Google Classroom. Rather than appraising the *functionality* of a LMS*,* this EdD project is an exploration of the, “Designs and *affordances* for dialogue in Google Classroom”. This is in order to better express the scope of this project which has identified novel and emerging uses of the Google Classroom platform; rather than limiting the work to evaluating the intended *functionality* of the LMS. The title also conveys an appreciation of the fact that a user's interaction with Google Classroom

may also constrain (Greeno, 1994) dialogue, but it is on those actions that have the potential to *support* dialogue that this project focused.

II.4.2 Where does agency lie?

According to Gibson (1979), *affordances* are properties of objects as perceived by an individual observer, but they are not entirely subjective. He considers artifacts to be *ecological objects* enriched by the values the user brings to them. Thus Gibson rejects the debate as to whether values are phenomenological or physical, seeing both nature and culture as aspects of a single intertwined environment. Norman (1988) moved the concept beyond a reference to the physical, believing that affordances result from the perceptual capabilities of the user (You & Chen, 2007), which results from their previous knowledge and experience.

By focusing on the *possible uses (affordances)* of a technology, Gavriel Salomon (1993) followed Gibson and Norman in rejecting a top-down view of design whereby the object has agency over the user. Whilst accepting that different technologies will enable people to complete tasks with varying degrees of ease, it is only with the imagination and interaction of the user that these are achieved. David Perkins (1993) built upon this by introducing the concept of 'Person Plus', whereby cognition is distributed between the person, environment and associated artifacts. Different combinations of users and contexts will allow new affordances of a technology to emerge. Whilst digital technologies have opened up the possibility of new forms of dialogue in and around the classroom, the realisation of this is still brokered by teachers. An enhanced use of dialogue will not be a natural consequence of having this technology to hand in the classroom; relevant affordances must be recognised and exploited by users if they are to have any effect.

II.4.3 Do Learning Management Systems serve a pedagogical imperative?

Learning management systems (LMS) such as Google Classroom are digital systems that offer a range of content and tools to their users (McFarlane, 2003).

They are characterised by being convenient cloud-based, on-demand networks that allow administrators to readily share resources with select groups of individuals and to offer feedback. LMS have the advantage of being flexible with regards to the problem-solving activities that are disseminated by teachers. They allow practitioners to create and select high quality, relevant content for their learners that is in keeping with their curriculum and cultural context. This is not possible when giving students access to most hardware and software tools that have fixed modes of use. For these reasons, and the increased demand for remote learning solutions in response to the Covid-19 pandemic, LMS have now reached a global audience. For instance, Apple's iTunes U reached over 1 billion content downloads (Apple Ltd., 2013), before being subsumed into Apple's own 'Classroom' app, released in 2018 (CNET, 2021).

LMS technology has the possibility of disrupting the traditional paths that teaching tends to follow. As with any novel technology, LMS affords practitioners the chance to change what is taught and how their curriculum content is delivered. Of course, positive changes may well be possible without LMS technology but this project aimed to identify the affordances that they provide those teachers wishing to create a dialogic classroom. Ultimately, the ability for LMS to serve this pedagogical imperative is entirely dependent upon the manner in which they are deployed. This must be considered in advance of any educational task which should be carefully tailored to the needs of the learners in a given context. To be effective in the classroom, technology use must be driven by learning goals, rather than the features of the tool at hand (Higgins et al., 2012). Research shows that resource-based interventions alone have a limited impact on student learning and that the intention to make use of an LMS must have "perceived usefulness" if it is to be accepted by students and teachers (Eraslan Yalcin & Kutlu, 2019). Technology should be subordinate to pedagogy as technology itself adds no value to education (Haßler et al., 2016), it must be integrated into existing pedagogy if it is to serve a purpose for students (Hennessy & London, 2013).

Haßler et al. (2016) describe three modes of technology use by educators that are in keeping with the Substitution-Augmentation-Modification-Redefinition (SAMR) model

(Puentedura, 2014). The first is that of *support*, whereby learning objectives remain the same but the process is somehow automated; this may improve efficacy but with unchanged content. Secondly, *extension* may occur when the processes or content are somehow altered; but in a way that could have been achieved regardless of the technology (although most likely in a less time-effective way). The third mode is that of *transformation*, where processes and content are changed in a way that would not have been possible without the technology at hand. The use of technology to merely support learning is no bad thing, given the time constraints and complex demands on teachers. The capacity of a novel technology to allow teachers to alter curriculum content or pedagogy for the benefit of their students should be investigated whenever a new tool, such as a LMS, is introduced to a setting. The ethical considerations of introducing these products should also be considered by practitioners. For instance, G Suite for Education and its associated LMS (Google Classroom) are free resources but the oft overlooked cost of use is that of the collected information that the provider can harvest as part of its terms of use, in order to hone its online marketing (Lindh & Nolin, 2016). There is also the issue that early familiarity with the products of a particular company may lead to brand loyalty that educators may not intend to endorse. Some high cost digital technology schemes, such as the $1.3bn Los Angeles iPad initiative have failed to have the impact that was envisaged (BBC News, 2015) and for many years, studies have shown that simply placing computers in schools does not impact student learning or address the digital divide (Wagner et al., 2005). This is in part due to the better ability of high-income communities to leverage new technologies (Haßler et al., 2016). Unfortunately, the implementation of digital tools in schools continues to be characterised by a focus on the technology itself rather than on pedagogy (Hennessy et al., 2017).

The rollout of technology and its ongoing management must be underpinned by a culture of leadership that promotes change and empowers teachers to make professional judgements as to how best to use tools such as Google Classroom. Teacher professional development (TPD) opportunities are also essential if any educational system is to undergo sustainable change for the better. Hattie's (2009)

meta-analysis showed a large effect size (0.62) for the influence of TPD on students' learning outcomes and this must be a long-term enterprise, infused within the daily practice of teachers and regularly revisited; as opposed to ad hoc, stand alone training sessions. There may also be resistance to change from teachers who, as discussed when considering the challenges of dialogic teaching earlier in this review, may fear challenges to their authority by new practices (Wagner et al., 2005). The expert-disciple dynamic may even be reversed if students are more au fait with the digital tools at hand than the teacher.

The level of impact achieved by any intervention is not determined by the technology but by the ways in which it is aligned with teaching and learning. Cultural context also seems to be important. As an illustration, researchers in Taiwan found a greater effect size of computer-assisted learning than other international researchers (Liao, 2007). Collaborative use of technology is also shown to be more effective than individual use (Higgins et al., 2012). The Education Endowment Foundation (EEF) conducted a meta-analysis of 48 primary research studies (Higgins et al., 2012) and found that individual technology-based interventions produced lower levels of improvement than other approaches, with an average gain of 4 months per student across age groups and subject areas (Tamim et al., 2011). These marginal gains are also coloured by the EEF finding that technological interventions cost an estimated £320 per student. This represents a high cost which is often underestimated by managers who fail to budget for the TPD and human resources required to support the intervention. Multiple studies have shown (Higgins et al., 2012) that ongoing TPD is key to the successful application of technology in the classroom; technology is at best a supplement to teaching and can not replace it. Choi et al. (2014) described the argument patterns produced by fifth-grade science students using Moodle, an online LMS. The task design allowed for asynchronous discussion between students and was the product of an intensive two-week TPD program. The findings of this study were limited by the lack of any content other than the written work of the students and reflections of teachers, this meant that interactions in the real world were not recorded and could not be used as a control. Whilst teachers reported that the platform did promote authentic learning, students found writing their thoughts

difficult, despite the teachers explicitly modelling argumentation strategies in class. LMS can only have an impact if there is a considered approach to integrating the tools into the existing curriculum and combining them with the best non-digital resources. Learning must be central to any task design that deploys LMS features if it is to avoid the sterile fate of most interactive whiteboards and other digital technologies in schools. The success of the tool is also dependent upon the digital infrastructure and the support of devices, another issue that must be addressed by school leadership. A lack of teacher time to master the use of these tools and ineffective TPD will otherwise act as barriers to teachers using the technology to its full potential.

Professional learning communities (PLC) of teachers are structures that bring educators together to improve student learning and are an effective form of TPD. They have been used to develop collaborative learning methods (Sigurðardóttir, 2010) and explore the use of digital tools to enhance classroom practice (Curwood, 2011) in similar projects to this. A review of 13 empirical studies (Doğan & Adams, 2018) found that PLCs have a positive impact on teacher practices and increased student achievement. This is most likely to occur when PLCs; (a) focus on collaboration, (b) have a shared vision and purpose, (c) focus on student learning, (d) make use of reflective dialogue between teachers and (e) have structures to make teaching practice public (Doğan & Adams, 2018). Each of these features of successful PLCs are present within the design of the joint planning activities (see Section III.8 for details) at the heart of this DBR project. The results of these are the design principles which emerged and are made public in Section VI.3 of this report.

II.4.4 Discussion

As outlined in the introduction to this literature review, systematic literature trawls using combinations of technology and pedagogic search terms were conducted on an annual basis between 2015 and 2021. Over that period, 34 papers of note on the topic of Web 2.0 technologies and their potential to support classroom dialogue were found. Much of the research in this area focuses on the effects of technology in the

science classroom; a meta-analysis of 55 primary studies found this to be the most frequently researched subject area when looking at the impact of technology on pedagogy (Wu & Wang, 2016). This is partly due to the emphasis that is placed on critical thinking skills in science curricula and the body of research that demonstrates the importance of social construction to scientific endeavour (Gilbert, 2016).

Given the points discussed earlier in this chapter, it is perhaps unsurprising that another common theme amongst the publications is the importance of effective and integrated TPD to ensure the success of 'e-education' (e.g. Gilbert, 2016). If digital tools are simply forced upon staff by an organisation, or if teachers only feel compelled to use new tools because of social pressure from their colleagues (Moreno et al., 2016) they are likely to be used in closed and unimaginative ways that do not promote new pedagogy or the construction of new knowledge. Often the use of digital technologies such as Google Classroom remains limited, merely digitising resources for existing tasks rather than supporting changes to pedagogy (Voet & De Wever, 2016 and Kong & Song, 2013). Thus, a traditional monologic transmission of knowledge continues to dominate classrooms, regardless of the digital tools at hand. Whilst students may be freed from secretarial tasks, the content they have access to online remains controlled and scaffolded by teachers, many of whom have found that that mobile technologies are ideal for preparing students for "high-stake" summative tests (Burden & Kearney, 2016, p.299). Whilst emerging technologies such as virtual reality (VR) hold great promise for exploratory learning (Fowler, 2015), LMS and Virtual Learning Environments (VLE) are essentially ring-fenced and thus bear little resemblance to the flexible and transient spaces that characterise the online world learners are familiar with (Burden & Kearney, 2016). The education of this generation of students is further complicated by wider paradigm shifts including globalisation and the advent of Web 2.0 technologies. The Web 2.0 is a diffuse concept thanks to the ever changing nature of networked-knowledge and the tools available to access it. However it can be considered to be the sum of the social software, micro-content and openness of the internet in its current state (Rahimi et al., 2015). The non-hierarchical structure of this networked knowledge means that students no longer need to wait for teachers to dole out

information that would be too complex to ever be learned by rote even if they did (Gilbert, 2015).

In light of this, some authors have implored teachers to cede control over digital resources and content in order to encourage the independence and interdependence of their students (e.g. Barak, 2016). These are skills that are more relevant to the contexts in which they live and the workplaces they are likely to enter. For instance, mobile instant messaging (MIM) technology could be employed by dialogic teachers and has been shown to promote reasoned dialogue (Mansour et al., 2015); thanks to its affordances of temporality and multi-modality (Tang & Hew, 2017). Online blogs and micro-blogging applications (e.g. Twitter) have also been demonstrated to provide spaces where effective dialogic interactions can take place (e.g. Cook et al., 2019). A writer's knowledge that their web-based writing is subject to an unpredictable audience may help to hone their critical thinking skills. In addition to online synchronous forums like these, threaded discussions are a common feature of LMS. However, Gao et al. (2013) suggested that these do not foster productive discussion and could be better designed in many cases, in order to promote asynchronous communication; the concern being that participants will most likely pay greater attention to posts according to their chronological order, rather than their content. To improve upon this, it is proposed that LMS forums should enable comments to be linked, visualised and anchored to some central text or resource so that they can be read and added to in context (Ak, 2015). The *comments* function present within the Google Classroom allows for this and has been scrutinised as part of this project.

In the registration document for this project I made extensive use of the term *digital native* (Prensky, 2001) in order to describe students in a contemporary classroom; however, upon further reading, the use of this term was eventually rejected for this study. The term was first coined to describe a generation of students, born after 1980 and the introduction of digital technology into daily routines for whom Marc Prensky proposed that a new form of education, or '*edutainment'* (Prensky, 2001, p.5), would be required to meet their needs. This was founded on the premise that the radical uptake of digital technologies in society

meant that the type of children the (U.S.) education system was designed to cater for no longer existed; that *digital natives'* brains had developed differently to those that preceded them, as they have grown up surrounded by different technologies. It is often assumed that *digital natives* innately possess the skills that will enable them to handle digital tools and the information they provide access to. However, this notion is increasingly discredited and has been described as a form of 'moral panic' (Bennett et al., 2008). In particular fluency with a digital tool does not imply its effective *educational* (versus social) use. Whilst the term has gained popularity in certain areas of policy and practice, a nationally representative survey in the UK (2350 respondents) showed that generation is only one of the predictors of advanced interaction with the Internet; age, experience and breadth of use are also important (Helsper & Eynon, 2010). A recent global survey of over 20,000 teachers from 165 countries across the world by T4 Education (Pota et al., 2021, in press) yielded the counter-intuitive finding that the most experienced teachers – those with 21-30 years teaching experience – used digital tools the most during the pandemic. They taught more classes online and deployed the most sophisticated and creative types of remote teaching. The authors concluded that this finding was likely related to their greater skill and confidence in the craft of teaching and their understanding of how children learn; they were most able to adapt their pedagogy to the advent of the new tools and approaches for remote learning. Meanwhile, personal ownership of hardware and internet confidence have been demonstrated to be poor indicators of information literacy (Šorgo et al., 2016). This reinforces the conclusion that technological fluency must be deliberately incorporated into curricula; it is not a skill that is naturally acquired and will impact the effectiveness of any digital tools that are intended to enhance learning.

This literature review has served to demonstrate the advantages of dialogic pedagogy in the social construction of knowledge and the relevance of this approach when working with contemporary learners. Due to the networked form in which knowledge now exists, information is too complex to be learned by rote. It is therefore churlish for educators to continue to focus on the vertical transmission of prescribed facts. Instead, students should be empowered to become stakeholders in knowledge, taking an active part in its co-construction through dialogue. Taking part in dialogue also expands the thought repertoire

of participants as they are exposed to the reasoning of others, which they in turn internalise (Vygotsky, 1978) and use to reflect upon and refine their own stance.

The appropriate use of digital technology has the potential to shift classroom learning from an emphasis on rote learning of content towards the acquisition of higher order thinking skills; but the quality of learning will be influenced more by instructional design than any one technology (Jung & Latchem, 2011). Given the likelihood that teaching and learning will be increasingly mediated by LMS in the future, the nature of the dialogue that can be conducted within these systems is of great importance. The internet is arguably the most disruptive technology to education since print technology became widespread in Europe in the fifteenth century; when Johannes Gutenberg first introduced the movable-type printing press. Print technology moved education away from an oral tradition towards the mass transmission of reproducible and standardised knowledge artifacts. Modern Web 2.0 technologies can reproduce and transmit these artifacts exponentially faster than print media, but they also have social features that reintroduce the fluidity of socratic oracy to the information. Dialogue can now be enriched by and anchored to flexible digital media that is endlessly augmented, edited and recontextualised by the user and LMS are an example of a digital space where this can occur; providing users with infinite time to respond to and reflect upon the different perspectives of others. As such, they provide an almost tangible form to dialogic space-time (Wegerif, 2013).

Dialogic pedagogy can be supported by digital technologies but this must be planned for by practitioners with dialogic intentions (Warwick et al., 2020). If students are to access and construct knowledge together within Google Classroom, the affordances that the LMS might have to support dialogue must first be identified and exploited by their teachers. In keeping with the principles of social constructivism, the methodological design of this study (see Part III for details) included means of engaging with fellow practitioners in Professional Learning Communities (Doğan & Adams, 2018). The focus of these collaborations was to design and refine novel uses of Google Classroom to document some of the affordances of the LMS to support reflective dialogue.

Part III: Methodology

III.1 Introduction

As highlighted in the literature review that supports this project (see Section II.4.3), Learning Management Systems (LMS) are now widely used to curate and support digital learning across the world. Whilst these platforms have been introduced into the lives of many practitioners and students, perceptions of convenience and the demand for remote learning solutions, accelerated by the Covid-19 pandemic, are more likely to be the reason for their introduction; rather than to meet an existing pedagogical need. As the presence of LMS is likely to prove disruptive to any educational setting they are found in, their potential to promote or constrain established and effective pedagogies, such as dialogic teaching, is worthy of exploration.

The tool under scrutiny in this study is the Google Classroom platform, a LMS that had “more than 10 million users” (Google for Education, 2015) when data collection began in 2017. By February 2021, usage had risen to “more than 150 million” students (Google, 2021a). 40 million were added in the previous twelve months alone as educators looked for remote learning solutions during the Covid-19 pandemic. Google Classroom is a free to use, web-based technology that allows teachers and students to access the G Suite for Education (formerly Google Apps for Education) and to store their work in the cloud-based Google Drive. This study focuses on the ways that LMS, and the affordances of Google Classroom in particular, can support dialogic pedagogy. This approach to teaching and learning stems from social constructivism and is underpinned by the notion that it is through dialogue with others that new meaning is co-constructed (Bakhtin, 1981) and learning takes place. The methods employed in this study were selected to explore how dialogue can be promoted in classrooms where the digital tools of the Google Classroom LMS are at hand.

The setting for this project was an independent, co-educational preparatory school in East Anglia, for children aged 4-13. Students attending the school tend to come from affluent homes with parents employed in the quaternary economy; none of those enrolled when data collection commenced were eligible for free school meals. In the school's last integrated inspection prior to the data collection, the quality of the pupils' achievement and learning was graded as *'exceptional'* by the Independent Schools Inspectorate (ISI). The school makes use of a wide range of ICT, with tablets (Apple iPads) predominantly used with younger children (4-9 year olds) whilst laptops (Google Chromebooks) are used with older year groups (9-13 year olds). The school includes some 'paperless' subject departments including science, the subject I was head of when this project began, and others that make little use of digital devices. Meanwhile, many staff at the school choose to provide a mix of traditional paper-based work and digital activities for their students. This range of approaches by different subject departments, year groups and teachers makes the school a useful location to explore the affordances of a LMS to support dialogic learning. Furthermore, the school development plan places an emphasis on promoting the critical thinking skills of the children (Dawes, Mercer & Wegerif, 2004) and the importance of collaboration in the creation of new knowledge; aims which are broadly aligned to the dialogic pedagogy under investigation. Whilst the teacher participants in this study shared this pedagogical outlook, the different subjects they delivered and their individual approaches to using Google Classroom allowed more generalizable affordances of the LMS to support dialogue to be investigated.

III.2 Research questions

As discussed in Section I.2, this study was designed to address the following:

> **RQ 1. What affordances do LMS (specifically Google Classroom) provide for the teacher mediation of dialogic learning?**
> **RQ 2. Do LMS open up new spaces for dialogue?**
> **RQ 3. What is the nature of interaction within a LMS?**

III.3 Project outline

Given the sociocultural factors at play when dialogue takes place in a classroom (as discussed in Section II.2), be that in person or online, a mixed methods design was determined to be the most appropriate means of investigating the research questions of this project. Mixed methods research is a paradigm of sociocultural studies that rejects the dichotomy between qualitative and quantitative data collection (Tashakkori & Teddlie, 2010); it is pragmatic and recognises that a single method of data collection would only lead to partial understanding of social phenomena (Greene, 2008). In this instance, a convergent parallel mixed method design (Teddlie & Tashakkori, 2009) was applied that leveraged a range of data collection instruments. Qualitative and quantitative data was gathered concurrently during this study and was equally prioritised during the analysis (Creswell & Plano Clark, 2011). The coding of audiovisual transcripts and student work from Year 7 (11-12 years old) lessons generated quantitative data that allowed the frequency of different dialogic moves to be readily compared between groups. Meanwhile, qualitative data gathered during each phase, including questionnaires, interviews and minutes from joint planning meetings, ensured that the social context in which the dialogues took place was also accounted for (Mercer, 2010). The findings from these overlapping methods were then integrated to produce 'meta-inferences' (Teddlie & Tashakkori, 2009); conclusions drawn from both the quantitative and qualitative data that confirm and support one another.

In keeping with design-based research (DBR; Brown, 1992) this project was designed to be an iterative process (Cobb et al. 2003); as such, design principles were refined during and between each phase. A total of three phases of implementation, analysis and refinement was conducted. Following each phase of data collection and analysis, provisional theories to account for the observations were postulated. The refinements and provisional theories put forward were built upon in subsequent phases of the DBR project. At the end of the process, provisional theories were integrated with one another and supported with longitudinal

data from across the phases to generate the final design principles reported in Part VI of this document.

III.4 Rationale for design-based research

The goal of DBR is to generate theory and actions that make a difference to real world problems. This form of research makes limited use of quantitative methods and is better suited to projects that focus on one aspect of pedagogy (Haßler et al., 2016), such as the dialogic interactions scrutinised here. Another framework that was considered for this project was case study (Basey, 1999), the strengths of which are the acknowledgement of the complexity of the situation under scrutiny and the embedded nature of knowledge. As artifacts, case studies are rich records and provide the opportunity for further interpretation but their goal is not to produce knowledge that can be readily applied elsewhere. There is a "tension between the study of the unique and the need to generalise" (Simons, 1996 p.237) and whilst multiple case studies can be conducted in a setting typically, generalising from any single case is not possible.

In many ways, DBR is similar to action research, another research paradigm in which professionals and practitioners seek to improve the quality of education within their own setting (Koshy, 2010). Like DBR, action research is a cyclical process involving action, evaluation and reflection. It is conducted by individuals who collaborate towards a shared goal, including students themselves (Nel, 2017). It is an ongoing process in which the practitioner constructs their own knowledge and improves their own practice; as the action evolves, contextual solutions emerge. Whilst action research has been used to answer questions in the field of educational technology, and has an emphasis on action and change in a particular context (Guldberg et al., 2017), its main aim is not to provide transferable knowledge.

The reason a DBR, rather than an action research or case study approach was applied to this project, was the ambition to develop design principles that can be applied elsewhere. This project embeds elements of case study within each phase of the DBR, describing the context and knowledge that practitioners bring to the design

so that emerging design principles can be clearly described and the reasons for their emergence theorised. As a practitioner-researcher, I was keen to improve my own dialogic pedagogy and better leverage the tools of the Google Classroom LMS at my school. However, the theory and knowledge generated by this project should be applicable to a wider range of settings, especially given the ubiquitous use of the platform in question.

The reflexivity and co-construction of designs during the joint planning meetings that are central to this project are themselves in keeping with a dialogic epistemology or *dialogism* (Linell, 2002). As an *insider* (Merton, 1972) practitioner-researcher, I have worked closely with colleagues and students to develop context specific solutions that can increase the frequency of classroom dialogue when applied in my own school. In so doing, we acted as *designers* (Wang & Hannafin, 2005), working towards the generation of transferable knowledge that could be of help to other practitioners in similar settings. Indeed the DBR process used here, could itself be applied elsewhere to generate new context specific designs for dialogue in a LMS. Alternatively, the design principles reported here (see Section VI.2) could be incorporated into a future engineering-based research (EBR) design (Burkhardt & Schoenfeld, 2003). In this process, the outcomes of small-scale DBR projects such as this one undergo a cycle of scaling across multiple settings, in order to confirm and disseminate the theories produced and include a greater number of relevant perspectives in their co-construction and refinement (Haßler et al., 2016).

III.5 Defining design-based research

Design-based research (Brown, 1992) (DBR) is a systematic approach that aims to improve educational practices in real world settings through iterative cycles of design, implementation, analysis and revision (Cobb et al. 2003). In keeping with my own research stance, DBR tends to strongly feature collaboration between researchers and practitioners (Major et al., 2015). It is an approach that accounts for the fact that most teachers are unable to conduct rigorous research while researchers often lack contextual understanding of educational settings (Anderson &

Shattuck, 2012). Collaboration with practitioners counters this and it is through their intimate knowledge of a unique setting that DBR draws its validity (Anderson & Shattuck, 2012) and an alignment of theory and practice is possible.

The strength of DBR lies in its adaptability (Herrington & Kervin, 2007), allowing it to be applied to unique contexts. Primarily, it has been used to develop small-scale interventions that have an impact at the level of individual practitioners and settings, often where digital technology is involved (Anderson & Shattuck, 2012), making it an ideal framework for this practitioner-research project. The aim of DBR is not to improve practice directly, but to generate a set of *design principles*, evidence-based heuristics that may not be optimal but are effective within the context that gives rise to them (The Design-Based Research Collective, 2003). These design principles explain why a design works and how it might be adapted to new circumstances (Cobb et al., 2003). Ann Brown (1992), the American researcher who first described the methodology, noted that “an effective intervention should be able to migrate from our experimental classroom to average classrooms” (p.143). As such, DBR serves more than its immediate setting (whilst remaining contextualised); it is a way in which theory is put to work (Cobb et al., 2003).

As a methodology, DBR is not without its flaws; largely due to the complexity of the contexts in which it takes place (Kelly, 2004). The messy, non-laboratory setting (Collins, 1999) of this DBR project is precisely what makes the findings relevant to practitioners; but it is also the source of a myriad of variables that will have impacted the findings. To mitigate this, the context of each phase of data collection has been detailed in order to improve its user generalisability (Winterbottom, 2017). A quasi-experimental structure was also applied to each round of joint planning activities; with *standard* and *augmented* lessons being delivered by each practitioner (see Section III.8 for details). By observing two lessons from each teacher in each phase, the impact of our task designs on the frequency and nature of dialogic moves could be better assessed.

III.6 Conjectures

DBR is founded upon a series of theory-based conjectures to be tested and refined. These conjectures are formed following assessment of the local context and relevant theory (Anderson & Shattuck, 2012). Conjectures lead to agreed interventions by collaborators which are then implemented (Herrington & Kervin, 2007) and assessed using multiple methods for data collection (Anderson & Shattuck, 2012). As outlined in the introduction to this methodology (see Section III.1), this study is an exploration of the affordances of a Learning Management System (LMS) that support dialogue. Three research questions (RQs) were mooted and from these, initial conjectures to be tested were formulated (see Table 3.1):

Table 3.1: Initial conjectures (based upon the EdD project research questions).

Research Question	Initial conjectures to be tested
1. What affordances do LMS (specifically Google Classroom) provide for the teacher mediation of dialogic learning?	Google Classroom has affordances supporting the teacher mediation of dialogic learning.
2. Do LMS open up new spaces for dialogue?	Google Classroom opens up new spaces for reflective dialogue to occur in.
3. What is the nature of interaction within a LMS?	Interactions within Google Classroom are *infinalisable* (the gap between perspectives remains open) and demonstrate *interthinking.*

The conjectures outlined above were tested in each phase of the project using a parallel mixed method design (Teddlie & Tashakkori, 2009). In Phase 1, teacher and student questionnaires were used to generate an informed view of the research context (see Fig. 3.1). Other data gathered during the first phase included video recordings of observed lessons, student work, interviews and minutes from joint

planning meetings (see Fig. 3.1); a process repeated for each subsequent phase. The wider DBR framework for this project is outlined in Figure 3.2.

The *Design-Based Research Collective* (2003) outlined the features of good DBR in which the development of both design and theory are intertwined and take place in authentic settings. The framework for this study enabled this to occur through three phases of implementation, analysis and refinement. The use of mixed methods to generate a variety of data helped to ensure that the context and limitations of any empirically grounded claims are made explicit (Cobb et al., 2003) in the findings. A 'fourth phase' of *final theorizing* was then undertaken in order for the design principles to be crystalised. These are not truly generalizable outcomes but reflect and are molded by the conditions in which they were generated and can be modified and applied elsewhere (Anderson & Shattuck, 2012), as such they have user-generalisability (Winterbottom, 2017).

Furthermore, in order to account for the contextual nature of these design principles it is important that the time and commitment required to implement these was documented throughout the process in order that others may better apply the intervention in their own contexts (Anderson & Shattuck, 2012). I had previously suggested that my research position would be *socially invisible,* as I was a fellow teacher of the children at the school (Denscombe, 2007), and that the data collected would be naturalistic. Not only do I now appreciate the folly of this statement but having further appraised DBR as a framework I am aware that this entangled practitioner-researcher position is a strength of the approach. It was thanks to these dual roles I was better able to contextualise the data collected and generate design principles. However, this privileged position of *insider researcher* (Merton, 1972) did present specific ethical considerations and a duty of care that needed to be accounted for when designing the study (see Section III.11 for details). Whilst making wholly generalisable assertions is not possible, the detailed descriptions of the context each phase of this study took place in (reported in Part V) should help others to apply (with modification) the heuristics generated by this project for themselves.

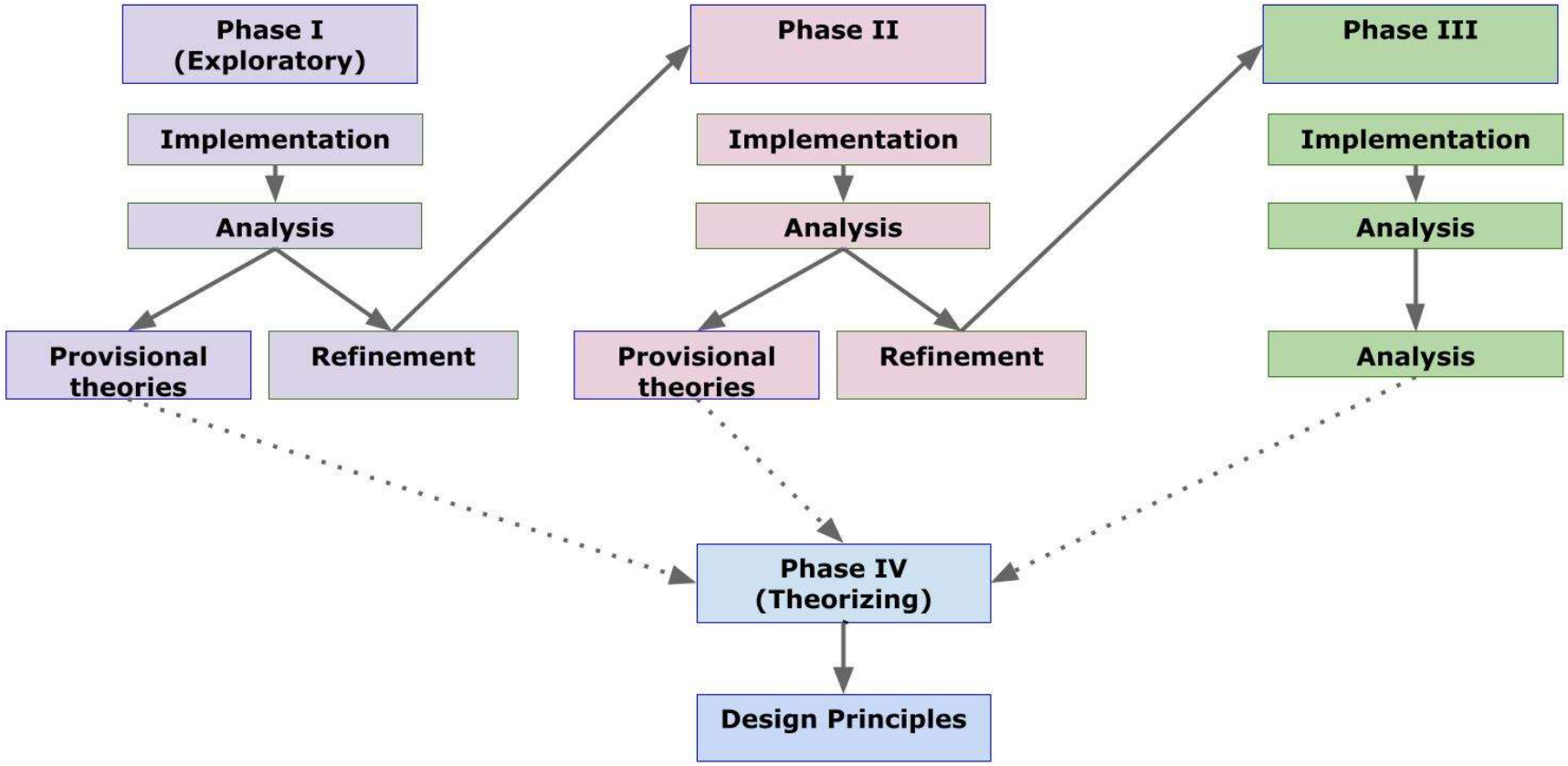


Figure 3.1: Summary of Phase 1 data collection.

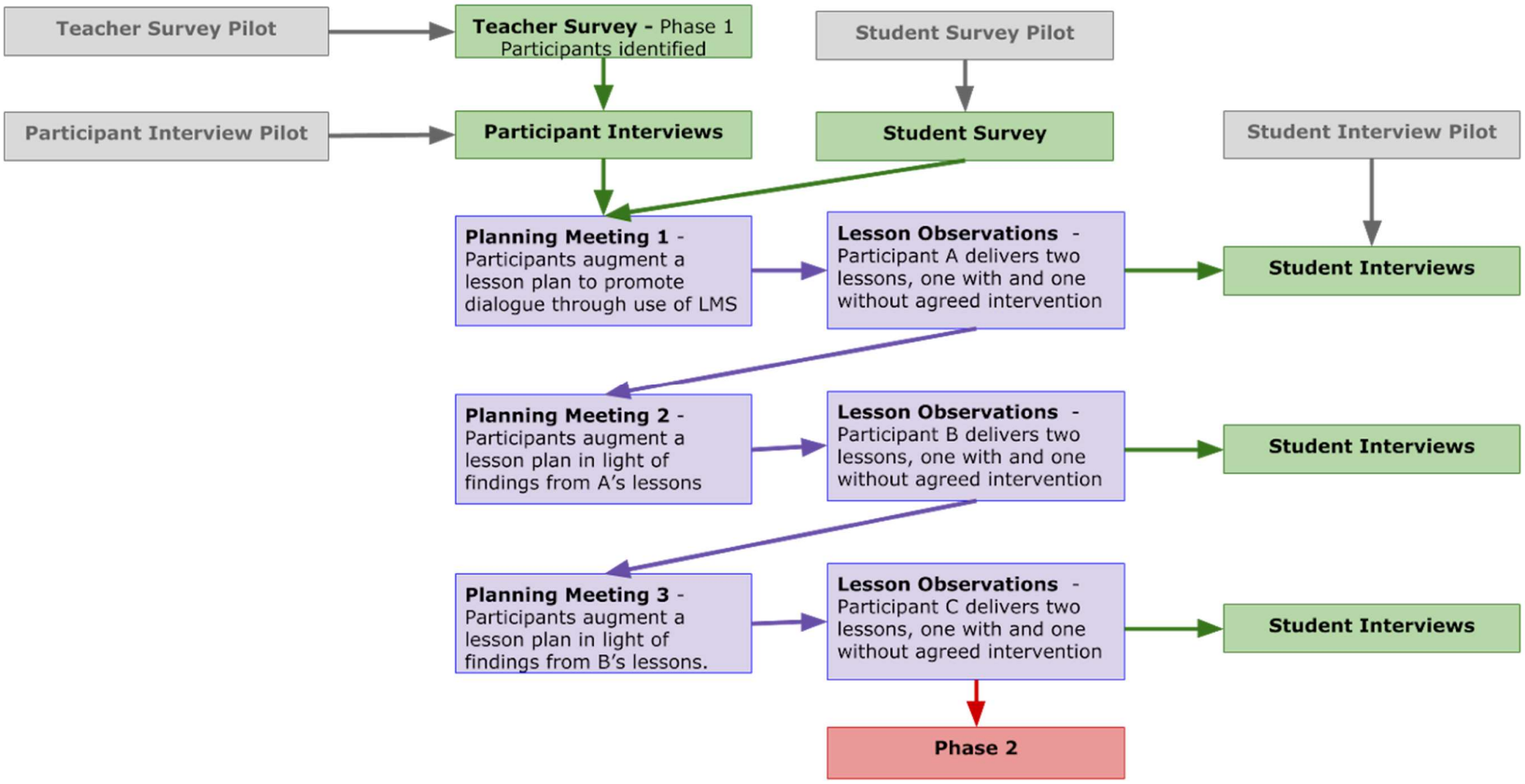


Figure 3.2: Summary of the DBR framework applied to the main study.

III.7 Data collection

III.7.1 Instrument selection

When participating in a dialogue, knowledge construction takes place in different participants at different times and to varying degrees. Whilst utterances can be directly observed, any cognitive change they lead to cannot. At best we can only hope to *approximate* the impact of dialogic pedagogy on a student in a given context. Consequently, a mix of approaches was selected for this project, in order to triangulate the findings and better produce heuristic design principles from the data (see Table 3.2 for a summary of the mixed methods used). These include a teacher questionnaire devised to better understand the prevailing beliefs about classroom technology and teachers' attitudes towards dialogue (see Appendix 1). Two respondents were then invited to become teacher *co-researchers* in each phase of the project. Selection criteria were that their self-reported attitudes towards dialogue (and use of Google Classroom) were in keeping with the aims of this study and they were teachers of Year 7 (11-12 year olds) classes, the focus group of this project. Initially, five teachers met these criteria. Their invitation to take part in the first phase of the project, or not, was based on the compatibility of their schedules with my own in order for the joint planning meetings to take place. This stratified purposive sample strategy (Teddlie & Tashakkori, 2009) ensured that only *knowledgeable* individuals were sampled (Cohen et al., 2018) and that their professional interests and outlook aligned with the aims of the study.

Table 3.2: Phases 1-3 data collection summary.

RQ(s)*	Method	Sample	Phase(s)
1	Teacher questionnaire	All teaching staff (n=70).	1
1	Student questionnaire	Year 7 cohort (n=60).	1
2, 3	Audiovisual recordings of observed lessons	Recordings of whole class interactions (and 3 small groups) in observed lessons (x6).	1, 2, 3
3	Student work	Digital media from 3 small group tasks in observed lessons (x6).	1, 2, 3
2, 3	Student interviews	One child from *augmented* lesson selects two same-sex friends for joint interview (x3).	1, 2, 3
1, 2	Teacher interviews	Joint planning participants interviewed (x2).	1, 2, 3
1, 3	Minutes from joint planning meetings	Written documents from joint planning meetings (x3).	1, 2, 3

*Research Questions (RQs) as outlined in Section III.2.

During the *Joint Planning Activities,* the participants co-constructed interventions that were trialed with Year 7 classes at the school (see Sections V.1.3, V.2.3 and V.3.3 for details). The teachers were observed delivering two lessons each, one as they would have typically planned it and, subsequently, an *augmented* version based on the joint planning meetings, with the aim of improving the quality and quantity of classroom dialogue within the framework of Google Classroom. This joint planning process was repeated in each of the project's three phases in order to generate and confirm the design principles that emerged. Following each meeting, minutes (see

Appendix 2 for example) were distributed to participants to confirm the agreed actions, and that the notes taken by the researcher accurately represented the intent and ideas of the participants. In keeping with the epistemological framework of *Dialogism* (Linell, 2002) discussed in Section II.1, by engaging in reflective dialogue, the practitioner-researchers were able to socially construct authentic tasks (Herrington & Parker, 2013) within the LMS. The Joint planning meetings also engendered reflexivity within each teacher as they shared and built upon one another's professional knowledge (Wilson, 2017a). In Phases 1 and 2, in addition to myself, two fellow teachers took part in these joint planning activities. However, during the 2019-20 academic year, when Phase 3 of the data collection took place, I was no longer a teacher of a Year 7 class and an additional teacher (meeting the same criteria) was invited to take part, although I did continue to play an active role in the joint planning meetings.

Three semi-structured interviews with same-sex student triads and separate teacher interviews (with each of the joint planning participants) were also conducted in each phase (see Appendices 3 and 4 for sample transcripts). The purpose of these was to explore the understanding and beliefs of actors within the school, the perceptions of whom enabled the design principles to be better described and any *a priori* conjectures to be confirmed or rejected. Prior to Phase 1, pilot student and teacher interviews were conducted in order to refine the interview protocols. These provided useful data which informed the design but, like the pilot student questionnaire, were not part of the main data collection. Participants in these pilot activities took no further part in the project (see Part IV for further details).

III.7.2 Teacher questionnaire

Surveying the opinions and experiences of teachers working at the setting of this DBR study was central to establishing the culture of the school and to better describe the design principles that emerged. By canvassing the teachers' professional knowledge at this exploratory stage, potential *affordances of Google Classroom that might provide for the teacher mediation of dialogic learning* (RQ. 1)

were also identified and informed the design of the classroom interventions generated in the joint planning activities (see Section III.8). Prior to Phase 1 of the main study, a questionnaire was devised to better understand the prevailing beliefs about, and use of, technology at the school in addition to the teachers' attitudes towards dialogue and collaborative learning (see Appendix 1). Questions exploring the teachers' underlying approaches to using educational technology were based upon the three modes of technology use described by Haßler et al. (2016); support, extension and transformation. In this instance, novel transformative classroom practices that would not have been possible without educational technology, and Google Classroom in particular, were of great interest. Statements asking for the respondents' level of *agreement* were designed and a 5-point Likert scale provided; strongly agree, agree, undecided, disagree and strongly disagree. The neutral, 'undecided' option was included in this scale so that respondents were less likely to report agreement or disagreement with a statement that they might actually have little knowledge or experience of, increasing the overall validity of the questionnaire (Cohen et al., 2018). Negatively worded statements were also included to counter potential 'respondent fatigue' (Lavrakas, 2008) to predictable patterns within the questionnaire; which might otherwise have led to invalid responses.

Statements exploring the different ways that teachers made use of educational technology to plan and deliver lessons were also generated, based upon my own experience of using digital tools at the school. These were supplemented by other examples of education technology use from the extant literature discussed in Section II.3.3 (e.g. Herrington & Parker, 2013) and provided exhaustive coverage of the subject (Cohen et al., 2018). A 5 point Likert scale with specific boundaries between the options (e.g. 'More than ⅔ of lessons' as opposed to 'often') was provided to reduce the potential ambiguity of responses to these statements whilst estimating the extent of the use of different technologies at the school. These statements were then rephrased, to establish the teachers' expectations of their students' use of the same technology, as these were not necessarily the same as their own, revealing gaps in the tool use which the co-researchers might later leverage in their joint planning activities (see Section III.8).

The initial design was piloted with three volunteers from my EdD research community and led to the rewording of some statements for clarity and the addition of three open-ended questions, so that any unanticipated answers teachers wished to provide could be recorded. This gave teachers greater ownership of the data they chose to submit, whilst offering the possibility of new lines of inquiry to the study (Krosnick & Presser, 2010). The questionnaire was then distributed to staff at the school using a *Google Form* following a short presentation delivered at a staff meeting in January 2017. To provide context and to further outline the rationale for the project, a copy of a poster I presented at the 2016 Cambridge EdD conference (see Appendix 7) was distributed at the same time as the questionnaire. A total of 25 responses (from a possible 70, a response rate of 36%) were received, representing teachers of children from Year 1 to Year 8 and all of the specialist subjects taught at the school. Responses were reviewed for internal logic and distinct patterns (Warwick & Chaplain, 2017) and none were rejected. In addition to generating an informed view of the research context, the teacher questionnaire also allowed suitable participants for the joint planning activities to be identified. Respondents who reported that they (a) 'strongly agree' that promoting dialogue between children in their subject is important, (b) 'agree' that educational technologies fit their subject and (c) use Google Classroom regularly were identified as potential participants for the DBR project. Further details and the findings of this questionnaire are reported in Section IV.1 of this report.

III.7.3 Student questionnaire

To establish the students' experiences of digital technology usage at the school, questions from the teacher questionnaire were reworded to create a draft survey for this new audience. Statements exploring the extent of the students' use of different digital tools during lessons, including features of the Google Classroom, were provided. These initial statements were then repeated to explore any differences in usage of the same tools for homework tasks. Statements based on the *Thinking Together Programme* (Dawes et al., 2004) were also included to canvas the

students' opinions about the use of talk as a pedagogical tool, and the extent to which they experience the use of this by different subject specialists at the school.

A pilot questionnaire was conducted with students in Year 8 of the school in March 2017. Following a short verbal introduction, the questionnaire was delivered using a *Google Form*, a format that the children of this year group were familiar with. A total of 51 responses were recorded from the year group which comprised 59 students. This pilot helped to refine the design of the student questionnaire (see Appendix 8) including the clarification of certain statements. For instance, mention of *Google Slides* was added to questions asking how often the students "create web pages or blogs" to present their work in lessons and for homework. The use of Google Slides was reported to be a common practice by the respondents to the pilot questionnaire, whilst few were asked to blog or create web pages by their teachers at this time. Including context-specific examples increased the likelihood that a student would interpret the statements as intended and provide a valid response. In April 2017, the refined questionnaire was administered to the Year 7 cohort at the school who would become the focus of the interventions of Phase 1 (reported in Section V.1.3). This was an unusually small year group within the school and 36 responses were gathered from the 42 members of the cohort. Further details and analysis of this questionnaire can be found in Section IV.2 of this report.

III.7.4 Teacher interviews

Teacher interviews helped to colour the findings of this project by revealing some of the social factors that influence the use of dialogue in their teaching, such as the shared history of the participants and the prevailing attitudes towards the Google Classroom LMS. A semi-structured interview protocol was used in order to provide the flexibility to respond to respondents' comments, to clarify ambiguity and bring to light unanticipated knowledge (DiCicco-Bloom & Crabtree, 2006). This approach also allowed for an interviewee's interpretation of a question to be explored with follow-up questions and tangential information to be collected (see Appendix 6 for protocol); giving the participants scope to ask questions of their own about the study. A pilot

interview was conducted in March 2017 (adapted from Voet & De Wever, 2016) with a member of staff who wished to take part in the study but was due to leave the staff later in the academic year. The interview focused on the practitioner's attitudes towards the use of technology (specifically Google Classroom) in the classroom and teaching approach and the semi-structured approach gave a great deal of latitude to the interviewee (Packer, 2011) whilst maintaining trust and informality (Warwick & Chaplain, 2017). Further details and analysis of this interview are reported in Section IV.3 of this report.

In addition to refining the teacher interview protocol, feedback following the pilot interview helped to modify the researcher's approach and establish the following principles for subsequent interviews:

- Repeat or reword questions as necessary to keep the interview focused.
- Pre-warn the interviewee that you may interject and do so as necessary.
- Provide subjects with a brief summary of the areas to be covered in advance.

All interviews were recorded using a smartphone dictaphone app in a comfortable, neutral meeting space at the school that all participants were familiar with. Interviews with the teacher participants (seven in total) took place before the first joint planning meetings in each phase of the project.

III.7.5 Student interviews

Interviews of children took place following each of the *augmented* lessons of the main study (nine groups in total). Within each phase, a child with the highest, lowest and median Cognitive Reasoning Test (CAT4, GL Assessment) score was selected for an interview following the three augmented lessons. CAT tests are completed on an annual basis at the school and this strategy was employed so that the voices of children with a range of academic profiles were recorded; to act as a representative sample of the students at the setting. The children were then asked to invite two friends to join them in single-sex triads. This was based on the finding of Light et al.

(1994) that talk between socially cohesive groups results in better reasoning and is therefore a productive interview method (Hopkins, 2014). In each case, a semi-structured interview lasting no more than 15 minutes (with a mean duration of 14 minutes) was conducted in a comfortable, neutral meeting space and recorded using a smartphone dictaphone app. The interviews focused on the children's experiences of educational technology in their lessons and the use of talk to support learning. In particular, the children were invited to reflect upon the subject they had been observed in, and artifacts from the observed lessons (Google Classroom screenshots, photos, IWB presentations etc.) were used to elicit memories of the group discussion task. As with the teacher interviews, the semi-structured protocol allowed for items to be repeated or rephrased if the students were unsure of a question and gave them scope to ask questions of their own about the study. In May 2017, a pilot interview was conducted with three Year 8 boys (13 years old), further details and analysis of this pilot interview are reported in Section IV.4 of this report whilst findings from the student interviews of Phases 1-3 can be found in Section V.

III.8 Joint planning activities

As described in Section II.4.3 of this document, teacher professional development (TPD) was an important consideration in order for the affordances of Google Classroom to promote dialogue to be recognised and developed within the school. In each phase of this participatory DBR project, I invited colleagues to become co-researchers with myself, in order to co-construct novel dialogic activities for Year 7 children at the school which leveraged the tools of the Google Classroom. The success of these interventions was then reviewed in the subsequent joint planning meeting before augmenting the next participant's lesson plan (see Fig. 3.1). By working with colleagues to develop interventions that serve their dialogic intentions (Warwick et al., 2020), the teachers supported the professional development of one another and ultimately, developed tools that the participants themselves were willing and able to adopt (Penuel et al., 2011). This approach was inspired by Lesson Study (LS), a teacher learning process practised since the 1870s in Japan which has since spread globally (Dudley, 2013) and is rapidly becoming one of the most adopted

TPD models (Warwick et al., 2016). Typically in LS, teacher-researchers consider the aims of a lesson and collaboratively plan actions to improve learner outcomes in an agreed way. This is then followed by the focused observation of specific pupils taking part in the planned activity and a followed up with a reflective meeting. A new LS cycle then begins with another joint planning meeting and a new collaboratively planned lesson, building upon findings from the first activity. Lesson Study has been demonstrated to have led to improvements in the quality of classroom instruction in a range of settings (Dudley, 2015) by developing teachers' professional knowledge (eg. Lewis, 2009 and Ylonen & Norwich, 2012), self-efficacy (e.g Chong & Kong, 2012 and Sibbald, 2009) and by shaping communities of practice in which teachers can share knowledge and experiment with new ideas (eg. Lewis et al., 2009). This approach to TPD, based on collaborative learning between teachers (DeLuca et al., 2017), is cost effective, rewarding and tailored to the participants; in keeping with the participatory nature of this DBR project.

The joint planning activities that occurred in each phase of this project followed a similar pattern to Lesson Study; however, there are some important distinctions. Firstly, the participants delivered two Year 7 lessons each, one as they would have typically planned it and subsequently, an *augmented* version based on the joint planning discussion; with the aim of improving the quality and quantity of classroom dialogue within the framework of Google Classroom. In a typical Lesson Study, only the *augmented* version would have been delivered. Secondly, when lessons were observed during this project only the lead teacher and researcher were present. In a typical Lesson Study, all teachers in the study group would have been present and charged with observing one specific case pupil each, having first predicted the impact of the intervention upon them (Dudley, 2014). In this methodology, no specific case pupils were identified. Instead, participants focused their observations on the nature of dialogue within (and around) the LMS whilst recordings of small group tasks were used for parallel analysis by the researcher. Finally, the structure of the planning sessions differed from that of LS; mindful of the bureaucratic load placed upon participants, the reflection and planning activities were conducted in the same meeting. This limited the opportunity for collaborators to research the relevant

theory, on dialogic pedagogy, independently but resulted in the development of an organic and novel set of interventions through the cyclical DBR process. As with the student interviews, reflections from the participants were elicited during these planning meetings using artifacts and quotes from the observed sessions resulting in a rich dialogue between the participants. Following each meeting, minutes were distributed to the participants to ensure they reflected the intentions and ideas of the group. In the second and third phases of the project, audio recordings (using a smartphone dictaphone app) of the joint planning meetings were made to further verify and confirm what was discussed.

Audiovisual recordings were made in all observed lessons during the project, with three small cameras or dictaphones used to capture small group interactions and one camera used to record the class as a whole. In order to obtain naturalistic video evidence, the equipment used was installed in advance of the sessions that were recorded, to attenuate students and teachers to the presence of the technology and reduce the possible impact it might have had. Observations commenced in a subsequent lesson with the class, once the teacher was confident that the classroom behaviour had returned to normal (Hopkins, 2014). A Google Chrome extension (Screencastify) was initially used to capture the on-screen actions of children when using the Google Classroom. However, the use of this browser extension proved disruptive to those children asked to activate it in the first observed lesson of the project. Whilst, the researcher and first participant of Phase 1 were confident that this was not the primary reason for the reduction in dialogic moves observed between the *standard* and *augmented* lessons (reported in Section V.1.4), the tool was not used for subsequent lesson observations. Transcripts of verbal interactions, in addition to comments and artefacts (both digital and on paper) generated by the students, were then analysed using an adapted version of the Cam-UNAM Scheme for Educational Dialogue Analysis (SEDA, Hennessy, et al., 2016). This analysis approximated the frequency of dialogic moves that participants made during the focus tasks and allowed for comparisons between *standard* and *augmented* lessons to be made (see Section III.9.2 for further details).

Year 7 students at the school are predominantly taught in classes that are set by prior attainment in English, maths and science. Whilst these were not necessarily the subjects being observed in each phase of this study, the setting arrangements meant that it was not always possible to observe groups of a similar academic profile being taught by each teacher, as demonstrated by the range (105-129) of mean Cognitive Reasoning Test (CAT4, GL Assessment) scores for each class (as reported in Sections V.1.3, V.2.3 and V.3.3). To reduce the possible effects of this on the frequency of dialogic moves made by groups during the focus tasks, the co-researchers delivered an equal number of *standard* and *augmented* lesson plans to 'top' and 'parallel' (or 'lower') sets and over the three phases of the project.

III.9 Data analysis

III.9.1 Analysis of interview data

Transcripts of all interviews were prepared using an artificial intelligence based transcription service (Go Transcribe) to create drafts that were then reviewed and refined by the researcher using InqScribe (version 2.2.4.262) software. During the transcription process, the following notations (adapted from Jefferson, 2004) were used in an effort to convey not only *what* was said but *how* it was said and to provide further context:

Table 3.3: Notation used in the preparation of interview and audiovisual transcripts, adapted from Jefferson (2004).

Symbol	Description
[2+]	A pause of at least 2 seconds.
(text)	Speech which is unclear or in doubt.
((text))	Annotation of non-verbal activity.
CAPITALS	Utterance that was said loudly or shouted.
...	Utterance that tails off before a statement is completed.
[X]	Reference made to another (anonymised) individual.

Pseudonyms were provided for all adults and student names were anonymised. Each transcript was then coded by reading each line in turn and noting where an utterance provided evidence for any of the pre-selected *a priori* themes (see Table 3.4). These themes were based on the affordances of technology (as discussed in Section II.4.1) to enhance dialogue, as described by Major et al. (2018) and the common affordances of technology for dialogue presented by Hennessy (2020). In tandem with this process, as each line was read, key words and phrases were noted and possible *emerging* themes identified within each transcript (see Appendix 9 for an example). As illustrated in Figure 3.3, each interview was then reviewed to look for further evidence that may have been overlooked in the text upon first reading. Where multiple utterances were found to support a potential theme, it was taken forward to the analysis of the next transcript under scrutiny and looked for alongside the *a priori* themes (see Table 3.4) and any other previously established *emerging* themes. Where new potential themes were identified in later transcripts, previous interviews in the same phase were reviewed to look for further evidence.

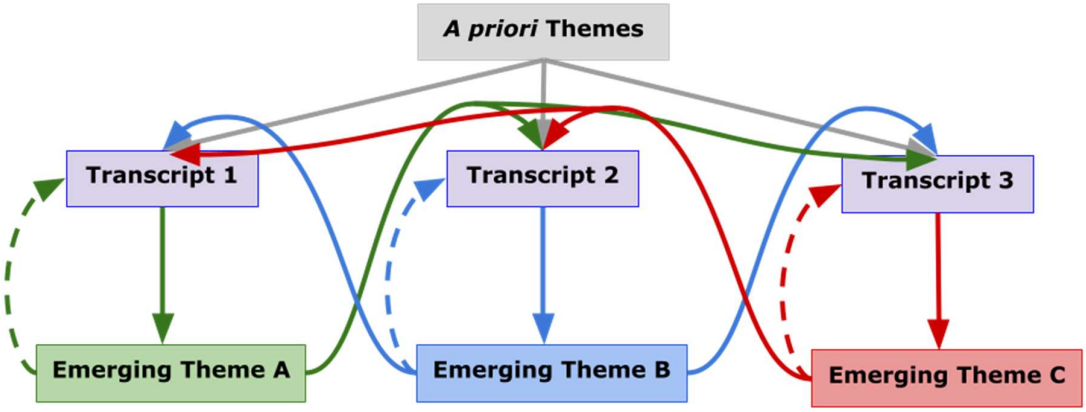


Figure 3.3: Illustration of the thematic analysis of interview transcripts within each phase (adapted from Bryman, 2008).

Once all of the transcripts in each phase had undergone this initial thematic analysis (Bryman, 2008), all of the *emerging* themes were reviewed and similar codes combined to eliminate repetition. Themes were also eliminated or accepted depending on their relevance to the research questions of this project (see Section III.2). At this stage it was important to apply each code in a standard way and each of the transcripts underwent a final review with definitions and key words at hand (see Table 3.5). Participating teachers have been given the opportunity to review and validate the analysis of their interviews, and the wider findings, from the phase they contributed to; as reported in Part V of this document.

Table 3.4: *A priori* themes considered during thematic interview transcript analysis, adapted from Major et al. (2018) and Hennessy (2020).

Theme	Description
Different Perspectives	Exposing participants to the perspectives and views of others through dialogue.
Co-construction	Supporting participants to build knowledge together through dialogue, including the creation of shared digital artifacts.
Metacognition	Thinking about the thinking of others when contributing to a dialogue.
Scaffolding	The use of dialogue to scaffold an understanding of other participants.
Collaboration and Community	The role of dialogue in fostering collaboration and a sense of community.
Multimodality	The ability to engage in and with multiple modes of digital activity concurrently.
Direct Manipulation	Engagement with concepts through interactive, digital representations
Dynamism	The use of moving images and models of dynamic processes.
Provisionality	The ability to shape, debate, reposition and improve digital artifacts.
Accessibility	Digital access to a wide range of resources.
Immediacy	The ability to provide users with immediate feedback and information contingent on their input.

Table 3.5: *Emerging* themes generated during thematic analysis of interview transcripts.

Emerging Theme	Description	Illustrative Key Words
Accessibility	Digital access to a wide range of resources.	information, research, resources, search, websites, YouTube
Barriers to Dialogue	Factors which prohibit or limit productive classroom dialogue.	accountability, difficult, fear, off-task, prejudice, purposeful, teacher talk
Co-construction	Supporting participants to build knowledge together through dialogue, including the creation of shared digital artifacts.	agreed, combine, decide, discussion, everyone's ideas, Padlet
Collaboration and Community	The role of dialogue in fostering collaboration and a sense of community.	collaborate, compromise, cooperated, joint projects, peers, safe environment, share, tolerant
Contextual Learning and Engagement	The use of digital tools to increase student engagement and to provide a context for learning that acknowledges their everyday digital technology use.	current affairs, engaged, engrossed, interesting, life, natural, phones, promote, stimulating
Dialogic Space-Time	The means through which ongoing and expansive dialogue can take place; unbounded by physical space or time.	flipped learning, go back, imagine, look back, listen again, re-visit
Different Perspectives	Exposing participants to the perspectives and views of others through dialogue.	accepting, corporate, impression, interesting takes, new thinking, open approach, opinions
Factors Limiting Digital Technology Use	Barriers and considerations that restrict the use of digital tools in the classroom.	boring, confidence, dangers, difficulty, off task, repetitive, slower, temptation, wary
Immediacy	The ability to provide users with immediate feedback and information contingent on their input.	Classroom Assignment, Classroom Stream, ease, Flubaroo, go back, hand in, quicker
Inter-subjectivity	Orientation towards other participants through which a shared subjectivity and empathy evolves.	comfortable, easier, empathy, emotions, feelings, flow, intersubjectivity, understanding
Meta-cognition	Thinking about the thinking of others when contributing to a dialogue.	bias, decisions, ideas and thoughts, listening to others, others' shoes, point of view, predict, reasoning
Pedagogy of Emancipation	The role of dialogue in reducing authoritarianism and transforming social relations in the classroom.	choice, facilitating, freedom, finding out for themselves, independent, own way, ownership, pride, valid opinion

Provisionality	The ability to shape, debate, reposition and improve digital artifacts.	correct, delete, edit, do it again, experiment, modify, plastic, start again
School Culture	Factors specific to the setting which foster or impede the use of educational technology.	confidence, development, embraced, evolved, examinations, repertoire, self-led topics
Support for SEND	The use of digital tools to enable students to take part in activities and dialogues that would otherwise be inaccessible to them, due to cognitive or physical barriers.	clarity, express ideas, get more done, handwriting, think freely, time to think

III.9.2 Analysis of audiovisual data

Analysis of the talk which occurred during the focus activities of observed lessons provided evidence for the research questions; '*Do LMS open up new spaces for dialogue?'* (RQ. 2) and *'What is the nature of interaction within a LMS?'* (RQ. 3). Transcripts of all audiovisual recordings were prepared by the researcher using InqScribe (version 2.2.4.262) software. Conversational turns were considered to be any uninterrupted utterances or digital statements that appear to have been read and acknowledged by both parties (Howe and Abedin, 2013). This approach to capturing both online and in person communication is in keeping with studies of a similar nature (eg. Novakovic, 2016) and the operational definition of dialogue for this project, ***"a sign-based interaction that promotes intersubjectivity between participants"*** (as discussed in Section II.1.2).

Coding of the data allowed the frequency and type of dialogic moves in *augmented* lessons, arising from the joint planning meetings, to be readily compared to their *standard* counterparts. A range of tools for the analysis of these classroom interactions were considered for this project, including Sociocultural Discourse Analysis (Mercer, 2010) and the Argumentation Rating Tool (Reznitskaya et al. 2015). Ultimately, the Cam-UNAM Scheme for Educational Dialogue Analysis[1]

[1] The Cam-UNAM Scheme for Educational Dialogue Analysis (SEDA:©2015) was developed by a research team from the University of Cambridge, UK, and the National Autonomous University of Mexico, led by Sara Hennessy and Sylvia Rojas-Drummond and funded through grant no. RG66509 from the British Academy. The original scheme and list of co-creators are available at http://tinyurl.com/BAdialogue.

(SEDA, Hennessy, et al., 2016) was chosen as the basis for a scheme by which audiovisual transcripts generated during this project were coded. This adaptable scheme allows for the analysis of utterances according to their function within a dialogue and all codes are equally applicable to student and teacher talk, with or without technology at play (Hennessy et al., 2020). The full SEDA scheme consists of 33 codes that can be applied at the micro-level of individual communicative acts (Hymes, 1972) that theory suggests are supportive of dialogue (Hennessy et al., 2020). SEDA codes are divided between eight clusters, pragmatic collections of theoretical constructs intended to maximise the reliability of coding when using the scheme. Codes within each cluster of the SEDA scheme are somewhat hierarchical and represent increasingly sophisticated dialogue moves.

Data analysis of audiovisual data collected in this project focused on the use of the following clusters of SEDA codes; Inviting elaboration or reasoning, Making reasoning explicit, Building on ideas and Positioning and Coordination (see Table 3.6). These SEDA codes were selected as they are indicative of exploratory talk (Mercer & Dawes, 2008) where participants engage in critical but constructive discourse. Furthermore, statements are challenged, counter statements justified (with alternative hypotheses offered) and knowledge and reasoning is made publicly accountable (as discussed in Section II.2.4). Detailed descriptions, definitions and examples of each code are provided in Appendix 10.

Table 3.6: Selected SEDA (Scheme for Educational Dialogue Analysis) codes used in the analysis of audiovisual data (adapted from Hennessy et al., 2016).

Cluster	Code	Description
I - Invite elaboration or reasoning	I1	Ask for explanation or justification of another's contribution
	I2	Invite building on / elaboration / (dis)agreement / evaluation of another's contribution or view
	I3	Invite possibility thinking based on another's contribution
	I4	Ask for explanation or justification
	I5	Invite possibility thinking or prediction
	I6	Ask for elaboration or clarification
R – Make reasoning explicit	R1	Explain or justify another's contribution
	R2	Explain or justify own contribution
	R3	Speculate or predict on the basis of another's contribution
	R4	Speculate or predict
B – Build on ideas	B1	Build on /clarify others' contributions
	B2	Clarify/elaborate own contribution
P – Positioning and Coordination	P1	Synthesise ideas
	P2	Evaluate alternative views
	P3	Propose resolution
	P4	Acknowledge shift of position
	P5	Challenge viewpoint
	P6	State (dis)agreement/ position

To confirm the reliability of the researcher's application of the coding scheme, an inter-coder reliability (ICR) exercise was carried out. In 2020 an open call was made to members of the Cambridge Educational Dialogue Research (CEDiR) group looking for a volunteer to code a sample of transcripts in parallel with the researcher. A fellow doctoral student studying at the Faculty of Education, with prior experience of working with the SEDA scheme, volunteered for this task. Individual training in the application of the specific codes applied in the project was provided and the volunteer also attended a SEDA workshop session (open to all members of the CEDiR group) that I convened in July 2020. At this workshop the scope and context of this project were presented along with a sample transcript. Attendees (including the ICR volunteer) were then invited to code and discuss the application of the project's selected codes in small groups.

The ICR exercise included six extracts (each 10-15 minutes in length) comprising transcripts from the focus activities of an augmented and standard lesson from each of the three phases (see Appendix 11 for a summary of the extracts and supporting artifacts included in the ICR sample). *Stage sampling* (Winterbottom, 2017, p.221) was used to ensure that, within the constraint of each phase and lesson type, random transcripts were selected. However, as the coding volunteer worked in an educational setting where some of the students who had taken part in observed lessons had since gone on to study, no audiovisual data captured when they were present was considered for selection. The selected transcripts represented a range of subjects and included 10% of the total audiovisual data gathered. Whilst at the lower end of the 10-25% that is typical of ICR exercises (O'Connor & Joffe, 2020), the transcripts were a representative sample of the data set that could be accurately processed with the limited human resources available.

Initial coding by the researcher and the ICR volunteer was followed by *social moderation* (Hennessy, 2020) so that the application of codes and their definitions could be further refined to increase reliability. Cohen's kappa value (K) of inter-rater reliability (Cohen, 1960) was then calculated using the IBM SPSS Statistics package

(Version 27). As opposed to a percentage agreement, Cohen's kappa accounts for the possibility that any agreement between two raters is likely, in part, to be due to chance rather than their interpretation of the data and coding scheme (McHugh, 2015). Although there is no absolute consensus for acceptable K values, Cohen himself (1960) suggested that values less than 0.20 represented *none to slight*, 0.21–0.40 as *fair*, 0.41– 0.60 as *moderate*, 0.61–0.80 as *substantial*, and 0.81–1.00 as almost perfect agreement. In this ICR exercise, where agreement was initially calculated as lower than 0.6 at the cluster level, the definitions and examples were further discussed, and the coding refined and repeated by both the researcher and volunteer, until a substantial level of agreement between independently coded transcripts was achieved.

The Cohen's kappa test was possible as the codes applied (within a cluster) were mutually exclusive and the data nominal. The paired observations were independent and the same choice of codes was available to both the researcher and volunteer. Results of the ICR for individual codes can be seen in Appendix 12. The degree of inter-coder reliability achieved at the cluster level in this ICR exercise is considered '*substantial'*, as shown in Table 3.7.

Table 3.7: Results of ICR exercise

	I **Invite elaboration or reasoning**	**R** **Make reasoning explicit**	**B** **Build on ideas**	**P** **Positioning and Coordination**
Frequency A	15	55	79	42
Frequency B	22	51	68	38
K	**0.792**	**0.891**	**0.704**	**0.755**
Standard Error	0.072	0.043	0.046	0.055

Following the ICR exercise, transcripts for the focus activities of each of the observed lessons of the project (18 lessons in total) were coded by the researcher. In all but two lessons (due to technical issues described in Sections V.1.4 and V.2.4 of this document) three transcripts of the small group tasks were generated (54 in total). Initially, the transcripts were analysed on a line-by-line basis. After a one-

month period, this coding was then reviewed on a code-by-code basis to improve reliability; “the consistency and repeatability of data collected over time” (Winterbottom, 2017, p.219). The coding was then confirmed or amended as necessary (see Appendix 13 for an example of a coded transcript). Where an utterance could not be coded with any of the codes from the abridged scheme, the line was coded as *Non-dialogic* (N). Where utterances were repeated verbatim or reworded to clarify a contribution, only the first instance was coded. Where an utterance was amended for another purpose, additional codes were considered. The number of dialogic moves was then adjusted to account for the difference in the length of time given over to the focus activity of each lesson (see Appendix 14 for a summary of the data). The average length of focus activity time across the 54 transcripts was 11 minutes and 50 seconds (mean =11.83mins, standard deviation =5.86mins); totals for each code were therefore adjusted by this factor and reported rounded to the nearest whole number. Following this adjustment, a series of two-tailed two-sample (unequal variance, i.e. heteroscedastic) t-tests were carried out to calculate the statistical significance of the differences between the total dialogic moves of the standard and augmented tasks in each phase.

III.10 Limitations

Whilst the use of a coding scheme allowed the audiovisual data collected in this study to be processed relatively quickly, all utterances have a subjective nature that must be accounted for during their analysis (Mercer, 2010). The epistemological framework of *Dialogism* (Linell, 2002) dictates that knowledge is dynamic and socially negotiated and coding alone is therefore an unsuitable means of studying classroom dialogue, as the intersubjectivity and context of the interactions is lost when reduced to static, independent units of information (Marková & Linell, 1996). Furthermore any quantitative data that was derived from the coding of transcripts is not as objective as the statistics generated would make them seem (Taber, 2013). Predefined categories, such as the SEDA codes applied here (see Table 3.6), reduce the sensitivity of the analysis of classroom talk and that is why additional tools were required to approximate the nature of dialogue within the LMS; the

participant surveys and interviews were an important means of validating findings from the audiovisual data captured during lesson observations. This idea of triangulation was made popular by the Ford teaching project (Elliott & Adelman, 1976) and ensured that the points of view of the teacher, students and observer were all accounted for. The use of both quantitative and qualitative tools in this project makes it more likely that alternative meanings of the utterances by the participants were captured and reported (Mercer, 2004). In this instance, the methods might be better considered to be 'coordinated' than truly mixed (Taber, 2013). They confirm and support the conclusions derived from one another, increasing the construct validity of the study i.e. that it is able to measure that which it purports to be measuring (Cronbach & Meehl, 1955).

As this DBR project was conducted at the school I worked at, the sampling strategies for the student (all Year 7 students) and teacher (all teaching staff) questionnaires was one of *convenience* and under my direct control as researcher (Winterbottom, 2017). Therefore, the conclusions drawn from this data are not generalisable to a wider population beyond the context of the setting. When administering the questionnaires ahead of Phase 1, the use of standardised, multiple choice options reduced the time burden placed upon respondents; however, the statements may well have been interpreted differently by each individual, with one person's 'agree' being another's 'strongly agree' for example. The number of respondents (36%) to the teacher questionnaire was also not large enough to be truly representative of the wider staff; particularly as those most interested in the themes of the questionnaire were more likely to respond (Teddlie & Tashakkori, 2009). However, saturation of relevant information gathered from the questionnaires occurred and it was unlikely that additional responses would have resulted in new information within this specific context. The responses were subsequently used as the basis for the *purposive* sampling (Winterbottom, 2017) of teachers, with those who expressed an alignment with dialogic pedagogy and who felt that educational technologies fit their subject, considered to become co-researchers in the project and take part in the teacher interviews. These individuals were not representative of the wider teaching staff at the school; however, this sampling strategy did ensure that only *knowledgeable*

individuals (Cohen et al., 2018) who were well placed to inform and comment upon the design principles generated by the project took any further part.

The semi-structured interviews of the co-researchers and students were another means by which the DBR conjectures were confirmed. The methods (described in Sections III.7.4 and III.7.5) are not without flaws, for instance the interviews could be characterised as *pseudo-conversations* (Packer, 2011) as the limiting nature of the protocol allows only one party to contribute knowledge and ideas to the discourse. As a researcher observing lessons in my own setting, there may also have been issues with the candour of interviewees who might have been more likely to express their thoughts openly with an outsider. Also, there was potential for *acquiescence response bias* (Breakwell, 2006), where interviewees, and children in particular, are likely to provide answers that they assume a researcher wants to hear. It was therefore important that the interview protocols emphasised interest in the interviewees' opinions and reassured them that there are no right or wrong answers. The semi-structured design also avoided the use of closed questions and allowed for the further exploration of the participants' initial answers, especially where these were brief. This approach allowed interviewees to be truly heard, to explore their ideas widely and for elements of everyday conversation and familiarity to detect and repair ambiguity, as opposed to following a wholly regimented interview script. The validity of the teacher and student interview data could have been further improved by adding additional items to the protocol that repeated the questions in different ways and at different stages of the interview (DiCicco-Bloom & Crabtree, 2006), although time constraints would have required other items to be removed for this to occur.

The subsequent thematic analysis of this interview data was interpretivist in nature. As such, my own standpoint and idiosyncrasies as a researcher will have influenced the findings and themes reported in this study, reducing their external validity (Teddlie & Tashakkori, 2009). As Dey (2003, p.117) noted, "there is no single set of [themes] waiting to be discovered. There are as many ways of 'seeing' the data as one can invent". It was therefore imperative that the evolution of the findings of this

DBR study were clearly charted, in conjunction with the extant research and professional knowledge with which they are intertwined, in Parts IV and V of this report.

Thanks to the synergy this project had with wider, long-term development plans at the school relating to educational technology and critical thinking skills, the data was as naturalistic as possible and relatively easy to attain; in keeping with DBR, these conditions have been made explicit to better describe the limits and context of the design principles reported in Part VI of this report. These reflect the conditions within which the study was conducted (Anderson & Shattuck, 2012) and, with adaptation, could be applied to similar contexts due to the *user-generalisability* of the findings (Winterbottom, 2017).

III.11 Ethical considerations

In addition to completing the risk assessment and ethics checklist forms submitted in conjunction with this thesis, the BERA (British Educational Research Association, 2011) guidelines for ethical research were also considered for this project. The ethic of respect for all individuals involved was paramount and all participants were made fully aware about the purpose and methods of this study and informed consent was obtained from all participants. In particular, I was acutely aware of the bureaucratic burden that this study might have placed on colleagues and students; especially the time required to take part in the interviews and joint planning meetings. As such, I encouraged teacher participants to decide when they would like their interviews and meetings to be held and worked around their schedules. When scheduling opportunities to speak to the students, I was conscious of popular lessons and extra-curricular activities and avoided using any of their break or lunch times. Instead, I negotiated 15 minute windows to conduct their interviews during lesson times, often during lessons delivered by the co-researchers.

Tangen (2014) divides the ethics of research into three domains. In the first considerations about the *quality of the research process and results* are considered;

this includes the central tenet of respect for the setting and participants involved. Primarily, this project was conducted 'through' the staff and students at the researcher's workplace and it was important to address the issue of power in this study and the researcher's duty of care as an educator and *insider researcher* (Merton, 1972). This was particularly pertinent to the observation, interviews and questionnaires of the children where there was an inherent power imbalance between myself and the participants. The protocols devised for the data collection ensured that informed consent was given; however the implicit social pressure to comply with the requests of teachers such as myself can not be entirely negated. For instance, parents and children may not have felt genuinely free to opt out of the project. To counter this, a summary for parents and students was produced to clearly set out the aims of the project, the ways in which any data collected was to be handled and to reiterate the option for participants to withdraw their participation and data at any time. This also highlighted the Headmaster as an independent point of contact for participants. At the start of each interview, participants were asked for their permission to record the session and I reiterated that all data would be treated confidentially, securely stored, anonymised prior to any publication and that they had the option to withdraw from the interview at any point.

As part of the sampling strategy for student interviewees (see Section III.7.5), a child with either the highest, lowest or median Cognitive Reasoning Test (CAT4, GL Assessment) scores was invited to take part in an interview following the observed augmented lesson they took part in. On more than one occasion, selected students declined to participate or had invited friends to join them who declined. This was not an issue as fortunately, many children were keen to take part, but it does demonstrate that the participants did not feel obliged to be involved. In fact, many that did take part expressed their gratitude for the opportunity to have their voices heard. There was also the potential for workplace power dynamics to influence the outcomes of the study and fellow teachers may also have felt obliged to contribute. As was the case with the students, some adults who were approached declined to participate whilst others were very keen to be considered. Positioning the teacher participants as co-researchers reduced any power imbalance that might have been

present due to their day-to-day roles in the school and level of experience. Furthermore, by taking part in the planning and observation activities myself and offering up my own practice for scrutiny, the teacher participants were less likely to feel they themselves were being judged whilst they were observed. Instead a collegiate feeling of exploration was engendered by the joint planning exercises and participants felt confident that it was the LMS and classroom talk that was under observation, not their professional practice.

Secondly, there was an obligation to *protect individuals from harm* which raised issues of anonymity for the participants and the setting as a whole. This project did not place any participant in any physical danger; however, their social standing was inevitably somewhat at risk. On an individual level, participants in the joint planning activities had their lessons scrutinised whilst children had their cognitive and collaborative skills assessed. Due to my publicly acknowledged role in the school it is impossible to protect the identity of the setting entirely, but every attempt to anonymise colleagues and children, including the use of pseudonyms, has been made and no data of a personal nature has been reported. Ahead of each interview it was important to reiterate to the participants that no data would be passed on, that it would be anonymised and stored securely by myself. This message was added to the interview protocols (see Appendices 5 and 6) along with a reiteration of the option for participants to withdraw their participation and data at any time. Additionally, the setting for this project, a fee paying preparatory school, has placed aspects of its inner workings on display to both competitors and prospective parents in this report. The senior leadership team at the school welcomed this as the research questions at hand investigate areas which parents and staff perceive as relative strengths of the school namely; the relationships between children and teachers and the strategic development of digitally enhanced learning at the school.

Finally, the research has the *potential for independent systemic critique* and could be – negatively or positively – disruptive to current practices and policies. This is the case potentially in the wider context of Google Classroom institutions but certainly at the local level of the setting, with at least some departments and practitioners

altering their practice as a result of this project. A great deal of planning, infrastructure and finance has been put towards enhancing digital learning at the school. Those who feel most invested in the perceived success of Google Classroom may have responded inauthentically to the project and found themselves at odds with the findings whilst others may have felt a social pressure to adopt these modes of instruction (Baker & Johnson, 1998). The selection strategy for teacher participants meant that whilst all co-researchers strongly agreed that promoting dialogue between children in their subject is important (when completing the teachers questionnaire), their use of digital tools in the classroom varied widely, as did their involvement in developing the school's digitally enhanced learning policies (see Part V for further details). Consequently, not only were the affordances of the Google Classroom to support classroom dialogue revealed by this project, barriers and considerations that restrict the use of digital tools in the classroom were also reported (see Section V.2.2).

Part IV: Preliminary Findings from Exploratory Phase

The following Part reports findings from the exploratory phase of this Design-Based Research (DBR) project into the affordances of a Learning Management System (LMS) that support classroom dialogue. Between January and May 2017, prior to Phase 1 of the main study, questionnaires and pilot interviews were conducted with teachers and students at the setting, an independent preparatory school in East Anglia. In keeping with the features of 'good DBR' (DBRC, 2003), the results of this initial data collection are reported here, in tandem with discussion of the extant research and professional knowledge with which they are intertwined, allowing provisional theories to be postulated. The implications that this pilot work had for the main study are also described.

IV.1 Teacher questionnaire

As outlined in Section III.7.2 of this report, in January 2017 a teacher questionnaire was conducted to better understand the prevailing beliefs about, and use of, educational technology at the school. In addition, questions exploring the teachers' attitudes towards dialogue and collaborative learning were posed (see Appendix 15 for summary of results). All 25 respondents (from a possible 70, a response rate of 36%) agreed that promoting dialogue between children is important in their subject and there was a strong agreement that educational technology (Google Classroom, iPads, IWBs, visualisers etc.) improved the quality of both teaching and learning at the school. 21 of the respondents (84%) felt that educational technologies correspond with their teaching philosophy and 20 (80%) agreed that they are helpful when creating collaborative activities for children. Some practitioners felt that the use of digital tools was a way to better engage students and to link the skills acquired in school to the wider world in a way that is relevant to the children's wider experiences, or as one respondent put it:

> I can see no value in clinging onto traditional chalk & talk teaching when technology can enable the same result to be achieved more easily for the

> teacher, more enjoyably for the pupils and with better end results for both parties. The sooner technology is allowed to sit at the heart of the modern-day classroom in all areas of the curriculum, the better. (Teacher respondent A)

Teachers also cited online “game” like activities as a valuable means of assessment and there was a consensus that technology is particularly useful when supporting children with special educational needs.

Some uses of technology seem to be ubiquitous at the school, for instance all respondents have used video applications (such as YouTube) in their teaching. However, 6 of the respondents (24%) never set tasks that ask the children to independently make use of these same resources. Indeed, there is a noticeable disparity between the technology use of teachers in order to prepare and deliver lessons and the activities of the children. The reluctance to employ educational technology in the classroom may stem from the fact that nearly half of the respondents (48%) did not feel it “fits” the subject(s) they teach most often. This is despite most (88%) stating that they have the technical knowledge to effectively integrate digital educational technology into their teaching and all but one respondent feeling they have sufficient knowledge of pedagogy to do so. This raises the question as to why teachers who consider themselves conversant with the technology and who recognise the benefits of using it in the classroom fail to do so? One possibility is that at this stage, the staff had not had sufficient time to integrate these new digital tools into their practice. Or perhaps they did not yet feel emboldened to yield control of the content to the children? Whatever the cause, there seemed to be a disconnect between the philosophy of staff and the classroom activities they ask children to engage in.

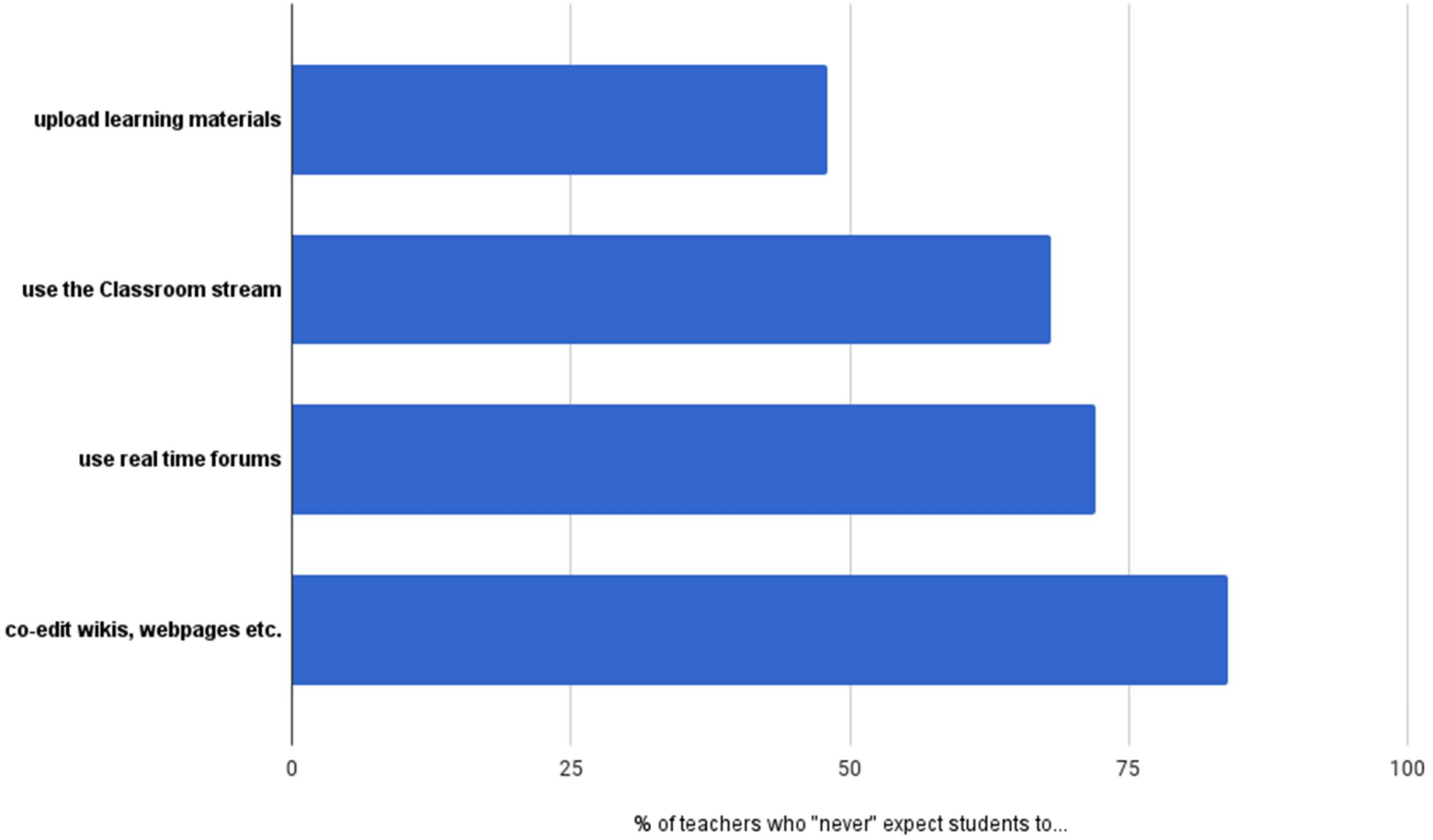


Figure 4.1: Percentages of respondents who “never” expect students to use different features of Google Classroom.

Regarding Google Classroom, 16 of the respondents (68%) had used features of the LMS for real-time collaboration in their lessons. However, this use was occasional for most teachers in 2017 and only 3 of the teachers claimed to make use of the LMS every lesson at this point in time. As demonstrated in Fig.4.1, many of the features of Google Classroom that could be used as means to promote dialogue were not utilised by the majority of staff. For some the LMS was only used to provide instructions for homework tasks and cover work; a finding in keeping with other large-scale studies of classroom discourse (Haneda, 2017):

> Thus far, I have only required the children to use Google Classroom and search engines during the lessons I have needed to be covered due to my absence. (Teacher respondent B)

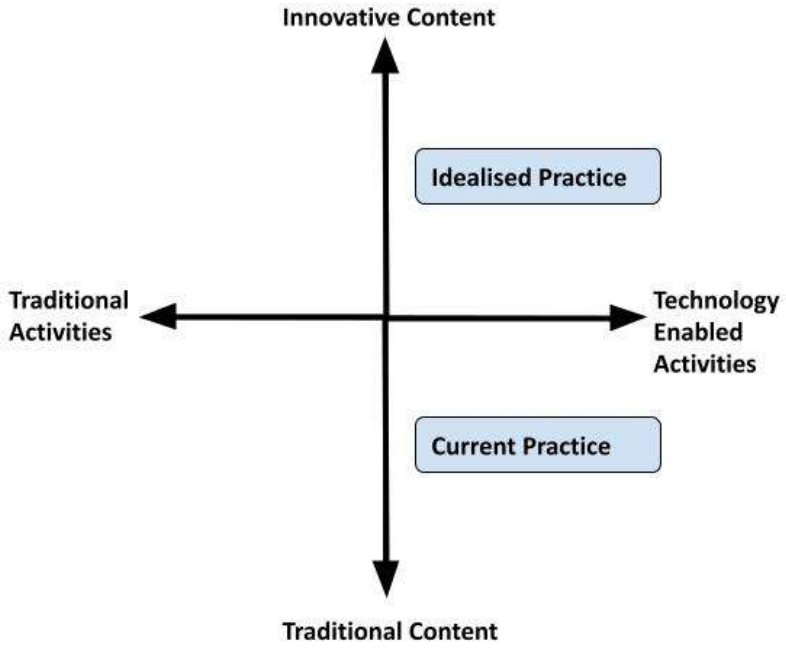


Figure 4.2: Idealised versus current practice within the setting (adapted from McFarlane, 2010).

18 of the respondents (72%) agreed that educational technologies have transformed the activities in their lessons and all but one of these (68%) felt that the educational content itself has been altered as a result. The questionnaire demonstrated a willingness to adopt new practices at the school in 2017 but there was a sense that finding the time to identify and develop these was limited. This may account for the gap between the idealised practice of the staff and their current means of instruction (see Fig. 4.2). Another barrier to the development of new practices was the provision of hardware across the school (Voet & De Wever, 2016) which was uneven:

> I will be starting to use things like Padlet now that there are more Chromebooks available in school. I haven't yet done this as I haven't had easy access. (Teacher respondent C)

IV.2 Student questionnaire

Comments from the pilot and Phase 1 questionnaires (collected in March and April 2017 respectively) showed that the Google Classroom LMS was valued by students for its capacity to aid them in organising, curating and submitting their work. These logistical affordances were further remarked upon during the pilot teacher (see Section IV.3) and student interviews (see Section IV.5). There was also evidence that the LMS helps certain individuals to get their work done more efficiently by providing access to search tools; “I find that if you really don't know something, or want to research something more, it is really easy to just type it in and look at what comes up” and that it helps them to get their “thoughts down much easier”. Usability was not an issue for most (83%), with 30 of the 36 respondents (from a possible 42, a response rate of 86%) who took part in the Year 7 survey finding the LMS easy to use. 32 of the students (89%) felt that Google Classroom gives them more freedom to find and add information that they find interesting to their work. Comments from the respondents also showed that this cohort placed an inherent value on working within the LMS, that it is more enjoyable and important than traditional tasks because “computers are the future”.

Responses from the student questionnaire also revealed hidden modes of student use. The students were making use of their digital skills and the tools at their disposal regardless of what was 'expected' of them by their teachers; completing tasks and managing their learning in ways that best suited them. For instance, 6 respondents in the teacher questionnaire (24%) never expected children to use online animations or videos to better understand a topic (see Fig.4.1) and yet 31 of the Year 7 children (86%) who took part in the survey were regularly doing so. Furthermore, students stated that they "always" use search engines in 67% of their lessons and yet amongst the teachers of this year group 68% "never" or "rarely" expected them to do so. Similar disparities could also be seen when considering homework (referred to as "prep" at the school), which saw 25 (69%) of the student respondents making use of the *Share* function at least occasionally. 6 (16.7%) of the children were also making use of social media to share information with other children when completing prep. Given that this practice was not permitted during their school day; it is unsurprising that no teacher set tasks that required it to take place at home. Indeed, most teachers would be unaware of this culture of *backchanneling* information with social media beyond the confines of the school day. By 2017, the Year 7 students' methods of communication and learning had already begun to be transformed by Web 2.0 technology, but this was hidden from view from their teachers and occurred without adult prompting as an extension of their in-school dialogues.

Regarding classroom collaboration; the Year 7 children were clear that talk is an important classroom activity, 28 (78%) of the respondents felt that it helps them to learn more (see Fig.4.3) and none considered it to be a waste of lesson time. "It's really important to share ideas, you learn more and you are more social." This reflects findings from the teacher questionnaire which showed that teachers in the school also placed a value on classroom dialogue; 33 (92%) of the students reported that they were asked to talk about their ideas with their peers in at least some of their lessons.

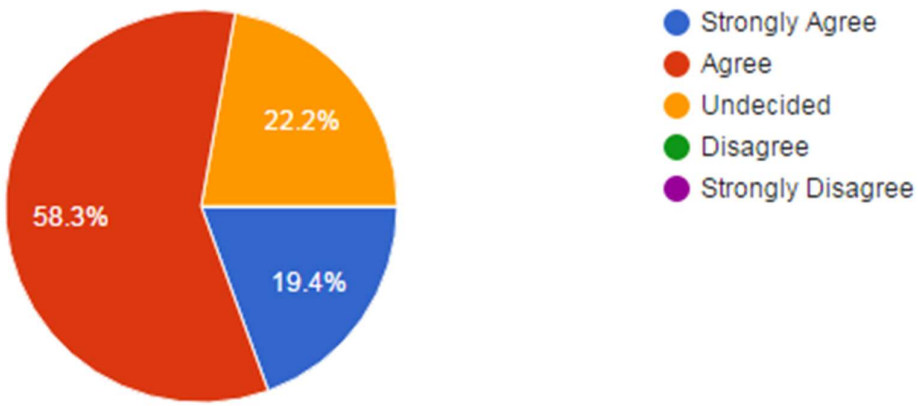


Figure 4.3: How strongly Year 7 children agree with the statement “talking to other children helps me to learn more”.

The children surveyed in 2017 had an appreciation of collaborative activities and felt comfortable when carrying them out, recognising that other children “might have other ideas” and that, “it helps you to discover a lot more on the topic, from each other”. That said, the children recognised that not all talk is productive and felt that teachers should retain some measure of control over the content and direction of talk:

> Often these conversations go off on a tangent like when we should be talking about poetry, but half the class is discussing how Arsenal did. (Student respondent A)

Despite the value placed on dialogue and collaborative activities by both staff and children, there was sporadic use of the *Share* function of the Google Classroom in lessons in 2017; 24% of the teachers of this year group would never have expected children to do this.

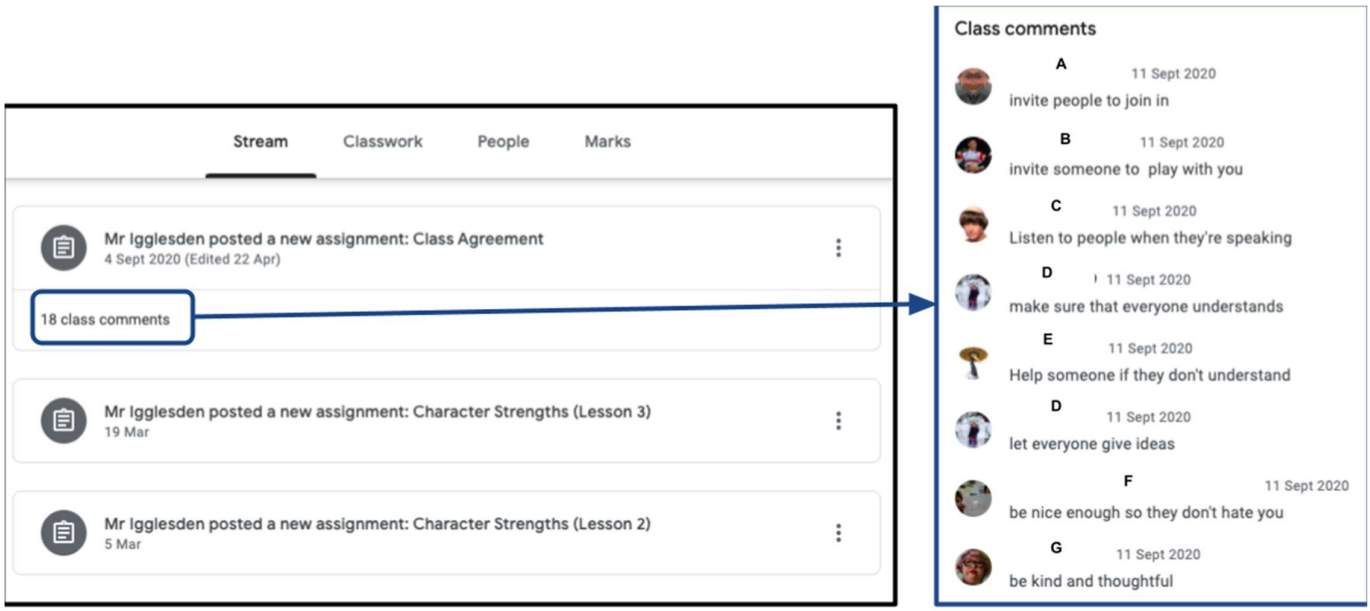


Figure 4.4: Example of class comments added to a Year 8 PSHEE Google Classroom *Stream*.

As reported by teachers, the Google Classroom *Stream* (see Fig. 4.4 for illustrative example) was also rarely (or never) used in 69% of subjects in 2017. However, one child remarked upon the usefulness of this tool; which they were regularly using with their peers to clarify and support one another with homework and tasks in lessons, circumnavigating the teacher. This threaded discussion board is a space in which dialogue can be held and constructed and is another feature of the LMS that represented hitherto hidden modes of use by the children at the school. Encouragingly, when teachers do open a dialogue with the Year 7 children, most respond to the comments (see Fig.4.5).

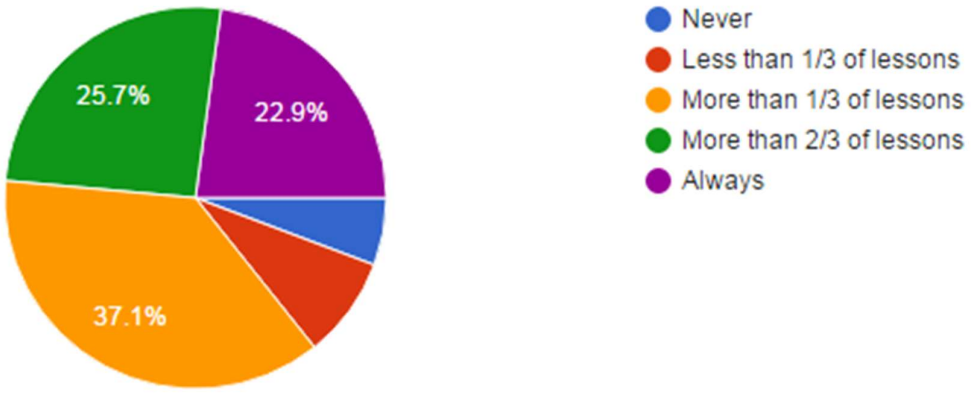


Figure 4.5: Percentage of lessons in which Year 7 children act upon comments a teacher has added to a Google Doc.

There was a sense of complicity between the children and the power structures that surrounded them in the responses to the questionnaire. The subjects that the children found educational technology most useful for correlated to those where it is most used and vice versa. “For the subjects that we do use computers for I find them very useful”. Several stated that in “academic lessons like maths it would not work” and this correlates to only 5 (14%) of the respondents identifying maths as a subject in which they were likely to use Google Classroom. Despite the fact that computers were regularly being used for maths games and challenges, there were a number of respondents who said that they did not feel that the LMS could be incorporated into the subject. In fact, 20 respondents (56%) felt that Google Classroom activities only work well in some subjects despite 26 (72%) feeling they learn more and 22 (61%) feeling that communication with other students is made easier by the LMS. These respondents were being educated in a time of flux for the school, where paper-based modes of working dominated in some areas whilst others were paperless. It was therefore unsurprising that the children were caught between these approaches but the questionnaire provided evidence that they themselves can select the tools that are most appropriate for their learning in different contexts with several offering comments on the power of paper, for instance:

> I much prefer working in books and writing by hand in most lessons as I like for my work to exist other than on a screen… I guess there'll always be something about paper. (Student respondent B).

Most respondents felt an increased engagement and sense of fun when using the LMS and there was an appetite to see the tools associated with it made more widely available to them.

IV.3 Pilot teacher interview

'John' is an experienced teacher of French and English and is recognised as an outstanding teacher of poetry. He did not complete a formal teacher training programme but moved directly into the private sector following his higher education at an Oxbridge college. John and I had been colleagues at the school for seven years at the time of interview (March 2017) when John had only three weeks remaining before leaving his post, having been at the school for more than 10 years. A semi-structured interview protocol (see Appendix 6) was followed and focused on his beliefs surrounding the use of technology (specifically Google Classroom) in the classroom and his teaching approach. The interview took place after a full day of teaching for John and upon his request, we moved the interview to a comfortable meeting room, away from his classroom. John was mindful of the fact he was feeling bored in the familiar space of his teaching environment and this new location was a relaxing, neutral space which was used for all subsequent teacher interviews.

As part of the interview, John was asked if "promoting dialogue was a good approach for English teachers". This may appear to be a loaded question, however he had already stated in his questionnaire that he strongly agreed with the statement. The question was intended to confirm this and to encourage him to expand on his position:

> I can't think of anything that you wouldn't want to incorporate dialogue into. Because that is what the use of the English language is all about. It's not just a written discipline. (John: Line 24)

John does not consider dialogue to be “purely a spoken thing” (John: Line 27) and points out the ways that written correspondence within Google Classroom can help to sustain dialogues for extended periods of time. In his experience, the LMS also expands the space for work to occur beyond the boundaries of the physical classroom. In one example, John described helping students to prepare for a debating competition, despite the fact that team members were not in the same English class.

John positions himself as a “big user” and “prime mover” of the new technology in the school. He has completed a Google Educator TPD course and is enthusiastic about the potential of the LMS:

> ...It won't be long before it will be possible to be in the digital school and that's exciting because it liberates and emancipates people who really wouldn't have had the same chances in education... (John: Line 57)

He felt that developments in the schools digital technology policy over the previous 18 months aligned closely with his own ethos, allowing him to make lessons go the way he “always envisioned”. However, he is not deterministic and believes that a teacher without access to any technology can do as good a job as one with it. John is circumspect about new technologies and stressed the importance he places on trialling new practices and resources before replacing previous activities with digital versions for the sake of it; “...I think it just needs to be embraced and allowed to develop organically.” (John: Line 57).

However, there was a tension between his advocacy of technology as a tool for pedagogical change and the need he feels to restrict student use of the tools, not least because of the “constant cyber threats and access to inappropriate material”.

His main frustration with the technology came from the blocking of online resources due to the school's internet controls but John felt that the measures are a “necessary evil”. Indeed, the issue of control was a theme throughout the interview. The LMS has the potential to allow greater student choice and is perhaps reframing the function of the teacher, “because they've got research skills and right in front of them the ability to research online, they can choose a topic that really genuinely interests them” (John: Line 31). In opposition to this, John described a need to be “constantly walking around, looking over shoulders” (John: Line 21) and monitoring their activity by looking at browsing history and revisions of documents if necessary. In an effort to hold the children's work to account John made it clear that he may display their work on the classroom interactive whiteboard from time to time.

In addition to *issues of control*, thematic analysis of the transcript revealed *changing practices* and the *affordance of the LMS to promote dialogue* as major themes. Examples John gave of changes to his teaching practice included activities that were now digitised and conducted in a way that would not be practical without the use of Google Classroom, for example:

> You can give them the task to go and find a source that uses semicolons, extract quotes from it, turn them into their own presentations or spreadsheets and it just allows them to engage with it in a real way rather than, ‘here's a passage, answer some questions on it.’ (John: Line 25)

John also placed a value on the logistical affordances of the platform, reporting that his lessons are now conducted with greater efficiency and that children complete twice as much work. He also felt that differentiating tasks within the LMS was much easier and that the cloud-based nature of Google Classroom means that collaborative work is curated in a more manageable way than using hard drives to store various versions of a document.

In addition to using the *Comments* feature to extend his own dialogue with the children, John highlighted the *Share* function of Google Docs as a useful means to promote dialogue:

> More often than not in the course of an activity I will stop and say 'and now share it with a friend or a group of friends or the whole class and give each other some feedback on how you think you are doing' and children are very receptive to that. (John: Line 18)

This approach facilitates dialogue (Mercer & Littleton, 2007) by making ideas public and allowing participants to critically engage with one another's ideas.

IV.5 Pilot student interview

A semi-structured interview was conducted in May 2017 with three Year 8 boys. The boys were missing a sports fixture due to poor weather and were happy to take part in the interview. One child, 'Alistair', was selected by his sports teacher to take part and was asked to invite two friends. The interview flowed well and the three boys were clearly comfortable in each other's company. As this did not follow an observed lesson, some of the protocol questions were out of context (see Appendix 5) and yet we managed to anchor the content of the interview to examples from the children's mixed use of educational technology in recent Latin lessons. I had taught all three children science for the previous three years and the interview was conducted in a meeting room as opposed to the classroom we tended to share. Thematic analysis of the transcript identified the following themes; dialogue as a *pedagogy of emancipation, co-construction, barriers to dialogue.*

The interviewees recognised the affordance of Google Classroom to improve the efficiency and curation of their work and that of teachers. 'Michael' suggested that using technology does not necessarily improve the activities teachers plan for them but can make them easier:

> … it's not like if you don't use it then your lessons aren't going to be enjoyable, because you can still get the same knowledge but through books instead. You could still make it fun but it's probably easier and more helpful by using technology. (Pilot Student Interview: Line 46)

They value the ability to “look it up yourself” (Pilot Student Interview: Line 64) when it comes to finding definitions and information but again, there is a tension between this freedom of access to information and the control that they feel should be exerted by teaching staff to children accessing unnecessary content on the internet.

When considering classroom talk, the boys tended to agree that it is helpful to hear the ideas of others: “it's almost like a debate. You can sort of hear both sides of the argument” (Pilot Student Interview: Line 44). There is also evidence that during structured talk tasks, such as the creation of key-word mosaics in science lessons, they understand the value of making their ideas explicit and value the opinions of others. As Alistair opined:

> I think that's quite helpful that you have to discuss as a group where we think everything goes and then we have to agree. Let's say one person wants [to put] it there, another person wants it somewhere else, then you just have to speak about it and say what we each think and make a decision on it. I think that's quite helpful. It's helpful to hear what other people think. (Pilot Student Interview: Line 34)

Alistair described the role of argumentation in reaching a consensus in talk activities. He seemed to recognise the “friction at the table” (Pilot Student Interview: Line 42) as a catalyst for the co-construction of knowledge, that cognitive change can be achieved when the tensions between ideas are made explicit (Osborne et al., 2013). Alistair certainly displayed the greatest evidence of metacognition of the interviewees and had clear ideas about how best to use talk to enhance his learning. By coming to a resolution with talk partners before drawing conclusions, Alistair engaged in higher order thought by internalising the group’s language use (Mercer & Wegerif, 1999).

The interview provided evidence that the children do not consider the act of talking in the classroom to be work, providing further evidence that they are complicit with the traditional structures and conventions placed upon their learning. 'Jonathan' felt that, "there are sometimes when you just need a bit of silent work" (Pilot Student Interview: Line 32) whilst Alistair stated that, "in some lessons you might talk and in some lessons you might get on with some work." (Pilot Student Interview: Line 66). The boys felt there is a need for teachers to plan and monitor their dialogue in order for it to be productive. As Jonathan says:

> If they ask you a question and then you discuss it and you have more time left… what are you going to do with that time? You're not really going to carry on discussing. (Pilot Student Interview: Line 36)

When asked about the impact that Google Classroom has had on the talk in their lessons, Alistair and Jonathan gave detailed descriptions about the use of the *Share* function of Google Docs. Both had used this feature to peer assess the work of fellow students in their English class and found the process useful. However, their interview also revealed frustrations with this approach and a need to control the communicative acts in this new space because sometimes, "people put stupid stuff in the suggestions" (Pilot Student Interview: Line 57). Having admitted to doing this to others, Alistair described the means by which he now controls the input of classmates; by limiting access to a chosen few that he can trust and by removing the capacity for them to edit any of his work directly, "if they want to tell me something they can tell me in person" (Pilot Student Interview: Line 57). This seems to be a mode of practice he has independently devised in order to use the tool more effectively and to avoid social conflict. It is evidence of etiquette being negotiated by users of this new space as they discover the affordances and constraints of the tools for themselves.

IV.6 Implications

Given that the questionnaire and interview questions were generated by operationalizing the research question, *'What affordances do LMS (specifically Google Classroom) provide for the teacher mediation of dialogic learning?'* (RQ. 1), it is unsurprising that themes such as *changing practices* and the *affordances of the LMS to promote dialogue* were identified during this exploratory phase. The capacity that the LMS has to transfer power from teachers to students had also been theorised (see Section II.4.4) and is indicative of the disruptive potential of the technology to reduce authoritarianism and transform social relations in the classroom. For example, by using the *Share* function in the devised interventions of the main study, the teacher's ability to 'filter' content and judiciously direct students towards a predetermined truth was diminished. Over the course of the main study further evidence that the LMS supports dialogue as a *pedagogy of emancipation* (see Section V.3.2) was revealed. However, the range of *control issues* reported was not entirely anticipated by myself when collecting the data. *Control issues*, along with the other themes reported here, were used in the initial thematic analysis of the interview data (see Section III.9.2) from the main study and in this case, later subsumed by the *emerging* themes of *barriers to dialogue* and *factors limiting digital technology use* (reported in Section V.2.2).

When conducting the data collection of this exploratory phase, I was struck by the privileged position I held as an *insider researcher* (Merton, 1972) and the responsibility to actively listen to and convey the lived experience of the participants (see Section VI.6 for further reflection). Whilst this would be imperative for any researcher, the potential to jeopardise relationships with colleagues, students and the wider school community was brought home to me as I made use of the data collection instruments for the first time. My relationships and *a priori* knowledge of the setting increased the possibility of participants offering detailed ideas, and my own ability to interpret them (Hockey, 1993). However, as unanticipated ideas and responses began to be collected, I became aware that my own experience of working at the school had led to assumptions which could limit the interpretation of

the data. In an effort to increase the chances that alternate readings of the data were considered, the thematic analysis of the pilot interviews, and all subsequent interview data, was revisited each time transcripts from a later phase of the project were analysed. In the case of the teacher interview, the draft report of Section IV.3 was also offered for scrutiny by the interviewee, to confirm that my findings were in keeping with what John had wished to convey; a process that was repeated with the co-researchers of Phases 1-3.

In addition to refining the teacher interview protocol, feedback following the pilot interview helped to established the following principles for conducting the interviews:

- Repeat or reword questions as necessary to keep the interview focused.
- Pre-warn the interviewee that you may interject and do so as necessary.
- Provide subjects with a brief summary of the areas to be covered in advance.

I was conscious of the time burden that this project placed on my fellow teachers in particular. These guiding principles helped to reduce the average interview time with the co-researchers of Phases 1-3 (average 26 minutes) compared to the 34 minutes that John's interview lasted. This meant that relevant data could be captured comfortably within a typical timetable 'period' at the school. These principles were also applied to the pilot student interview which was completed within the 15 minutes it had been scheduled for. However, contributions to this group interview were somewhat dominated by Alistair, the student who had been selected to take part by his teacher. In response to this, an alternative selection strategy for the student interviews of the main study was devised. As described in Section III.7.5, this was based on their Cognitive Reasoning Test scores (CAT4, GL Assessment) rather than their rapport with teachers; generating a more representative sample of the students at the school.

Part V: Main Study

The following Part outlines the findings from three phases of design-based research (DBR), conducted between April 2017 and June 2020, exploring the affordances of Google Classroom to support dialogic teaching practice. This follows, and is informed by findings from, the exploratory phase of this project (see Part IV).

The evidence collected during each phase of this main study included teacher interviews, minutes from joint planning meetings, audiovisual recordings of observed lessons and student interviews (as described in Part III and summarised in Fig.3.1). The data is presented here in the chronological order in which it was collected. Within each phase, provisional theories to account for the findings of the data analysis are postulated, as are refinements to the design principles to be put forward to subsequent phases. These emerging design principles and the theory that supports them are entwined and the tandem reporting of them in this part is in keeping with the features of 'good DBR' (Design-Based Research Collective, 2003); as it is not possible or desirable for them to be artificially separated. The final design principles, and the affordances of Google Classroom to support dialogue, are reported in Part VI of this report.

Phase 1

V.1.1 Introduction

Following a teacher questionnaire conducted in 2017 (see Part IV: Preliminary Findings for details), two teachers at the school accepted the invitation to take part in three fortnightly joint planning activities with a focus on promoting student dialogue by capitalising upon features of the Google Classroom LMS. Both participants were experienced practitioners and were identified as suitable candidates having expressed an alignment with dialogic pedagogy in the teacher survey. Both also met the aforementioned selection criteria (see Section III.7.1) in that they 'agreed' that educational technologies fit their subject, they made regular use of Google

Classroom and were teachers of Year 7 (11-12 year olds), the focus group of this project. This stratified purposive sampling strategy (Teddlie & Tashakkori, 2009) ensured that their professional knowledge, interests and outlook aligned with the aims of the study (Cohen et al., 2013).

'Paul' is a teacher of geography and has worked at the school for over 20 years whilst 'George' has been at the school for over a decade, predominantly teaching history. In my capacity as a science teacher at the school I acted as the third participant in this phase of the project.

V.1.2 Teacher interviews

In each phase of the project, participating teachers took part in semi-structured interviews to explore their understanding and attitudes towards classroom dialogue and their use of digital tools (see Appendix 6). Interviews were recorded using a smartphone dictaphone app in a comfortable, neutral meeting space at the school that participants were familiar with. Interviews with both participants took place before the first joint planning meetings. In particular, these interviews aimed to explore the assumptions and knowledge that the participants might bring to bear in addressing the following research questions:

> **RQ 1. What affordances do LMS (specifically Google Classroom) provide for the teacher mediation of dialogic learning?**
>
> **RQ 2. Do LMS open up new spaces for dialogue?**

The audio files were transcribed by the researcher using InqScribe (version 2.2.4.262) software and thematically coded (as outlined in Section III.9.1 of the Methodology). A summary of the major themes identified in the teacher interviews and selected supporting evidence can be seen in Table 5.1, with further explanation of each theme following.

Table 5.1: Summary of supporting evidence for themes reported in Phase 1 teacher interviews.

Theme	Description	Example Excerpt(s)	Supporting Data	Key Words
Different Perspectives	Exposing participants to the perspectives and views of others through dialogue.	...the dynamic in the room is such that it's almost like having a conversation between two people. But two people that have varied and interesting takes on something. (Paul: Line 47) ...it just opens doors to new information, new thinking which is very stimulating for both the children and for me. And there's, there's often, often, there's sometimes quite a frisson, frisson of excitement in the room when everyone thinks yeah that's new stuff. (Paul: Line 80) Listening to what other people have got to say about an event or what someone was thinking just then helps them to build up their ideas and that then comes through in their knowledge and understanding I think. (George: Line 55) …[dialogue is] two people talking about an event or a person or the causes of an event of the effects of an event [2+] and [2+] stating what they think about it but also then accepting other people's ideas and perhaps even, in the light of that information adjusting their own thoughts and perhaps even changing their opinions. (George: Line 57)	Paul: Lines 20, 26, 47, 48, 80 & 81 George: Lines 49, 53, 54, 55, 57, 58, 61 & 117	accepting, corporate understanding, impression, interesting takes, new thinking, open approach, opens doors, opinions, varied
Immediacy	The ability to provide users with immediate feedback and information contingent on their input.	I think it certainly makes it easier to access deep and more diverse information and easier to deal with information and sources that you have. (George: Line 81) ...the Classroom stream for instance on a Classroom assignment, anything they put there is still there and we can go back to that and I think that the old fashioned way where as I would put a couple of links up on the board, although I can store those links and keep producing them I think that the ability, that when the children are at home and they can go back onto their Classroom the research is still all there. (George: Line 88)	George: Lines 79, 81, 88, 98, 99, 106 & 110	Classroom Assignment, Classroom Stream, easier, Flubaroo, go back, in one place, links, posts, sharing, shortcuts

		I like the fact that, the children, for the children it's all in one place. They log on, they're in the habit now of going to their Classroom so you say go to your Classroom and because we've used it for long enough now everyone knows how to get to their Classroom. (George: Line 98)		
Inter-subjectivity	Orientation towards other participants through which a shared subjectivity and empathy evolves.	I find that flow is very useful in terms of, initiating and drawing from the children, their very best thinking. I think from my own courses I suspect that we are demonstrating at times a degree of intersubjectivity and that we are showing that we understand what people understand at a deeper level and can almost predict what is going to be said at another level. (Paul: Line 21)	Paul: Lines 21, 81 &107 George: Line 27	empathy, emotions, feelings, flow, intersubjectivity, understanding
Meta-cognition	Thinking about the thinking of others when contributing to a dialogue.	I do a lot of questioning. [2+] As in why do you think so and so did this? Or what do you think so and so was thinking at the time so empathy and questioning linking together. (George: Line 27) I think that the more I can ground it in the people in the past and their ideas and thoughts the children find it easier. (George: Line 31)	Paul: Lines 21, 48 & 51 George: Lines 27, 29, 53 & 76	bias, decisions, ideas and thoughts, listening to others, others' shoes, point of view, predict

In addition to the *a priori* theme of **collaboration and community** (expanded upon in Phase 3), Paul's interview gave testimony as to how dialogue can enhance the metacognition of participants. **Metacognition** is considered to be a feature of productive dialogue between teachers and students and is one of the five major themes identified in literature reviews on productive classroom dialogue (Howe et al., 2019). Ideally, dialogic activities provide participants with the opportunity to co-construct knowledge and artifacts, during the making of which, they are provoked to "think about their own thinking and others'" (Major et al., 2018b, p.2005). In addition to teaching geography, Paul was also a teacher of 'study skills', a recent addition to the school's enrichment programme at the time of interview. Paul spoke of his aim to center his delivery of this programme around the children's metacognition:

> My role within study skills is to work with colleagues in designing a programme and delivering a programme that is really relevant to children to help them to understand how they learn best and to understand how they can best prepare for examinations. (Paul: Line 58)

The thematic analysis of Paul's interview also gave rise to the theme of intersubjectivity. **Intersubjectivity** builds upon the metacognitive acknowledgement of the space between perspectives; as the co-construction of knowledge takes place, an orientation towards the other is fostered (Wegerif, 2005) and a shared subjectivity and empathy for the position of others evolves. When describing his own definition of dialogue, Paul commented that:

> We are demonstrating at times a degree of intersubjectivity… that we understand people at a deeper level and can almost predict what is going to be said. (Paul: Line 21)

He feels that there is a shared understanding and dynamic in a productive classroom and that this understanding is "within and around and between the class." Intersubjectivity opens doors to new information and stimulates thinking between the participants: "there's sometimes quite a frisson of excitement in the room when everyone thinks yeah; that's new stuff."

In his interview, Paul stressed his belief that engaging emotions to bring to the surface and crystallise tacit knowledge already present within the children was an important aspect of his practice. In doing so, he hopes that an enduring *feeling* of understanding can develop over time as they become conversant in the ongoing dialogue of humanity. The intention of dialogic teaching is to encourage attunement (Hennessy et al., 2016) and engagement (Haneda, 2017) with the **different perspectives** of others (another of the *a priori* themes summarised in the methodology: see Table 3.3). This was a theme within both Phase 1 participant interviews and during the second teacher interview, George spoke of the richness

that preliminary, small group dialogue can then bring to subsequent whole class discussion:

> we all come together as a class; you've got 22 people's impression of what might happen and then, generally the strands of thoughts and ideas will become more apparent because of that [initial] dialogue. (George: Line 54)

George's interview provided testimony that listening to others helps participants to build up their own ideas and knowledge, increasing their own *repertoires* of thought as the voices of others become internalised (Vygotsky, 1978). Reflecting on his teaching of history, George expressed his belief that exposing children to the thought process of people of the past is key to their understanding of the subject. He believes that through dialogue with testimony and evidence from the past, in addition to dialogue with their peers, children can get an *impression* of what characters from history might have felt. The ability to engage with different perspectives from other times and situations serves a cultural imperative; introducing students to existing knowledge and realities whilst inviting them to build upon a body of knowledge (Coffin and O'Halloran, 2008) and take part in the ongoing dialogue of humanity.

George's interview also attested to the idea that promoting **collaboration and community** (expanded upon in Phase 3) and **metacognition** are means through which a dialogic approach is effective. **Immediacy** was another of the *a priori* themes of this study and George also speculated upon this theme in his interview. The idea of immediacy as an affordance of the digital tools at hand to offer immediate feedback contingent on the input of the user (Kershner et al., 2020) was broadened in this study to account for the immediate access users have to information and resources when using the internet.

> ...it's not the be all and end all of the ability to teach history in the classroom. I think it certainly makes it easier to access deep and more diverse information and easier to deal with information and sources that you have. (George: Line 81)

Whilst George clearly did not believe digital tools were essential to the teaching of history, he considered that they do provide more immediate access to more information upon which dialogue can be based compared to traditional media. George also described some of the means by which grading and feedback can be automated within the Google Classroom (use of Google Forms or third party add ons such as Flubaroo) so that it is more immediate and can facilitate dialogue between teacher and student in real time (George: Line 110); as opposed to the taking in and marking of work in books with inevitable delays between the gathering, assessment and returning of work before dialogue can recommence.

These comments also touch upon an emerging theme within other teacher participant interviews; **dialogic space-time**. Further evidence for this as an affordance of dialogic teaching within the Google Classroom is reported in Phase 2 of this document.

V.1.3 Joint planning activities

In April 2017, the **first of three Phase 1 joint planning meetings** between the two teacher participants and myself (acting as a fellow practitioner-researcher) took place. The research questions of this DBR project were introduced and the features of exploratory dialogue (Mercer and Littleton, 2007) were used to prompt an initial discussion:

- Participants engage critically but constructively with one another's ideas.
- Everyone participates.
- Tentative ideas are treated with respect.
- Ideas may be challenged.
- Challenges are justified, reasons are given and alternative ideas or understandings are offered.
- Opinions are considered before decisions are made and agreement is sought.
- Knowledge is made publicly accountable and so reasoning is visible in the talk.

The group came to the decision to focus on devising an intervention that would *encourage everyone to participate*, to *justify their stances* and *make their knowledge explicit*. We also discussed the possible affordances of Google Classroom to promote classroom dialogue, adding *announcements* and *class questions* to a list of functions previously identified in the teacher questionnaire and participant interviews (namely; *Comments,* the *Classroom Stream* and *Share).* We then reviewed a geography lesson plan Paul provided (see Appendix 16); this included several discussion activities surrounding the development of the London 2012 Olympic site. An activity in which Paul intended to pause a documentary (CNN, 2012) at key moments was selected for augmentation. Paul's intention for this activity was to promote discussion between the children about sustainability and to identify different examples of this from the film. It was suggested that by using the *Share* function, children in the *augmented* second lesson could pause, discuss and review the video independently of the teacher. The lesson plan for Paul's second class (see Appendix 17) was therefore altered to include a Google Slides activity, whereby children were asked to select and annotate screenshots in a presentation shared with their partner, having first negotiated their choices. Furthermore, the children were to be encouraged to add *Comments* and expand or challenge the ideas of others. The focus activities for these geography lessons and others observed in the phase, along with further contextual information, are summarised below (see Table 5.2):

Table 5.2: Summary of focus activities observed in Phase 1 lessons.

Teacher	Lesson	Subject	Date	Class Size	Setting Arrangement	Mean CAT Score	Focus Activity
Paul	Standard	Geography	02/05/17	20	'Top' set determined by attainment in English	126	Teacher paused a 2012 documentary on the sustainable development of the London 2012 Olympic site at key moments to prompt small group discussion and note taking in exercise books.
Paul	Augmented	Geography	04/05/17	20	'Parallel' set (one of two below 'Top' set) determined by attainment in English	114	Discussion groups used Google Classroom to view the documentary independently of the teacher and select their own examples of sustainable design by taking screenshots of the video and adding annotations to a shared Google Slide show.
George	Standard	History	18/05/17	9	'Parallel' set (one of two below 'Top' set) determined by attainment in English	110	Discussion groups considered the long-term effects of the Black Death on medieval England, co-constructing mind-maps on paper before agreeing upon 'the most important consequence' which Teacher then added to an IWB display.
George	Augmented	History	18/05/17	17	'Top' set determined by attainment in English	123	Discussion groups considered the long-term effects of the Black Death on medieval England, before agreeing upon 'the most important consequence' which they recorded on a shared Google Slides presentation using their own choice of illustrating their ideas with the digital tools at hand.
Tristan	Standard	Science	26/05/17	17	'Top' set determined by attainment in science	123	Discussion groups prepared for a question and answer session from the class on how a musical instrument (brought into class by a volunteer) creates different sounds.
Tristan	Augmented	Science	09/06/17	12	'Parallel' set (one of two below 'Top' set) determined by attainment in science	110	Discussion groups prepared for a question and answer session from the class on how a musical instrument (brought into class by a volunteer) creates different sounds and created a single Google Slide (in a shared presentation) to illustrate their ideas.

In the **second joint planning meeting** (May 2017), Paul shared his thoughts on the two lessons he had delivered. He felt that the first, standard lesson had proceeded as he had expected and that the learning objectives had been achieved. He felt that in pausing the video he was able to prompt the children's thinking and guide their lines of enquiry. When listening to their conversation he felt that they "saw this as new information and they wanted to explore." After the second lesson, Paul was once again confident that the learning objectives had been achieved but commented on the different atmosphere in the room once the LMS was in play. He described this as positive and studious and noted that children in some of the discussion groups were displaying an intersubjectivity not seen in the first lesson; that the children were "connecting to one another." I*D*RF (Initiation, *Discussion,* Response, Feedback) sequences were framed by the technology and proved to be conducive to productive talk in this lesson (Mercer & Wegerif, 1999). This was in spite of some initial technical difficulties with sound and access to the video for some of the children.

Paul noted the body language of talk partners who, whilst looking at their own machines, chatted and collaborated simultaneously, describing a comfortable "at home on a beanbag" feel to the work. There was a studious, committed feel to the room but despite this, Paul commented that the Chromebook-based activity "did not allow us to really develop points until the plenary". He also felt less control over the direction and rate of the children's inquiry and the co-researcher group agreed that the circumnavigation of the teacher as a *filter* of content may well have changed the trajectory of the dialogue in Paul's second lesson.

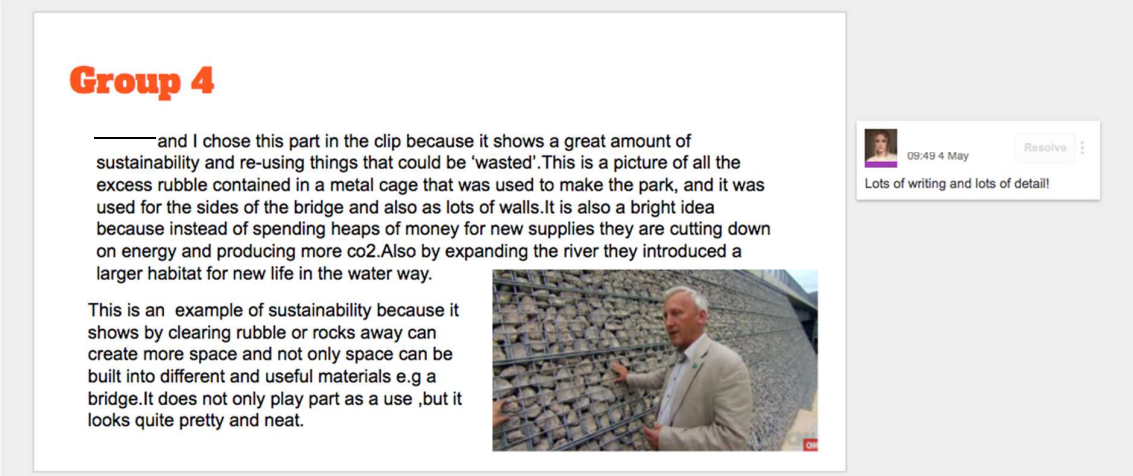


Figure 5.1: Google Slide (with comment) from a Year 7 geography lesson.

Paul agreed with my observation that the time he spent working with each pair was better attuned to the needs of the learners due to the fact that the video clips they had selected acted as clear prompts for his feedback. I also suggested that some of the examples of sustainability raised by the children had been different to those prompted by Paul in the first lesson. However, he felt that the outcomes were actually quite similar, but that the "journey was different". We all agreed that an apparent strength of the intervention was the removal of the teacher's control of the media. The manipulation of video by the children represented a novel task, made possible by the technology at hand (Crook et al., 2010) rather than merely the digitisation of a traditional activity.

The group remarked that very few of the children moved on to comment or exchange in dialogue with any other group's work as had been hoped and where they had done so, the comments failed to build upon one another's ideas (see Fig. 5.1). Paul observed that the children were "wrapped up in what they were doing" and did not find time to move on. With this in mind, we decided that in George's augmented lesson we would focus solely on encouraging dialogue between small groups of students (whilst they selected and manipulated media) rather than expecting them to also engage in written dialogue with other groups.

The remainder of the second joint planning meeting was spent discussing the lesson plan George had provided for a Year 7 history lesson wherein children were to consider the long-term effects of the Black Death on medieval England. George planned to ask pairs of children to consider a range of effects before agreeing upon 'the most important consequence' which he would add to an interactive whiteboard presentation (see Fig.5.2). We decided that it would be during this activity that dialogue might be better served by features of Google Classroom. In keeping with Paul's intervention, George agreed to provide the children in his augmented lesson with a blank Google Slides presentation in which they could write (and share) their answer to the question for themselves; thereby selecting their own means of illustrating their thoughts rather than using the shared central interactive whiteboard display.

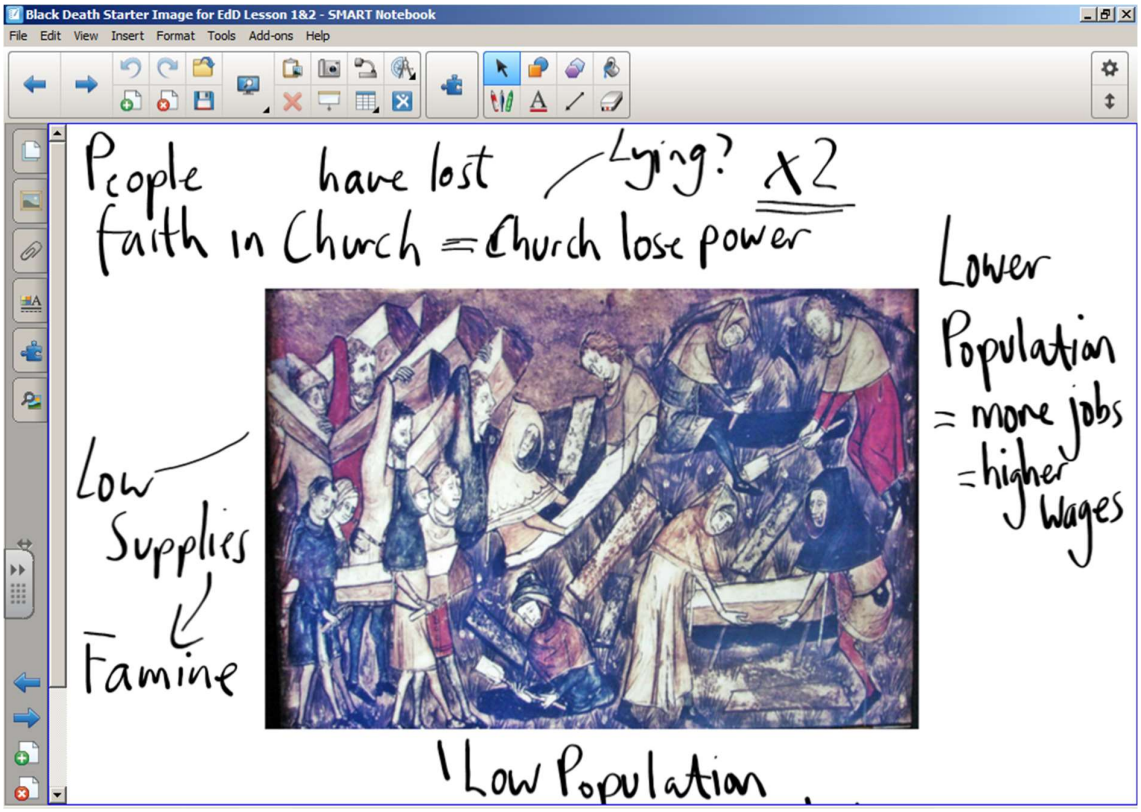


Figure 5.2: Annotated interactive whiteboard slide from a Year 7 history lesson.

In the **third joint planning meeting**, George shared his thoughts on the two lessons he had delivered and was particularly pleased with how the 'consequences'

discussion had proceeded in the first. This was delivered to a very small group (with only nine students in the class on the day) and on the whole they seemed curious and happy to share their ideas with one another. Indeed, George felt he had to "bully" one group into ending their discussion before they had reached a consensus and noted how rich and productive their argumentation was. I also shared an example of the power of 'talk time' I had seen in the lesson whereby one girl, who tends to be reticent to share her ideas with the class, was visibly thrilled when George praised her group's contribution. Even though she had not been the one to utter it to the class, she felt an ownership of the idea and may not have offered it for critique if not for the 'talk time' provided.

George did not feel the same activity went as well with the second class who undertook the augmented lesson plan. The increased number of children (17) and distribution of the Chromebooks meant that the activity took longer to conduct and the dialogue did not happen as readily. George remarked on the fact that as they logged onto the machines, talk stopped and that he had to prompt them to use talk to complete the task successfully. He feels this may have been due to the mechanics of logging on and that once underway discussions were in fact productive. Whilst using Google Slides, children shared their thoughts and ideas more completely and one group offered a consequence (that the leadership structure collapsed) that had not been anticipated by the teacher. Once again, there was a consensus between the teacher participants that the intervention (see Fig. 5.3) had led to more explicit reasoning, connections and the better coordination of ideas (see meeting minutes in Appendix 2). The group also felt that limitations placed on the design of the slides (limiting the number of slides and images to be used) increased opportunities for dialogue by creating more actions that required the opinions of others to be considered. The intervention also made knowledge publicly accountable and enabled students to engage critically with one another's ideas by virtue of being shared with all members of the class who could observe in real time as ideas were added to the slides of one another.

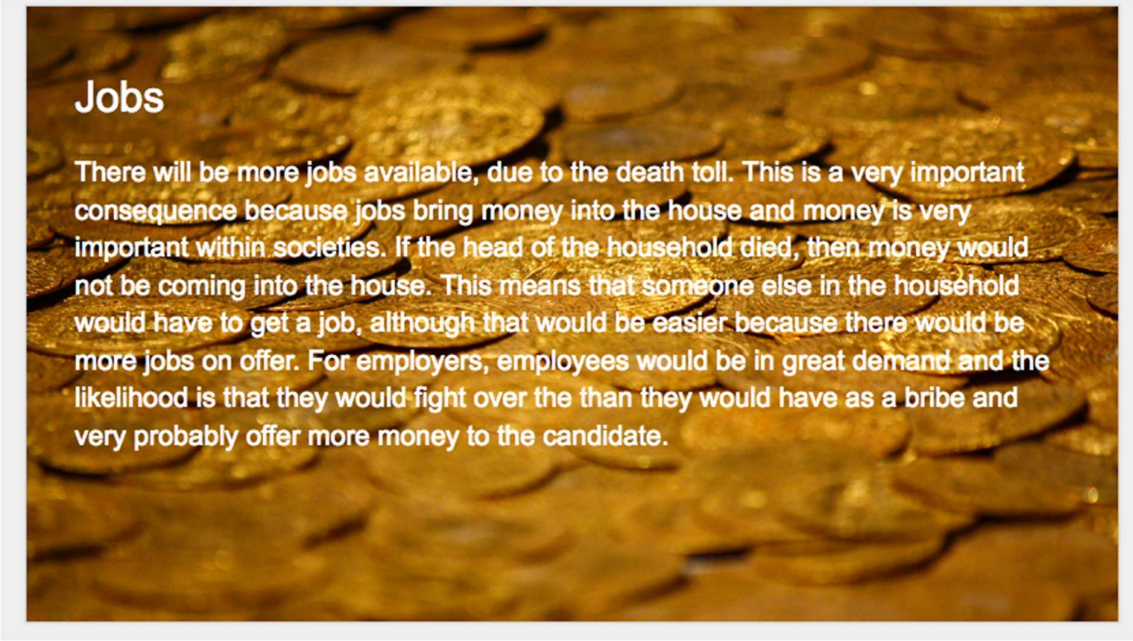


Figure 5.3: Google Slide created during a Year 7 history lesson.

With these findings in mind the group looked at a Year 7 science lesson plan to be delivered by myself. As part of this lesson plan on the topic of 'Sound', students were asked to find information and create materials to support a short presentation about how different sounds are created by musical instruments in small groups. Paul suggested that rather than preparing a *fixed* presentation, the children should prepare to hold question-and-answer sessions on a musical instrument. The group agreed that this approach would increase the opportunities for dialogue between the children and the *standard* lesson plan was altered accordingly. We then identified the preparation for this question and answer session as an opportunity to further dialogue between the students using the same 'Slide' intervention described above, limiting the children to only 20 words and two images per group (see Fig. 5.4).

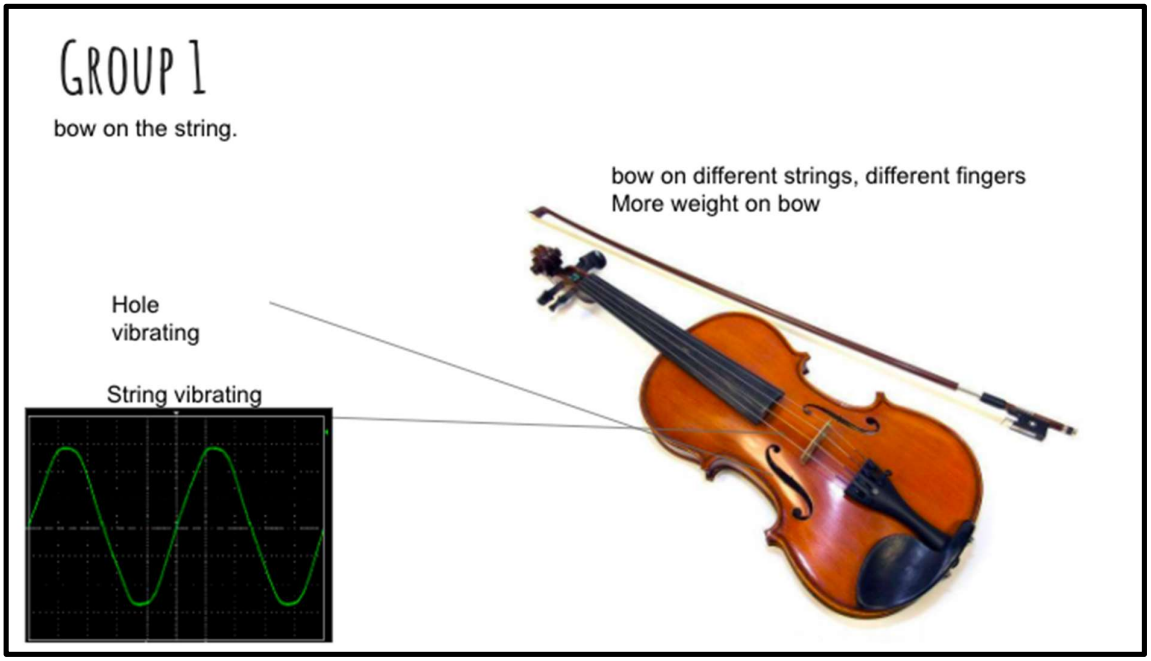


Figure 5.4: Google Slide created during a Year 7 science lesson.

Following the third *augmented* lesson of this Phase, the participants informally discussed my observations from the science lessons. There was a feeling that in both the *standard* and *augmented* lessons, there was not a great deal of productive talk during preparations for the question and answer activity; although the question and answer activities themselves led to productive dialogue in the plenary of the lessons. This may have been due to the role that one child inevitably found themselves in each group, that of the *expert.* In each group a volunteer had brought their own instrument to the science lesson and this was used as the basis of the group's work and discussion. This created an *expert-novice* dynamic at the centre of each group, not dissimilar to that of the traditional, monologic role of a teacher and their class. In this instance, a vertical transmission of existing knowledge rather than the co-construction of new knowledge was taking place. The participants agreed that this imbalance should be avoided in subsequent phases and in this particular instance, perhaps instruments that were novel to all (for example, from other cultures) would have better promoted dialogue between the children in this particular lesson.

V.1.4 Analysis of classroom dialogue

Small high definition cameras (Phillips Cam 110 models) were used to capture interactions of three pairs or small groups of children in each of the Phase 1 lessons. In each case, audio from the focus activity that was selected for augmentation during the joint planning meetings was transcribed. Transcripts of the verbal interactions, in addition to any artifacts generated by the children, were then coded using selected codes from the Cam-UNAM Scheme for Educational Dialogue Analysis (SEDA) Wayne et al. (2008) as described in the Methodology (see Section III.9.2) of this project. See Appendix 16 for an overview of the coding results for the Phase.

Paul's focus activity in the **first participant's lessons** was a discussion activity based upon a video about the 2012 Olympic urban regeneration project (CNN, 2012). The standard lesson, delivered to a higher attaining set of Year 7 geography students in May 2017, gave the children a total of 7 minutes of paired discussion time for the focus activity. This took place after Paul had presented the video to them, pausing and restarting to point out key points. The children in this standard lesson were encouraged to make notes in their books as they discussed how the film illustrated sustainability in action. The augmented lesson plan was then delivered to a parallel set which allowed the children to control and manipulate the video playback using features of the Google Classroom LMS. Children were asked to select their own screenshots to include in their joint notes on a shared Google Slide and were given 27 minutes to complete this extended task.

The numbers of dialogic moves were adjusted to account for the differences in the length of time given over to the focus activity in each lesson (as described in Section III.9.2). Frequencies are reported rounded to the nearest whole number and represent the adjusted total per 12 minute episode. The number of total dialogic moves reduced from 43 to 12 between the standard and augmented activities in Paul's lessons. Whilst similar numbers of moves that invite elaboration or reasoning and positioning and coordinating were seen in the focus activity of both (see Table 5.3), there was a marked reduction in the number of moves where participants make

their reasoning explicit (Standard = 11, Augmented = 2). A greater difference was observed in moves where participants build upon ideas (Standard = 27, Augmented = 5).

Table 5.3: Cluster level coding of dialogue during focus activities of Phase 1, Participant 1 lessons.

Lesson	Group	Inviting elaboration or reasoning	Making reasoning explicit	Building on ideas	Positioning and coordinating	Total Dialogic Moves
Standard	1	2	2	9	2	14
Standard	2	0	9	34	2	44
Standard	3	5	21	37	5	69
Standard	**Mean**	**2**	**11**	**27**	**3**	**43**
Augmented	1	3	1	2	1	7
Augmented	2	4	3	9	5	21
Augmented	3	3	2	3	1	9
Augmented	**Mean**	**3**	**2**	**5**	**3**	**12**

In the **second participant's lessons**, George delivered history lessons to two Year 7 classes in May 2017. In the first lesson, the standard version of the focus activity was delivered to a parallel set of children. Pairs (and one group of three due to an odd number of children in the group) of students were given 7 minutes to complete a discussion activity and agree upon what the 'most important consequence of the black death was'. Subsequently, George delivered the augmented lesson plan to a top set of children who were asked to record their joint answer to the question on a shared Google Slides presentation via a Google Classroom assignment. The pairs were also asked to devise a means of illustrating their idea on their slide and were given 15 minutes to complete the task. Due to a fault with the second camera, audiovisual data was only collected for two pairs of children on this occasion.

Similarly to the first participant's lessons, the number of total dialogic moves reduced from 54 to 18 between the standard and augmented activities in George's history lessons. In this instance, the coded dialogue reduced in all four analysed clusters

(see Table 5.4). This reduced number of dialogic moves was in keeping with George's report to the group during the third joint planning meeting. As George put it to the class during the augmented lesson, "We've opened the Chromebooks, it's stopped the discussion. Which is interesting."

Table 5.4: Cluster level coding of dialogue during focus activities of Phase 1, Participant 2 lessons.

Lesson	Group	Inviting elaboration or reasoning	Making reasoning explicit	Building on ideas	Positioning and coordinating	Total Dialogic Moves
Standard	1	13	10	31	13	66
Standard	2	7	11	31	15	64
Standard	3	2	2	21	6	31
Standard	**Mean**	**7**	**8**	**28**	**11**	**54**
Augmented	1	1	2	12	7	22
Augmented	3	2	2	5	3	13
Augmented	**Mean**	**2**	**2**	**9**	**5**	**18**

The **third participant's lessons** were delivered by myself (in the role of practitioner-researcher) to two Year 7 science classes. These lessons were on the topic of 'Sound' and students were charged with preparing for a question and answer (Q&A) session about how different musical instruments work. The children's discussions as they prepared for the Q&A were the focus activities for these lessons. In the standard lesson, delivered to a higher attaining science set in May 2017, the children were able to use the internet for research but only recorded their notes onto a mini dry-erase whiteboard. The small groups (three or four children) were given 13 minutes to complete the task and prepare for the Q&A. In the augmented lesson, delivered to a parallel set in June 2017, the children were also given the opportunity to edit a shared Google Slides presentation (via the Google Classroom LMS) to help communicate their ideas during the Q&A. The children in this second lesson were given 17 minutes to collaborate in their small groups and complete this task.

In keeping with my own reflections on the lesson, coding of the transcripts from the Phase 1, Participant 3 lessons showed that a relatively low number of total dialogic moves took place amongst the student groups in both the standard (18) and augmented (16) science lessons. There was no significant difference between the numbers of any of the four SEDA clusters that were the focus of the analysis (see Table 5.5).

Table 5.5: Cluster level coding of dialogue during focus activities of Phase 1, Participant 3 lessons.

Lesson	Group	Inviting elaboration or reasoning	Making reasoning explicit	Building on ideas	Positioning and coordinating	Total Dialogic Moves
Standard	1	4	2	5	3	13
Standard	2	8	1	12	4	24
Standard	3	5	2	9	3	18
Standard	**Mean**	**5**	**2**	**8**	**3**	**18**
Augmented	1	8	3	8	1	20
Augmented	2	4	3	7	1	15
Augmented	3	5	2	7	1	15
Augmented	**Mean**	**6**	**3**	**7**	**1**	**16**

V.1.5 Student interviews

Following each of the three *augmented* lessons in this phase, a Year 7 student was selected for an interview as per the sampling strategy outlined in Section III.7.5, which made use of the children's Cognitive Reasoning Test (CAT4, GL Assessment) scores. Following the lessons by Paul, the child with the median average score for the class, a boy with a 115 average CAT score, was selected. A girl with the highest CAT average (131) was selected from George's class and following this researcher's own augmented lesson, a boy with the lowest CAT score in the class (104) was invited to take part. These children were then asked to invite two friends to accompany them in their joint interviews. Following the thematic analysis of the interview transcripts (see Section III.9.1 for details) the themes of **accessibility,**

immediacy, provisionality and **different perspectives** characterised the three student interviews in Phase 1. Evidence for another *a priori* theme, **collaboration and community**, was also found, a theme that is expanded upon in Phase 3 of this report.

Table 5.6: Summary of supporting evidence for themes reported in Phase 1 student interviews.

Theme	Description	Example Excerpt(s)	Supporting Data	Key Words
Accessibility	Digital access to a wide range of resources.	Well, it's quite useful because the internet has lots and lots of stuff and you can get pretty much everything you can get in books on the computer. But I also think, having books and maps and being able to read maps and things is obviously really important. So it's a mixture basically. (1.1: Line 19) Well we've been using iPads in Art and doing digital drawing and I think that's really good. I really like that kind of feel of doing a picture. Because basically you're having one tool to rule them all as it were. Because you can get access to every kind of paint brush, you can get different colours but you don't actually have to go over and get different thinness of paintbrush. You don't have to go get a stylus pen. You don't have to get this roller, you don't have to go get that paint. So they might not have the kind of colour you want, you can just get it and I think that's really useful. (1.1: Line 47)	Interview 1.1: Lines 19, 22, 23 & 53 Interview 1.3: Lines 40, 45 & 54	Chromebooks, everything you can get in books, found, Google Translate, Google Search, information, research, thesaurus
Different Perspectives	Exposing participants to the perspectives and views of others through dialogue.	Well, you can still talk to people on the other side of the room without shouting because you can comment on their work if it's accessed with you. But, with communication I don't think it has changed much because you still have a partner next to you, you can chat about stuff that you've found. You can share work, you can work together and you still talk. You can comment, like I said, on people on the other side of the classroom. So you can talk to basically everyone in the classroom. (1.1: Line 40)	Interview 1.1: Lines 5, 13, & 40 Interview 1.2: Lines 18, 20, 21, 47 & 81 Interview 1.3: Line 5	comment, different, everyone else's input, ideas, opinion, share ideas, talk, views

		Yeah because it's nice if you can get everyone else's input into it. Because then you are like, it might make it easier for you to learn something if someone else said it. Like one of your friends or someone like one of your classmates said it because sometimes it's quite hard to learn something if a teacher says it because they put a lot of facts into it but your friends sometimes say a little bit of fact and say something else which helps you remember. (1.2: Line 18) if I was on my own I might have chosen something different. Something that I now think wasn't the right [answer]. (1.2: Line 47)		
Immediacy	The ability to provide users with immediate feedback and information contingent on their input.	Instead of asking the teacher a question, which could take a few minutes if they're answering someone else, you could just search up the word and you'd have it. (1.1: Line 31) You don't have to hand anything in for the teacher to mark it so you could, you don't have to bring your computer with you. That's nice. They can mark it as you do your prep. It's a lot quicker. (1.1: Line 42) ...teachers are all over the place helping everyone and they could go around the other side of the room and you've been waiting with your hand up for 5 minutes or so still waiting for her. So if you had some iPads you could look up on the internet to do the question. (1.1 Line 57)	Interview 1.1: Lines 31, 23, 42, 55 & 57 Interview 1.2: Lines 100 &112 Interview 1.3: Lines 45 & 59	easier, Google Classroom, hand in, quicker, search, taking a while, waiting
Provisionality	The ability to shape, debate, reposition and improve digital artifacts.	I really like having someone next to me telling me "Oh look at that bit over there, you've missed it" but I also quite like the feel of someone, on a computer, by themselves, perhaps on the other side of the room. Because I might have the person next to me's view, and that could be really constructive but then if I want more views then I'm pretty much stopped there because I can't get anyone other than who's next to me so, thanks to Classroom and stuff like that I can share it with them and they can see it and mark it and have a look at it. (1.1: Line 41)	Interview 1.1: Lines 41 & 50 Interview 1.2: Lines 98, 101, 113 & 114	delete, edit stuff, editing, do it again, experimenting, look at that, refer back, share, start again

		...So when you're doing an experiment and you get a result which you think looks odd and then you have to do it again it's much easier if you can immediately delete it and just start again... (1.2: Line 98) You can edit stuff. (1.2: Line 113)		

Accessibility, the access that digital tools provide to a wide range of resources beyond the border of the classroom (Major et al., 2018b), was a theme within the student interviews of Phase 1. The children described their enjoyment when working with a wide variety of resources, both digital and traditional rather than being restricted to a single approach that may only benefit certain learner profiles. The interviewees particularly appreciated the range of tools available when working online and the greater variety of approaches and information they can find there; rather than being restricted only to a point of view or method provided by their teacher. The children interviewed gave positive examples from a range of subjects including history, geography, science, English and art where use of digital tools was widely encouraged in the school at the time:

> You can get access to every kind of paint brush, you can get different colours but you don't actually have to go over and get different thinness of paintbrush. You don't have to go get a stylus pen. You don't have to get this roller, you don't have to go get that paint. So they might not have the kind of colour you want, you can just get it and I think that's really useful. (Student Interview 1.1: Line 47)

However, as one child described, “some of the computer stuff like Wikipedia is all adult sort of stuff and the kids sometimes don't understand it.” Assigning work through the Google Classroom can help to direct children towards curated materials so as to keep dialogue and learning within a predetermined scope set by the teacher.

The theme of **immediacy**, the ability to provide users with immediate feedback and information, was also present in the student interviews of Phase 1, as it was in the interview with the second teacher participant.

> You can find your own information. You don't have to ask or get a book to research it. You can just type it in and you'll probably get the answer. (Student Interview 1.1: Line 22)

One reason children value the immediacy of the feedback they receive when working within Google Classroom is that there tends to be a delay between asking for support in a classroom and the teacher being able to provide it. While modern communication is “immediately dialogic and communal” (Wegerif, 2007, p.174), in a classroom setting a teacher needs to navigate both the physical space and the needs of others in the room before they are able to provide feedback to an individual. In particular, the children stated they would value this in some of the lessons that did not make extensive use of digital tools at the time of interview (such as maths) where they know there are materials that could help them online but they are not in a position to access whilst in school.

The children also discussed the theme of **provisionality** as an affordance of a LMS to support dialogue in the Phase 1 interviews. The ability to shape, debate, reposition and improve digital artifacts was considered to be of value by the students. The children repeatedly referred to the *share* function of Google Classroom in the Phase 1 interviews. This function was being used by students to have their ideas critiqued by others in order to better refine them thanks to the provisionality of the artifacts. This seemed to occur despite the fact they were not necessarily directed to do so by a teacher or actually tasked with collaborating to co-construct an artifact:

> I really like having someone next to me telling me "Oh look at that bit over there, you've missed it" but I also quite like the feel of someone, on a computer, by themselves, perhaps on the other side of the room. Because I might have the person next to me's view, and that could be really constructive

> but then if I want more views then I'm pretty much stopped there because I can't get anyone other than who's next to me so, thanks to Classroom and stuff like that I can share it with them and they can see it and mark it and have a look at it. (Student Interview 1.1: Line 41)

The fact that the sharing of artifacts is not restricted to those in physical proximity is valued by the children and opens a greater number of ideas up for debate. Acknowledgement and critique of different opinions is one of the top five recurring themes in the literature on the topic of productive dialogue (Howe et al., 2019). In keeping with both teacher participant interviews in Phase 1, the student interviews also highlighted the role that exposure to **different perspectives** plays in dialogic teaching and the affordances of Google Classroom to promote this. The children discussed the positive outcomes of being exposed to the perspectives of others, not least the increased engagement and interest they feel when this takes place. The Year 7 students interviewed felt that this was not only founded upon, but increased, a sense of mutual respect in their lessons:

> I thought the talk was very positive. Not something like "Oh no, you've got that wrong you need to change that". It's more like "Oh, I think you might have done something a bit different there. What do you think about this?". (Student Interview 1.1: Line 13)

In general, the children interviewed felt empowered to challenge the views of others and to receive and act on constructive criticism themselves. When working within the Google Classroom, this dialogue is no longer restricted to the children that immediately surround them and contributions are no longer limited to those who raise their hands and have their answers vetted by the teacher.

V.1.6 Provisional theories

The data gathered in Phase 1 of this DBR project has provided initial evidence for the three research questions at hand and allowed for *provisional* theories to be postulated:

RQ 1. What affordances do LMS (specifically Google Classroom) provide for the teacher mediation of dialogic learning?

Evidence from the Phase 1 of this DBR study suggested that Google Classroom affords dialogic practitioners the opportunity to further students' metacognition, intersubjectivity and awareness of different perspectives. The accessibility, immediacy and provisionality of knowledge artifacts within the LMS were identified as potential means through which this is possible.

Presenting students with the opportunity to co-construct knowledge and artifacts within the Google Classroom encourages **metacognition** whereby they "think about their own thinking and the thinking of others'" (Major et al., 2018b, p.2005). **Intersubjectivity** can then be built upon this metacognition, as a shared subjectivity and empathy for the position of others evolves. As evidenced in Phase 1 of this DBR project, a corporate feeling within and between students can be brought about through dialogue, leading participants towards a shared humanity. As Paul (Participant 1 in this phase) suggested in his interview, dialogue produces "a sort of playing field [where] we all understand the rules, we understand what we're trying to get to and we understand each other".

It is widely accepted that becoming educated is not simply a matter of accumulating information; it involves the gradual induction of students into new perspectives on the world" (Mercer, 2008, p.34). In reflective dialogue (Wegerif, 2013), the **different perspectives** of participants are made explicit to one another and the gaps between these remain open. Participants may then adjust their thoughts and opinions in the light of new information and the ideas of others. Evidence from Phase 1 of this DBR project suggests that Google Classroom has affordances that can promote this including the use of the *share* function within assignments. The Year 7 children interviewed in this phase discussed the positive outcomes of being exposed to the perspectives of others through the LMS, not least the increased engagement and interest they feel when this takes place. In this regard, dialogue serves a cultural

imperative, introducing students to existing knowledge and realities whilst inviting them to build upon a body of knowledge (Coffin and O'Halloran, 2008) and take part in the ongoing dialogue of humanity.

The **accessibility** that digital tools provide to a wide range of resources beyond the border of the classroom (Hennessy, 2020) is one means by which Google Classroom might facilitate dialogue, as evidenced by the data of Phase 1. Dialogue is made possible with voices and artifacts from a range of times and cultures furthering the repertoires of thought that the students develop. However, whilst LMS may provide users with access to an infinite number of resources through their search engines and functionality, they paradoxically provide a mechanism for teachers to curate and reduce the range of online materials available to students. When setting assignments on Google Classroom, for instance, teachers may guide students towards resources that are suited to the task at hand in order to promote productive talk but in so doing, curtail other possible avenues of dialogic inquiry.

The **immediacy** of access to these resources, information and feedback made possible through the digital tools of Google Classroom is another affordance of the LMS that could support dialogue. In reducing the time between dialogue turns when work is submitted, assessed and returned to a student, Google Classroom can allow dialogue to flow with fewer interruptions between student and teacher. The Phase 1 data also suggests that **provisionality** is an affordance of the LMS to support dialogue. The ability to shape, debate, reposition and improve digital artifacts was considered to be of great import by the students interviewed in this phase (see Section V.1.5).

RQ 2. Do LMS open up new spaces for dialogue?

In using Google Slides in such a way that the ideas of all groups are immediately available for consideration and comment, the augmented lessons of Phase 1 made participants' knowledge explicit and was a means to engender dialogue (Mercer & Littleton, 2007). The students interviewed in Phase 1 appeared to value the

opportunity to engage in multiple dialogues with their peers, using the *share* and *comments* functions of the Google Classroom to do so. This allowed children to engage in dialogue with a wider variety of people, not just those talk partners in their immediate time and space and in some instances, ideas and knowledge that had not been anticipated by the teacher were then generated within this digital space.

> You can comment, like I said, on people on the other side of the classroom. So you can talk to basically everyone in the classroom. (Student Interview 1.1: Line 40)

Evidence from the teacher and student interviews of this phase also referred to their use of other spaces that the LMS provides for dialogue such as the associated *Padlet* app (https://en-gb.padlet.com/). This allows users to share ideas and resources via virtual bulletin boards, linked to their Google Classroom accounts. The Google Classroom *Stream* itself can also be used for this purpose, referred back to and further refined as the dialogue which surrounds these mutable artifacts continues. Both of these digital spaces were reported as examples of useful forums for dialogue by George and his history students when interviewed in Phase 1 as, “what they produce, or their thinking, or their questioning… if it's recorded then it's still there” (George: Line 87) and they can, “refer back to it” (Student Interview 1.2: Line 101).

RQ 3. What is the nature of interaction within a LMS?

In the first Phase of this DBR project, whilst the potential affordances of the Google Classroom to support dialogue (as described above) were identified by participants, the attempts to leverage these in the observed lessons did not lead to an increased number of total dialogic moves (see Fig.5.5).

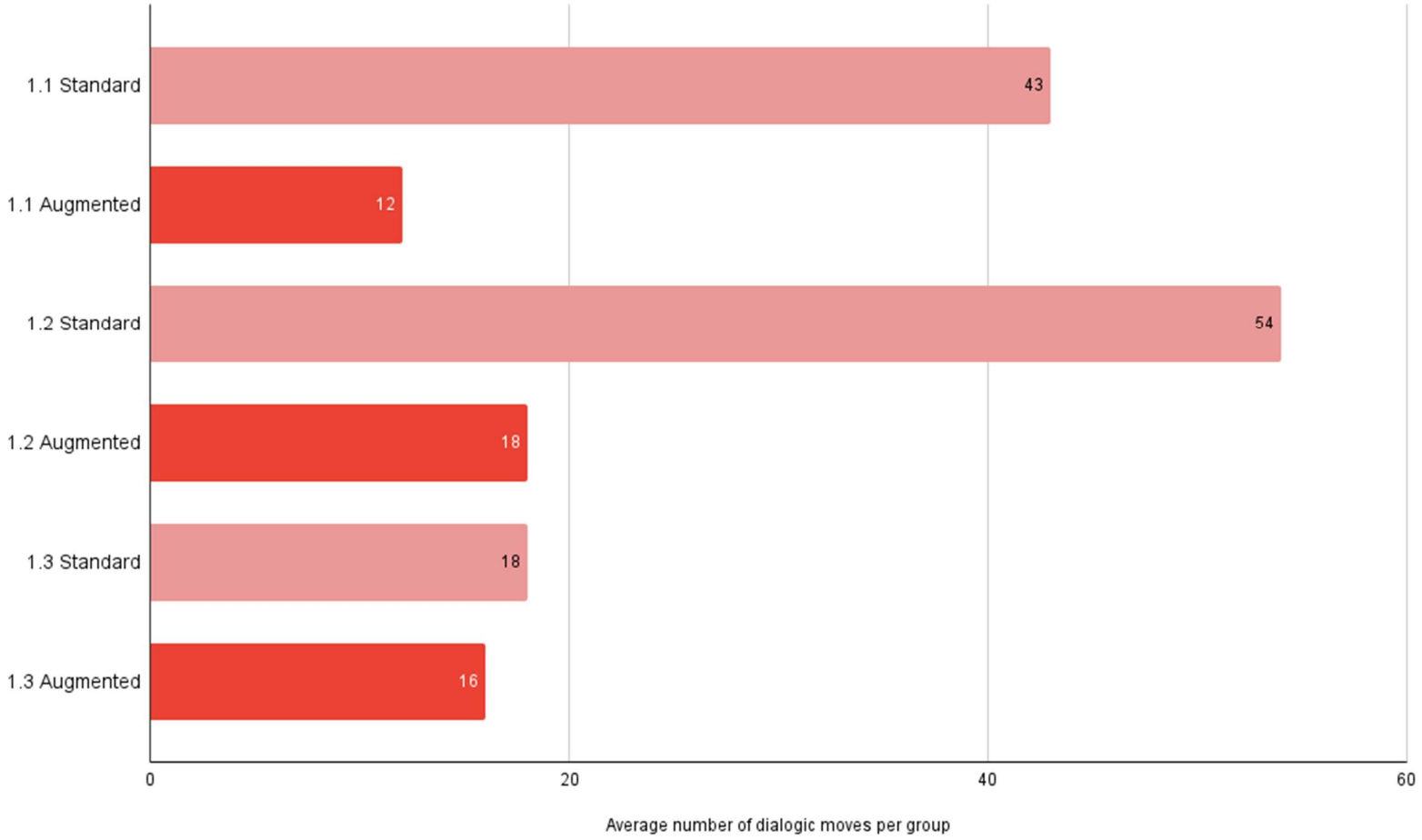


Figure 5.5: Average number of dialogic moves per group during the focus activities of Phase 1 lessons.

At the cluster level, reductions in the numbers of positioning and coordination moves were noted in both Participant 2 (Standard = 11, Augmented = 5) and Participant 3's (Standard = 3, Augmented = 1) lessons. This might perhaps be explained by the 'physical' manipulation of media on screen which replaced moves that would otherwise be verbal in nature as the children co-constructed artifacts. This shift towards 'non-verbal' dialogue would have been made possible by the provisionality of items in the Google Classroom LMS.

Whilst reduced in frequency, the nature of the dialogue within the LMS was fundamentally altered by the children's ability to manipulate the media directly; as opposed to a teacher moderating their contributions and summarising their ideas on a central whiteboard or display. This removed the traditional power structure as the children were able to circumnavigate the teacher's *filter* of ideas, opening up novel routes for dialogue to take. Working in this way, a dialogic practitioner continues to play an important role in introducing children to the discourse of their culture but with even less certainty over the direction that dialogue might take.

The students interviewed in this phase also reported a greater sense of equality when using Google Classroom as contributions were no longer limited to those children who raise their hands and have their answers successfully vetted by the teacher. The collegiate nature of the Google Classroom activities observed in Phase 1 resulted in an intersubjectivity. The body language of the children when working collaboratively with the Google Classroom tools was summarised by Paul as an "at home on a beanbag" feel. The participants worked productively and were open to one another's ideas. The Google Classroom allowed these ideas to be more widely broadcast and gave children the opportunity to engage with multiple perspectives. One student described an advantage of this open natured dialogue:

> It might make it easier for you to learn something if someone else said it. Like one of your friends or one of your classmates… because sometimes it's quite hard to learn something if a teacher says it because they put a lot of facts into it. (Student Interview 1.2: Line 18)

This might suggest that the LMS gives students the opportunity to find an alternative expert voice to that of their teacher. The Google Classroom affords them the opportunity to access voices that may be better attuned to their own and in a closer Zone of Proximal Development (Vygotsky, 1978 p.86) in order for them to further their own understanding.

V.1.7 Refinements after Phase 1

The joint planning activities proved to be successful and engaging with fellow practitioners in professional conversations encouraged reflexivity about our teaching practices. The joint planning meetings led to the co-creation of interventions that altered the nature of dialogue within the participants' lessons; emboldening the teachers to decentralise their control of digital resources to the benefit of the children.

As a result of the three joint planning exercises and the provisional theories that followed, the following refinements were brought forward to the next phase of the DBR project:

- Use of the *Share* function of the Google Classroom.
- Creating a single shared Google Slides presentation for the class.
- Assigning a single slide (within the shared Google Slides presentation) to each group.
- Placing design limitations on the use of the slides.
- Promoting the manipulation of digital media.

Using the *Share* function and a single shared slideshow not only provided the children access to the ideas of others, but encouraged them to participate and make their own knowledge and ideas explicit. Assigning single slides to pairs (or groups) of children and placing further imitations on their designs increased opportunities for dialogue by creating more actions that required the opinions of others to be

considered. Another refinement of Phase 1 to be taken forward was the removal of the teacher's control of the media being used. The manipulation of digital video, information and images by the children represented a novel task, made possible by the technology at hand (Crook et al., 2010) rather than merely the digitisation of an otherwise traditional activity.

The shared nature of artifacts within the Google Classroom affords users the opportunity to comment and engage in dialogue with other groups. However, evidence for this taking place (despite encouragement from participating teachers) was lacking in the observed lessons of Phase 1. The participant group remarked that very few of the children moved on to comment or exchange in dialogue with any other group's work as had been hoped and where they had done so, the comments failed to build upon one another's ideas (see Fig.5.1). Whilst this functionality will still be in place, it was decided that encouraging dialogue between the small groups of students (whilst they selected and manipulated media) is of greater importance during the lesson time. Removing the *expectation* for them to also engage in written dialogue with other groups was predicted to be beneficial for children in the next phase.

In Phase 1, a requirement to reach consensus through dialogue was present in the small group tasks delivered by all three participants. As discussed in the Literature Review (Part II), in subsequent phases of this project, a move away from dialectical argumentation towards a more reflective dialogue was taken forward. Another issue to be avoided in subsequent phases of this DBR project was the design of tasks that create an expert-novice power dynamic, as seen in the science lessons delivered by myself in Phase 1.

Phase 2

V.2.1 Introduction

Following a review of the teacher questionnaire conducted in 2017 (see Part IV: Preliminary Findings for details), two more teachers of Year 7 children (11-12 years old) were identified as being potential participants for the study. Both strongly agreed with the statement that, “Promoting dialogue between the children is important in my subject(s)” and disagreed with the statement, “Educational technologies do not fit the subjects that I most often teach”. Both were happy to be approached to take part in the DBR project and accepted the invitation to be Phase 2 participants in March 2018.

‘Rebecca’ is a teacher of English who had worked at the school for nine years prior to the study whilst ‘Laura’ is an Art teacher who had been with the school for 5 years. Coincidentally, both practitioners had become teachers at the preparatory school following a career change into teaching in their forties. As was the case in Phase 1 of the project, I acted as the third participant in my capacity as a Year 7 science teacher.

V.2.2 Teacher interviews

In March 2018, the Phase 2 teacher participants took part in semi-structured interviews. The interviews were recorded using a smartphone dictaphone app in a comfortable, neutral meeting space that the participants were familiar with. Interviews with both teachers took place before the first joint planning meetings. Audio files were then transcribed using InqScribe (version 2.2.4.262) software and thematically coded (as outlined in Section III.9 of the Methodology). A summary of the major themes identified in the Phase 2 teacher interviews (and selected supporting evidence) can be seen in Table 5.7, followed by further exploration of each theme below.

Table 5.7: Summary of supporting evidence for themes reported in Phase 2 Teacher Interviews.

Theme	Description	Example Excerpt(s)	Supporting Data	Key Words
Barriers to Dialogue	Factors which prohibit or limit productive classroom dialogue.	The children like it when you're very very clear about how you get the marks. (Rebecca: Line 31) Some children struggle with the freedom of it and they disappear down a rabbit hole and you have to make sure you're circulating. (Rebecca: Line 96) …when you're collaborating, it's quite hard to tell who's done what bit. So there's a bit more hiding and a bit more ability to slide I feel. So accountability I think it's something to bear in mind if there's more than one child working on something. (Rebecca: Line 101)	Rebecca: Lines, 27, 28, 29, 31, 41, 96 & 101	accountability, clear, engagement, exam preparation, guided, prejudice, purposeful
Dialogic Space-Time	The means through which ongoing and expansive dialogue can take place; unbounded by physical space or time.	I can show bits of film or play bits of audio or use images and then they can be there for the children to use at their leisure if they want to listen to them again or go back to them when they're working from home. So you get there's a lot more you can, there's a much richer set of resources that you can put at the children's fingertips. (Rebecca: Line 89) They realise the potentials of where you can go and that you can use your imagination and your subconscious and your dreams as well as the actuality of what's realistically there, within their work. (Laura: Line 37)	Rebecca: Lines 52, 78, 89 & 92 Laura: Lines 26, 31, 36, 37, 44, 73 & 79	different ways of seeing, flipped learning, go back, imaginations, look back, listen again, next steps, potentials, self-led, various stages, visual language
Factors Limiting Digital Technology Use	Barriers and considerations that restrict the use of digital tools in the classroom.	...sometimes I can get caught out by children going off task because they have the internet at their fingertips. (Rebecca: Line 96) A good question is whether or not it has to be embedded at this age or whether it should be... Some people might argue, and I do believe in this, but I can see that some people think that at this stage that it should all be about paper and charcoal and pen and paint. (Laura: Line 51) It's not like Pandora's box, there's a lot of really good stuff but it's... again you have to be very careful how you use it I think	Rebecca: Line 96 Laura: Lines 51, 54, 55, 60, 61, 81, 87 & 89	careful, copy, dangers, embedded at this age, lack of confidence, off task, not original, Pandora's box, Pinterest, repetitive, temptation, wary

		because of the temptation, if the iPads are there; they love going on them and it's easy to use them as source material. (Laura: Line 54) I've had children come in and they'll have done a really interesting painting, then I've looked on Pinterest and it's like they've copied it lock stock and barrel from Pinterest without furthering their own, you know, their own things that they put into it. (Laura: Line 61)		
Provisionality	The ability to shape, debate, reposition and improve digital artifacts.	...one of the main skills that we are hoping that the children develop is fluency in writing. The fact that they can edit and modify it, in the old days you write a piece of writing then I would correct it and then they'd have to write it out again. (Rebecca: Line 74) ...they don't approach it with a heavy heart. They can correct it really easily and I think that's very good for their confidence and makes them feel that writing is a plastic thing rather than a thing that's fixed and so it must be perfect the first time you do it. So it's great for that. (Rebecca: Line 75)	Rebecca: Lines 51, 74, 75 & 87 Laura: Lines 65 & 66	correct it, easily changed, edit, modify, plastic

Rebecca's interview included the *a priori* themes of **accessibility** (reported in Phase 3) and **provisionality**; the ability to shape, debate, reposition and improve digital artifacts (Hennessy, 2020). The adaptable nature of objects within the Google Classroom is an affordance that supports learning in her English lessons:

> They don't approach it with a heavy heart. They can correct it really easily and I think that's very good for their confidence and makes them feel that writing is a plastic thing rather than a thing that's fixed and so it must be perfect the first time you do it. So it's great for that. (Rebecca: Line 75)

As opposed to traditional writing with paper and pen, work within Google Classroom is only ever tentatively positioned and is easily reversed, making it possible for ideas to be further refined (Kershner et al., 2020). This gives students a greater sense of control over the final artifact and an increased confidence to contribute their ideas. As Rebecca points out, digital artifacts generated within the platform are malleable

and can be revisited and amended over great periods of time, extending dialogues indefinitely. The affordance of provisionality within the LMS that Rebecca describes is in keeping with the findings of other studies on the use of digital technologies to support classroom dialogue. For example, when looking at Interactive Whiteboard (IWB) use, the provisional, fluid and transitory nature of ideas recorded on the device has also been recognised as a means to further dialogue (Major et al. 2018b).

The inductive thematic analysis of Rebecca's interview revealed **Barriers to dialogue** as an emerging theme and various factors which prohibit or limit productive classroom dialogue were highlighted. These included Rebecca's own sense of accountability for examined content to be covered in a purposeful way. Examinations for independent senior schools to which children at the setting would typically move on to take place in Year 8 (12-13 years old) and tend to include English papers. Rebecca felt that at times, particularly during Year 7 and 8 English lessons that were building towards these external exams, a dialogic approach was not always suitable. She felt that some children can *get lost* in the freedom of a discussion and that guidance and ultimately, direct instruction as to how to gain marks in an exam is preferred. Rebecca's interview comments also demonstrated a concern regarding the accountability of individual children when collaborating through dialogue and her ability to assess the understanding of each individual in readiness for assessments. She also spoke of some children *hiding* during discussion activities and for some, finding sustained engagement in such tasks difficult.

Despite the pressure to prepare children rigorously for academically selective schools, Rebecca does embrace dialogue in the majority of her lessons and makes use of Google Classroom tools to facilitate this. Peer assessment through the use of *shared* documents is one example:

> They might take criticism in inverted commas better from a peer, as long as you've chosen the right children to work together, than they will for me. (Rebecca: Line 87)

Another theme which emerged from Rebecca's interview was the affordance of Google Classroom to allow **dialogic space-time** to become manifest. The LMS represents a means through which ongoing and expansive dialogue can take place; unbounded by physical space or time. This theme was also a major feature of Laura's interview and for both teachers, there was a sense that the curation of this dialogic space-time was an important part of their practice.

> I can show bits of film or play bits of audio or use images and then they can be there for the children to use at their leisure if they want to listen to them again or go back to them when they're working from home. (Rebecca: Line 89)

Marshalling the resources within a discursive space (Segal et al., 2017) means that teachers maintain a certain degree of control over students' learning whilst giving them license to find alternative routes through the dialogic space-time. Users of Google Classroom can therefore be exposed to multiple **different perspectives** simultaneously, a theme expanded upon in the Phase 1 teacher interviews (see Section V.1.2) and also within Laura's interview. Another theme of Laura's interview was the **pedagogy of emancipation** (Shor & Freire, 1987) that dialogic teaching represents, expanded upon in Phase 3 of this report (see Section V.3.2).

A major theme of Laura's interview which emerged during the thematic analysis was the **factors limiting digital technology use**. Barriers and considerations that restrict the use of digital tools in Art lessons seem to fall under two categories for Laura; active selection of the most appropriate tools for the learning at hand and to a lesser extent, the expertise and confidence of users.

> A good question is whether or not it has to be embedded at this age [digital technology] or whether it should be... Some people might argue, and I do believe in this, but I can see that some people think that at this stage that it should all be about paper and charcoal and pen and paint. (Laura: Line 51)

Laura is cautious in her approach to using technology in the Art room and is particularly mindful of the effect that social media apps such as Pinterest can create when children are looking for source material for inspiration. She is keen that the children explore their own imaginations and develop their own practice which they can carry with them for life; rather than using the internet for inspiration which can lead her students to produce repetitive and unoriginal work due to the *echo chamber effect* of social media platforms. Laura identifies as a non-didactic "artist-educator", constantly developing her own practice whilst hoping to expand the visual language of the children, bringing them into the ongoing dialogue of art history:

> I like that edge that you can get to, where you are practising something and then you're imparting that knowledge to the next generation. (Laura: Line 21)

Whilst making regular use of iPads in art lessons, Laura was *undecided* when responding to the statements, “Educational technologies enhance communication between students” and “Educational technologies enhance my communication with students” in the teacher survey. Laura had also not made use of the Google Classroom LMS before Phase 2 of the project began and her interview responses highlighted the need for digital tools to meet a pedagogical imperative before being integrated into practice.

As was seen in Paul’s interview (Phase 1, Participant 1), both Rebecca and Laura’s interviews also included the *a priori* theme of **collaboration and community**. This theme is reported in Phase 3 of the main study where further evidence of the role of dialogue in fostering collaboration and a sense of community was collected.

V.2.3 Joint planning activities

In May 2018, the **first of three Phase 2 joint planning meetings** between the two teacher participants and myself (acting as a fellow practitioner-researcher) took place. As was the case in the first such meeting in Phase 1, the research questions of the DBR project were introduced and the features of exploratory dialogue (Mercer and Littleton, 2007) were used to prompt the initial discussion. The Teacher Scheme

for Educational Dialogue Analysis (T-SEDA) was also examined by the participants (Vrikki et al., 2018). In the first augmented lesson within the phase, the group decided to focus particularly on devising means to invite elaboration and reasoning from the children. This was inspired by the first coding cluster (I) of T-SEDA which the group thought epitomised their shared dialogic approach; inviting others to elaborate, explain, justify, agree, disagree and/or use possibility thinking relating to their own or another's ideas. The refinements to be brought forward from Phase 1 of the DBR project were also discussed (see Section V.1.7).

Rebecca provided a Year 7 English lesson plan for scrutiny by the group and the starter activity was chosen as a suitable target for augmentation. In the standard lesson, the children were being introduced to riddles and in the first activity, were charged with finding patterns or conventions of riddles with their talk partners using photocopied examples provided by Rebecca. These were to be annotated and highlighted in different colours on the paper whilst in the augmented second lesson, we decided that a shared digital copy of the worksheet could be used for the same purpose. For this lesson, Rebecca preferred to work with a shared Google Doc within each pair, rather than a centralised Google Slide presentation, as had been trialled in the three augmented lessons of Phase 1. The focus activities for these English lessons and others observed in the phase, along with further contextual information, are summarised in Table 5.8:

Table 5.8: Summary of focus activities observed in Phase 2 lessons.

Teacher	Lesson	Subject	Date	Class Size	Setting Arrangement	Mean CAT Score	Focus Activity
Rebecca	Standard	English	11/06/18	18	'Top' set (of four) determined by English	118	Discussion groups were challenged to find patterns within the examples of riddles they had been provided with. Groups shared single photocopied worksheets, these were annotated and highlighted in different colours to record their ideas.
Rebecca	Augmented	English	22/03/19	10	'Lower' set (of four) determined by English	105	Discussion groups were challenged to find patterns within the examples of riddles they had been provided, via a shared Google Doc. These were then annotated and highlighted using digital tools to record each group's ideas.
Laura	Standard	Art	26/06/18	20	'Mixed' set based on pastoral 'Form' grouping.	113	Prompted by a Google Slide presentation delivered by the teacher on the Interactive Whiteboard during the introduction to the lesson, groups were asked to use the Google Search engine (via a shared iPad) to find further images and information about the life and work of Ukrainian artist Sonia Delaunay and record their ideas in their individual sketchbooks. Ground rules for talk were displayed.
Laura	Augmented	Art	29/06/18	15	'Mixed' set based on pastoral 'Form' grouping.	113	A Google Slide presentation was presented to the students and then shared with the class using Google Classroom. Discussion groups (using a shared iPad) found further information and responded to the questions about Ukrainian artist Sonia Delaunay directly on the shared Slides presentation. Ground rules for talk were displayed.
Tristan	Standard	Science	02/07/18	19	'Top' set determined by attainment in science	129	Discussion groups rearranged words representing biological structures from the smallest to largest. These were provided as a list within a Google Doc. Discussion groups worked on these on shared Chromebook devices. Ground rules for talk were displayed.
Tristan	Augmented	Science	03/07/18	18	'Parallel' set (one of two below 'Top' set)	108	Discussion groups rearranged words representing biological structures from the smallest to largest. These were provided as text boxes on slides within a central Google Slides presentation. Discussion groups worked on these on shared Chromebook devices. Ground rules for talk were displayed.

Unfortunately, when delivering her standard lesson, Rebecca neglected to present the ground rules to the class and so removed them from her augmented lesson plan also. Despite this, Rebecca felt that the language the children used in the activity was impressive and rich and she felt that she had greater license to, “let go and not hold on so tight”, allowing the children’s discussion to flourish. Whilst there were preordained features of riddles that Rebecca wanted to make the children aware of, the descriptions and examples of these came from the children themselves. This lesson followed the build up to an end of year examination for the class and Rebecca felt she had license to be less prescriptive with this activity and the creative writing task that followed as it was not a “core” part of their curriculum.

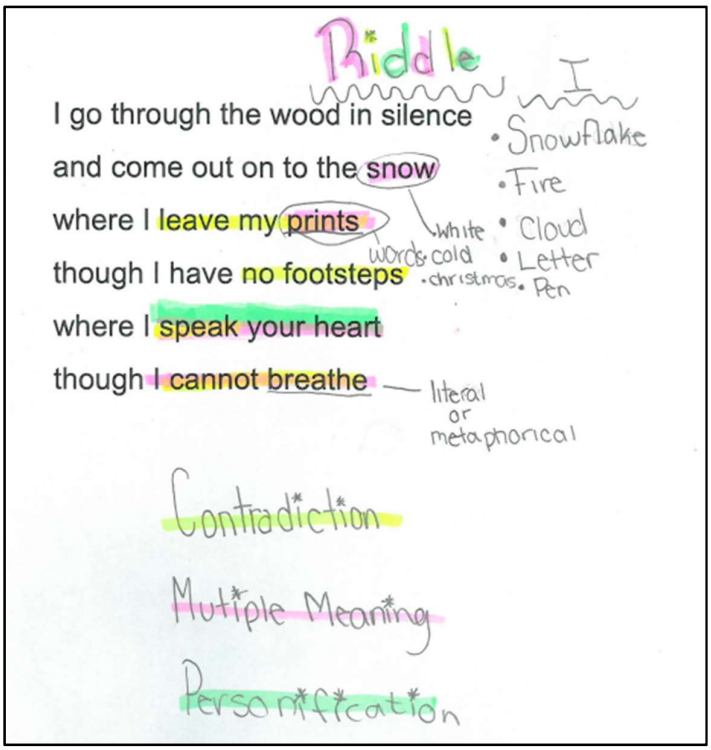
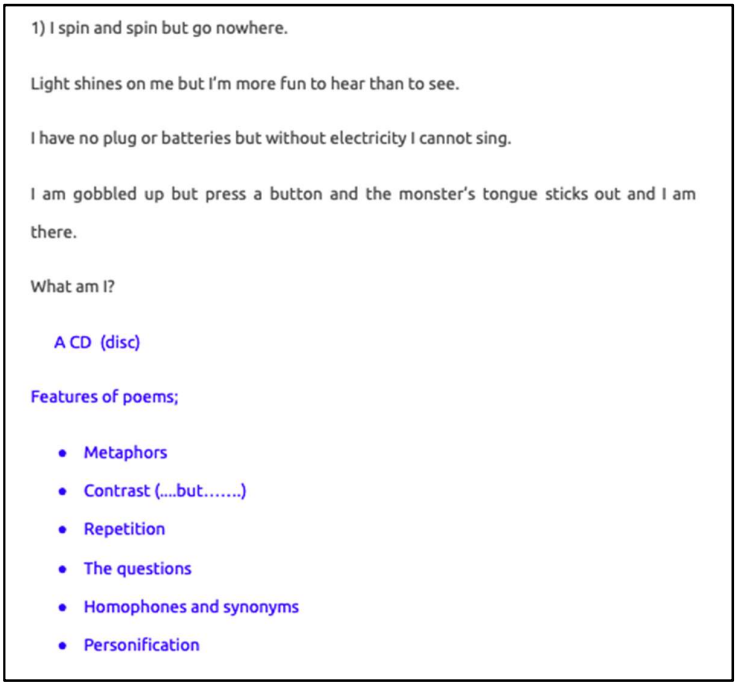


Figure 5.6: Example of annotated worksheet from a Year 7 English lessons on riddles.


1) I spin and spin but go nowhere.

Light shines on me but I'm more fun to hear than to see.

I have no plug or batteries but without electricity I cannot sing.

I am gobbled up but press a button and the monster's tongue sticks out and I am there.

What am I?

A CD (disc)

Features of poems;

- Metaphors
- Contrast (....but.....)
- Repetition
- The questions
- Homophones and synonyms
- Personification

Figure 5.7: Example of annotated Google Doc from a Year 8 English lesson on riddles.

Rebecca's second, augmented lesson was scheduled to be delivered later that same week in June 2018. However, due to unforeseen circumstances, it was not possible for Rebecca to deliver this until the following academic year. It was not until March 2019, that Rebecca delivered her augmented lesson plan to the same English class that would have taken part in the study the previous summer. Now in Year 8 (12-13 years old), the children were in their final year at the school and had all recently completed their formal examinations for entry to a range of independent senior schools. As they had not taken part in the creative writing lesson on riddles with Rebecca previously, the children were in a similar position to their counterparts from the previous summer. This class contained only ten children on the day and there was a subdued feel to the lesson. Despite having ownership of their seating arrangement and working in friendship groups, the pairs were generally reluctant to talk to one another during the discussion activity with some children clearly distracted by the different functions and settings of their individual Chromebook devices. One group required intervention from Rebecca on several occasions to refocus their attention to the Google Doc she had provided: "OK, can you not go

anywhere else on the internet and just look here please?". In general, Rebecca felt that the children were looking to her for confirmation and *the answers* rather than exploring the features of riddles for themselves. Rebecca felt that this might have been a consequence of her teaching style with this particular group, particularly during their exam preparation earlier in the year.

In June 2018 the **second joint planning meeting** of Phase 2 took place. Unfortunately, it was not possible for Rebecca to attend this meeting in person, however she did pass on her thoughts on the standard lesson which she had recently delivered. In particular, she wished to convey her sense that the shared paper resource had led to a richer dialogue between the pairs than individual copies would have. With this in mind, Laura and I felt that limiting talk partners to a single, shared resource in both her standard and augmented art lesson might similarly promote dialogue. Having looked at the standard lesson plan, we decided to focus on the activity where pairs of children were asked to use the Google Search engine to find images and information about the life and work of Ukrainian artist Sonia Delaunay (1885-1979) and record their ideas in their sketchbooks. This research task was prompted by questions and images presented by Laura using a Google Slide presentation on the Interactive Whiteboard during her introduction to the lesson. For the augmented second lesson plan, Laura chose to use a centralised Google Slide presentation, similar to that which had evolved during the lessons of Phase 1. Rather than merely presenting her Slides presentation to the children on the IWB, by using the Google Classroom, the children were given access and permission to edit the document directly. In doing so, each child worked with their talk partners to decide how they wanted to respond to the questions and prompts but could also see and build upon the ideas of other groups, working in the same domain. It was also decided that Laura should provide the ground rules for talk at the start of each lesson, as Rebecca had intended to do.

Following Laura's art lessons, the **third joint planning meeting** of Phase 2 took place in June 2018. Again Rebecca was unable to attend but Laura and I met to discuss her observations of the two art lessons. Laura said that she felt she had less *buy-in* from the group that undertook the standard lesson and that she was not

surprised that there was relatively little dialogue between them. Whilst typical of life at a preparatory school, the flow of the lesson was not aided by several interruptions due to children coming and going from rehearsals for a summer concert. Ahead of Laura's second, augmented lesson there was a power cut due to a marquee being prepared for an event outside the art room. However, this did not impact the children's use of the Chromebooks (which had been charged in advance) and there was a greater sense of flow to the lesson. After 10 minutes of the lesson Laura exclaimed, "I'm already enjoying this much more than last time". Whilst there was some confusion when children thought their work had been deleted by others (in fact it had been moved), Laura felt that the children collaborated effectively and enjoyed the activity. She noted that if they became stuck, the fact that the children could see one another's contributions on the shared Google Slides presentation helped to improve their understanding. Laura noted that there was a cumulative effect, as the children found and added more ideas and detail to the central resource their understanding grew. In contrast to the standard lesson, Laura felt that limiting the children to work with the specific images she had provided of Sonia Delaunay's work, rather than searching for their own examples using Google, focused the dialogue and helped to "contain" the lesson.

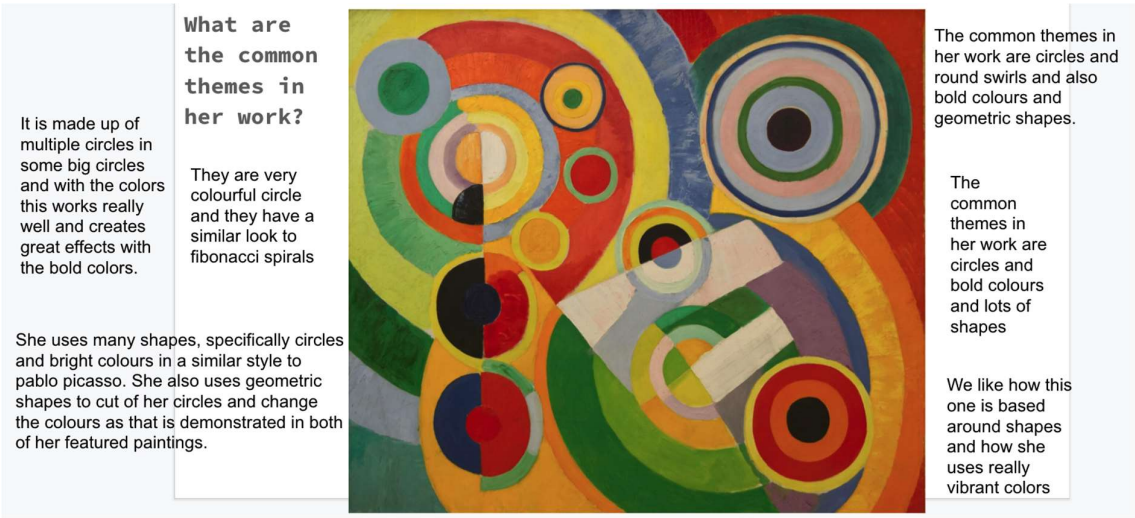


Figure 5.8: Google Slide with annotations from a Year 7 art lesson.

With these findings in mind, Laura and I looked at a Year 7 science lesson plan to be delivered by myself, on the topic of ‘Organ Systems’. As part of this lesson students are asked to rearrange words representing biological structures from the smallest to largest. In the standard lesson, these were provided as a list within a Google Doc distributed via the Google Classroom to each child. This was a typical example of an activity within the school’s paperless science department. An introduction to the ground rules for talk was added to this lesson plan, as was the requirement for children to only work on one device and one copy of the Google Doc in each pair. For the augmented lesson, it was decided that rather than using a Google Doc, a single shared Google Slide presentation would be used with the words provided within text boxes so that they might be more easily moved around the screen by the children.

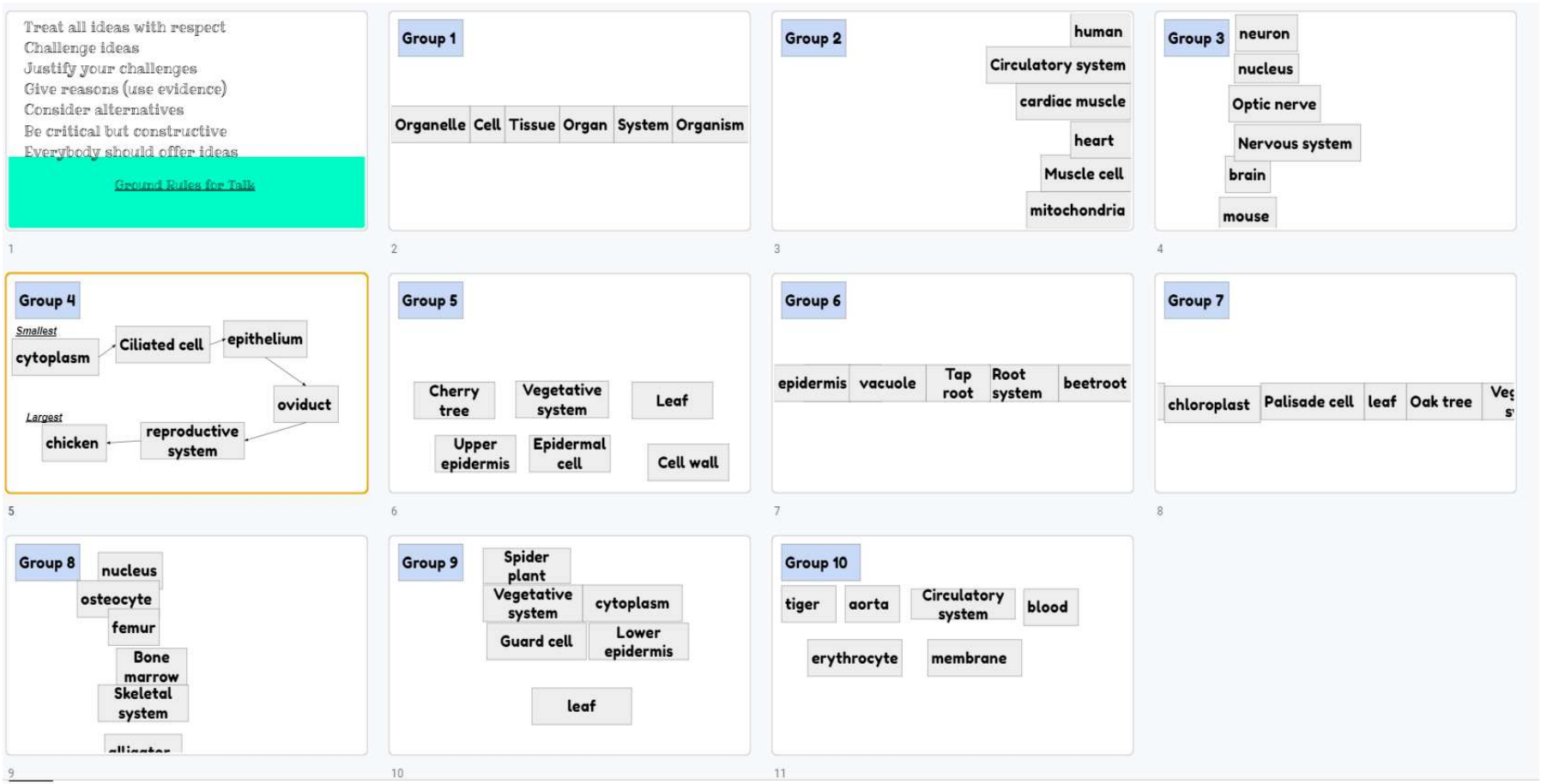


Figure 5.9: Google Slides presentation from a Year 7 science lesson.

After delivering the science lessons I noted that a similar frequency of dialogue seemed to have taken place in both classes during the discussion activity and both groups enjoyed similar levels of success in terms of arranging the words correctly. This was despite the standard lesson having been delivered to a higher attaining set of children and the augmented lesson taking place after a school production that involved the majority of Year 7 children the previous evening. The centralised Google Slide presentation (see Fig. 5.9) also led to a rich class discussion after the task had been completed, as the solutions that each pair had arrived at could be immediately presented and on the IWB. This was in contrast to the individual documents that children in the standard lesson had used.

V.2.4 Analysis of classroom dialogue

In the Phase 2 lessons, digital dictaphones (Tascam DR-05 Audio Recorder models) were used to capture the verbal interactions of three small groups (pairs or triads) of children whilst a video camera (Sony NX70 model) with external microphone was used to capture a recording of the wider classroom. Audio from the focus activities were later transcribed and coded as described in the Methodology (see Section II.9.2) of this project. See Appendix 16 for an overview of the coding results for this Phase.

The focus activity in the **first participant's lessons** was a discussion activity based upon examples of riddles provided by Rebecca. In the standard lesson, delivered to a parallel set (second of four groups in terms of attainment) of Year 7 English students in June 2018, children were given a total of 6 minutes of discussion time for the focus activity. The children were encouraged to make notes on a shared photocopy of the worksheet as they looked for shared characteristics and features between the riddles (see Fig. 5.6). The augmented lesson plan was then delivered to a lower attaining Year 8 set (fourth of four) in March 2019. The children were asked to complete the same task as before, using a digital Google Doc distributed through the Google Classroom rather than a paper copy of the worksheet (see Fig. 5.7) and

were given 7 minutes to complete the discussion activity. In both of these English lessons, the children recorded using the dictaphones. They mostly worked in pairs, with one triad recorded in each lesson due to the uneven numbers present.

Table 5.9: Cluster level coding of dialogue during focus activities of Phase 2, Participant 1 lessons.

Lesson	Group	Inviting elaboration or reasoning	Making reasoning explicit	Building on ideas	Positioning and coordinating	Total Dialogic Moves
Standard	1	9	22	26	15	71
Standard	2	8	19	23	4	55
Standard	3	6	15	9	6	37
Standard	**Mean**	**8**	**19**	**19**	**9**	**54**
Augmented	1	7	8	17	2	33
Augmented	2	3	11	8	8	30
Augmented	3	9	12	5	2	27
Augmented	**Mean**	**6**	**10**	**10**	**4**	**30**

As described in the methodology (Section III.9.2), the numbers of dialogic moves per group were adjusted to account for the differences in the length of time given over to the focus activity in each lesson of the project. Frequencies are therefore reported rounded to the nearest whole number and represent the adjusted total per 12 minute episode. The number of total dialogic moves reduced from 54 to 30 between the standard and augmented activities in Rebecca's English lessons. Whilst similar numbers of moves that invite elaboration or reasoning were seen in the focus activity of both (see Table 5.9), there was a marked reduction in the number of moves where participants make their reasoning explicit (Standard = 19, Augmented = 10), build upon one another's ideas (Standard = 19, Augmented = 10) and position or coordinate their ideas (Standard = 9, Augmented = 4).

Both of the **second participant's lessons** took place in June 2018 and saw Laura teaching two Year 7 art lessons to groups that were not set according to attainment in the subject. In the standard lesson, students were given 11 minutes to complete a

research and discussion activity to identify the major themes and techniques of artist Sonia Delaunay (1885-1979). Laura then delivered the augmented lesson and asked the children to record their joint answers to the questions on a central Google Slide presentation, distributed using the Google Classroom (see Fig. 5.8). The children were given 13 minutes to complete the task. In both of these art lessons the children for whom verbal interactions were recorded worked in pairs.

Table 5.10: Cluster level coding of dialogue during focus activities of Phase 2, Participant 2 lessons.

Lesson	Group	Inviting elaboration or reasoning	Making reasoning explicit	Building on ideas	Positioning and coordinating	Total Dialogic Moves
Standard	1	1	3	4	3	12
Standard	2	1	1	6	3	11
Standard	3	3	2	5	5	16
Standard	**Mean**	**2**	**2**	**5**	**4**	**13**
Augmented	1	2	3	2	2	9
Augmented	2	2	3	5	5	14
Augmented	3	0	1	13	2	17
Augmented	**Mean**	**1**	**2**	**7**	**3**	**13**

The average total number of dialogic moves recorded per group was relatively low in both of Laura's lessons at 13 per episode. There was no discernible difference in the amount of dialogue within any of the four analysed clusters (see Table 5.10).

The **third participant's lessons** were delivered by myself to two Year 7 science classes in July 2018. These lessons were on the topic of 'Organ Systems' and in the focus activity, students were asked to rearrange words representing different biological structures from smallest to largest. The standard lesson was delivered to a higher attaining science set and the children were asked to work together on a Google Doc using one child's Chromebook device. The pairs of children were given 6 minutes to complete the task. In the augmented lesson, delivered to a parallel set, the children were given the same sorting activity but asked to work on a shared

Google Slide presentation via the Google Classroom LMS (see Fig. 5.9). The children in this second lesson were given 9 minutes to collaborate and complete this task. In both of these science lessons the children for whom verbal interactions were recorded worked in pairs however, due to a fault with one of the digital dictaphones, audio data was only collected for two pairs of children in the second, augmented lesson.

Table 5.11: Cluster level coding of dialogue during focus activities of Phase 2, Participant 3 lessons.

Lesson	Group	Inviting elaboration or reasoning	Making reasoning explicit	Building on ideas	Positioning and coordinating	Total Dialogic Moves
Standard	1	9	20	18	13	59
Standard	2	2	18	20	16	56
Standard	3	4	25	6	14	49
Standard	**Mean**	**5**	**21**	**15**	**14**	**55**
Augmented	1	5	7	22	9	43
Augmented	2	3	13	8	18	42
Augmented	**Mean**	**4**	**10**	**15**	**13**	**43**

In keeping with my own reflections on the lesson, coding of the transcripts from the science lessons in Phase 2 showed that a similar number of dialogic moves for the inviting elaboration or reasoning, building on ideas and positioning and coordinating clusters took place in both the standard and augmented lessons (see Table 5.11). However, there were fewer examples of moves where participants made their reasoning explicit in the data from the second, augmented lesson (Standard = 21, Augmented = 10).

V.2.5 Student interviews

Following each of the three *augmented* lessons in this phase, a student was selected for interview on the basis of standardised cognitive reasoning scores (CAT4, GL Assessment) which are completed annually at the school. These children were then

asked to invite two friends from their class to accompany them in the joint interview. Following the lessons by Rebecca, the child with the median average score for the class, a boy with a 112 average CAT score, was selected. A girl with the highest CAT average (123) was selected from Rebecca's class and following my own augmented lesson, a boy with the lowest CAT score in the class (93) was invited to take part. In keeping with the student interviews of Phase 1, some evidence for the *a priori* themes of **accessibility, immediacy** and **different perspectives** were seen in the student interviews of Phase 2 and once again the theme of **collaboration and community** (a theme that is expanded upon in Phase 3 of this report) was also seen. Thematic analysis of the interview transcripts also found evidence for several emerging themes (see Table 5.12).

Table 5.12: Summary of supporting evidence for themes reported in Phase 2 Student Interviews.

Theme	Description	Example Excerpt(s)	Supporting Data	Key Words
Barriers to Dialogue	Factors which prohibit or limit productive classroom dialogue.	I sometimes feel a bit pressurized if they ask me a question and I have no idea. I find it easier to talk to a friend and ask something that may be an easy question but I fear to ask the teacher. (2.1: Line 13) Well I know when I'm sitting next to X, sometimes he's talking about cricket or rugby and I'm trying to focus and when it comes to a compression we are supposed to answer together, we have no idea what the question is. I've been listening to him going on about cricket and we've dug ourselves into a hole. And then you've got to back out of it. (2.1 Line 17) Most of the time she [Laura] just lets us get on with our work and doesn't really ask us any questions other than "Oh are you proud?" or something like that. (2.2 Line 33) Too many people working on something makes it really difficult because they are saying, that's wrong, that's wrong, that's wrong. But if you have a couple of people. (2.3: Line 26)	Interview 2.1: Lines 9, 13, 17, 19, 27 & 33 Interview 2.2: Lines 19, 23, 25, 31, 33, 47 & 80 Interview 2.3: Lines 8, 26, 28, 31, 35, 52, 54 & 58	busy, conflicting ideas, difficult, doesn't ask questions, engrossed, exams, fear, friends, loose focus, naughty, off-task, pressurised, teacher talk, test, time, too many people, upset, wouldn't talk

Factors Limiting Digital Technology Use	Barriers and considerations that restrict the use of digital tools in the classroom.	It depends on different lessons. Because in certain lessons it makes some people more silly and they mess around. But then sometimes it also just helps everyone to stay in their own space so it almost depends on different lessons. (2.2: Line 72) Sometimes all the documents can get repetitive. (2.2: Line 86) And today especially in science we were doing the graphs on the Chromebooks. It was a bit harder to do it because you have to label everything and it would have been much easier to do that if we are on paper. We could have just easily done that on paper. (2.2: Line 91)	Interview 2.1: Line 40 Interview 2.2: Lines 7, 39, 72, 85, 86, 89, 91 & 92	boring, harder, load time, mess around, off-task, play games, repetitive, temptation, tool selection, typing
Inter-subjectivity	Orientation towards other participants through which a shared subjectivity and empathy evolves.	I think talking in lessons means that you have more of a voice of what you can say, if you don't understand or something. If you are allowed to talk as you say. Or collaborating and maybe listening to a person more of your age's voice, it might feel more comfortable. (2.1: Line 12) ...If you have 4 people you can tailor the situation to all of their needs, but if you have like seven people it is more difficult.... (2.3: Line 35)	Interview 2.1: Lines 12, 13 & 50 Interview 2.3: Line 35	collaborating, comfortable, easier, friend, needs, tailor, understandable, voice, your age
Support for SEND	The use of digital tools to enable students to take part in activities and dialogues that would otherwise be inaccessible to them, due to cognitive or physical barriers.	I think so because usually my handwriting is completely ilegible. (2.1: Line 37) I find that when I'm on a computer, if I'm writing something down, I think more freely. I think that when I'm talking to a teacher on the spot, I lose what I am thinking. I've got to answer. I crack on the spot, whereas on a computer I can think more freely, I have time to think about what I'm thinking about or what I am going to write. I find Google slides and Google docs an easy way to work. (2.1: Line 44)	Interview 2.1: Lines 37, 42, 44 & 46	get more done, handwriting, pain, think freely, time to think

A major emerging theme from all three student interviews of Phase 2 was **barriers to dialogue**, which also characterised Rebecca's teacher interview earlier in this phase (see Section V.2.2). Factors which the children felt prohibit or limit productive classroom dialogue could be divided between those that prevented the teacher from

providing opportunities for dialogue and issues that reduced the productivity of dialogue when it did occur. The children were aware of the role the teacher played in brokering productive talk and noted that they were not invited to elaborate on their ideas or reasoning as a matter of course by all of their teachers. The Year 7 children seemed particularly aware that teachers were placing an onus on preparing them for examinations in subjects such as English and maths and seemed to accept that this necessitated a more monologic style of instruction to take place due to the time pressures both they and their teachers were under. Extended teacher talk time coupled with a lack of prompts for the children to add their own ideas to the discourse were other issues. One child touched upon their experiences of Google Classroom reducing the need for teacher preamble so that the group could then spend longer completing activities:

> ...because you can't talk when the teacher is talking, you are losing time for talk…. you have quite a lot of added time because a lesson brief takes like ten minutes? Ten, fifteen minutes. In Google Classroom like, two? So you are saving quite a lot of time by just having Google Classroom for the lesson brief. It's quite useful, you have more chance to do the lesson and learn. (Student Interview 2.3: Line 54)

Where dialogic activities were provided, the children identified face threat, confidence and social pressures within their peer group as the major barriers to productive dialogue. The students recognised that dialogue can veer off course, particularly when working with friends who might lose focus and use the opportunity to discuss other shared interests rather than attend to the task at hand. They also recognised the issues that occur when too great a number of participants are asked to come to a consensus and the upset that can be caused when particular voices and ideas are silenced during a discussion.

Factors limiting digital technology use was also an emerging theme of the Phase 2 student interviews. Barriers and considerations that restrict the use of digital tools identified by the children could be divided between similar categories to those seen in Laura's teacher interview. The first being the selection of digital tools by teachers,

influenced by their confidence in the students to use the technology in a focused way and their level of expertise. Whilst the children felt that some teachers might be missing the opportunity to integrate more technology in their classrooms they felt that others with a more paperless approach might be blind to some of the frustrations they experience, such as load time and repetition of task type. Also, those wedded to using the Google Classroom LMS might not always select the best tool for a task:

> …in science we were doing the graphs on the Chromebooks. It was a bit harder to do it because you have to label everything and it would have been much easier to do that if we are on paper. We could have just easily done that on paper. (Student Interview 2.2: Line 91)

The second set of factors limiting digital technology use was the expertise and actions of the student users once it was in their hands. This included issues with their typing speed and the temptation to “mess around”, “play games” and go “off task” when given access to digital tools.

Intersubjectivity also emerged as a theme from the Phase 2 student interviews. Feeling comfortable when collaborating through dialogue was important to the children, they find this easier when working with friends to whom they can better tailor their comments and ideas. In particular, the children articulated the usefulness of hearing information delivered by a peer, to whose voice they might be better attuned to than a teacher’s:

> On the talking side I refer back to the point that I made, hearing a child's voice when you're actually a child of maybe the same age, maybe it would be more understandable. Rather than when a grown person says it. (Student Interview 2.1: Line 50)

The final theme to emerge from the student interviews of this phase was the **support for special educational needs and disability** that Google Classroom might provide SEND students. Evidence for the affordance of the LMS to enable students to take part in activities and dialogues that would otherwise be inaccessible to them, due to

cognitive or physical barriers came from the third student interview. Two of the three boys who took part were SEND children and were open about the advantages that the LMS provided in terms of reducing the demands on their secretarial skills and handwriting. Both had been assessed by an educational psychologist and were encouraged to use a laptop for all extended writing tasks and assessments. Both had difficulty with phonological processing, visual recall and handwriting but when using digital tools, the children felt that they had more time to think and completed a greater volume of work:

> I find that when I'm on a computer, if I'm writing something down, I think more freely. I think that when I'm talking to a teacher on the spot, I lose what I am thinking. I've got to answer. I crack on the spot, whereas on a computer I can think more freely, I have time to think what I'm thinking about or what I am going to write. I find Google Slides and Google docs an easy way to work. (Student Interview 2.1: Line 44)

V.2.6 Provisional theories

The data gathered in Phase 2 of this DBR project has provided initial evidence for the three research questions and allowed for the following *provisional* theories to be postulated.

> **RQ 1. What affordances do LMS (specifically Google Classroom) provide for the teacher mediation of dialogic learning?**

Evidence from the Phase 2 of this DBR study suggests that Google Classroom affords dialogic practitioners the opportunity to give their students access to unbounded dialogic space-time and to promote intersubjectivity between them. The *a priori* theme of provisionality was also seen within the data whilst the affordance to support those with special educational needs and disabilities (SEND) to better access dialogues emerged in this phase.

The **provisionality** of digital artifacts (Hennessy, 2020) generated in the Google Classroom means that both the digital objects and the dialogues that surround them can be easily modified. The plastic nature of objects such as Google Docs and Slide presentations may also encourage students to take greater risks and consider more imaginative responses during their dialogues and collaborative work, safe in the knowledge that their contributions can be refined. This provisionality is in part what makes it possible for **dialogic space-time** (Wegerif, 2013) to be revisited and remolded by participants. The features of the LMS, including assignments, posts, comments, shared documents and presentations allow dialogues and supporting materials to be made available ahead of, during or after lessons. Although these remain under the curation of the teacher, the digital materials can provide a platform from which unbounded dialogue can spring, should teachers permit it to do so.

In Phase 1, the teacher interview with Paul provided evidence that the Google Classroom afforded practitioners with the chance to promote **Intersubjectivity** between participants. The students interviewed in this phase lend weight to this as an emerging affordance of the LMS and spoke of the cognitive advantages to working within groups where a shared subjectivity and empathy exists. The comfort and greater understanding when hearing ideas in the voice of a peer rather than an adult in the role of expert teacher is of value to the children. The efficacy of this approach might perhaps be explained by the idea of the *zone of proximal development* or ZPD (Vygotsky, 1978 p.86). This is the gap between the independent problem solving and potential development of a learner, as measured by their ability to solve problems with and without expert assistance, typically from an adult teacher. The cognitive support provided by an expert needs to be sensitively adjusted to account for the expertise of other participants (Van de Pol et al., 2010) so that dialogue remains within the ZPD. When working in dialogue with their peers, the gap between perspectives is perhaps naturally closer and more likely to result in cognitive change for some.

Another potential affordance of the Google Classroom is to provide **support for special educational needs and disability (SEND)** students to access dialogues

that might otherwise be inaccessible to them, due to cognitive or physical barriers. In addition to reducing the demands on the participants with regards to their secretarial skills and handwriting, the platform may also reduce the cognitive load placed upon children who experience phonological processing, short term verbal working memory and visual recall difficulties. Evidence from the Phase 2 of this DBR project suggests that when resources to support or elicit dialogue are provided using the LMS, children with such issues are able to "think more freely" and feel they have greater time to do so than when taking part in dialogues without such tools to support them. This tallies with the findings of the Shaping the Future of Technology Use in the Classroom (SHAPE) project (Guldberg et al., 2017) which found that using a digital storytelling platform allowed practitioners to co-construct narratives with children with autism. Using digital platforms to provide prompts and cues for students for whom contributing to dialogues is a real challenge, reduces the quantity of secondary knowledge (Sweller, 2011) they are required to access from their short-term, verbal working memory. Thus, sensitive use of a LMS may allow participants to contribute to dialogues and collaborate on joint artifacts with greater confidence.

Evidence from Phase 2 of the project also revealed some of the **Factors limiting the use of digital technologies** such as Google Classroom. These were predominantly under the control of the teacher and to some extent reflected their confidence, experience and training with regards to integrating the technology into their practice. However, the factor with the greatest influence over the use of digital tools at the school was the teacher's active selection of the most appropriate tools to enhance the learning of their students. This judicious approach may help to prevent technology being used merely for its initial appeal and the surface appearance of engagement which is so often the fate of technology *parachuted* into a setting (Major et al., 2018b). Whilst the Google Classroom can be used to facilitate the learning of certain skills and knowledge, it can also inhibit some actions (Hennessy et al., 2017) and should be combined with the best non-digital resources available to meet the learning goal at hand.

This phase also brought to light some of the **Barriers to dialogue** at the setting, within the context of Google Classroom usage. One such issue was the need of the

teachers to assess and hold children to account for their individual contributions when co-constructing digital artifacts, rather than the group. As with all tools and approaches, teachers must be pragmatic when considering the needs of their students, particularly where high-stakes, external assessments are concerned. So long as these require children to write *correct* answers in a *correct* way, teachers will often feel that didactic approaches better serve their ends in order to provide their students with clarity and to prevent them from disappearing "down a rabbit hole". Whilst such linear monologism (Brandist, 2002) restricts expansive dialogue, it is seen as an effective means to an end by some practitioners. A wider shift in pedagogy and epistemology (Major et al., 2018b) would be needed in the independent education sector in the UK if teachers within the school are to feel emboldened to make greater use of dialogue when introducing core areas of the curriculum and not just those around the margin (Segal et al., 2017).

RQ 2. Do LMS open up new spaces for dialogue?

Educational dialogue is not merely verbal interactions within a classroom but the lived experience of a shared space (Kershner et al., 2020) which Buber called 'the in-between' (1958) and Wegerif (2007) described as 'dialogic space'. The term 'dialogic space-time' (Wegerif, 2013) builds upon this further to encompass the asynchronicity of dialogues made possible by Web 2.0 technologies, of which Learning Management Systems are an example. Evidence from Phase 2 of this project suggests that it is possible for dialogic space-time to become manifest within Google Classroom. The LMS represents a means through which ongoing and expansive dialogue can take place; unbounded by physical space or time. Users of Google Classroom have the ability to track alterations and signpost others towards materials and ideas which are simultaneously ever changing and eternal. Digital artifacts within the LMS are instantaneous and up to date whilst also evidence of past dialogues and activity that can be reengaged with. This duality can support dialogue between users, both students and teachers alike, that is imaginative and unbounded.

RQ 3. What is the nature of interaction within a LMS?

In the second phase of this DBR project, whilst some potential affordances of the Google Classroom to support dialogue (as described above) were identified, the attempts to leverage these in the observed lessons did not lead to an increased number of total dialogic moves (see Fig.5.10) in the augmented lessons.

Whilst no significant difference in the amount of dialogue was detected within any of the four analysed clusters in the art lessons delivered by Laura (see Table 5.10), a reduction in the number of moves where participants made their reasoning explicit was seen in both Rebecca's lessons (see Table 5.9) and my own (see Table 5.11). In Rebecca's English lessons there was also a reduction in the number of moves where participants build upon one another's ideas and position or coordinate their ideas indicative of a general reduction in the frequency and quality of dialogue between the two observed English groups. In the science lessons I delivered, the change in the frequency of children making their reasoning explicit verbally was due largely to the changes in the number of utterances coded specifically with the 'speculate or predict' (R4) code (Standard = 14, Augmented = 3). This difference may have been due to the requirement in the standard lesson for children to agree and type their answers on the shared screen. In the augmented lesson, students were able to freely move and reposition the words which had been provided as text boxes on the screen; enabling them to visualise their speculative solutions and reduce the need for them to verbalise their ideas.

The Phase 2 interviews with both teachers and students alluded to the greater confidence and ease with which dialogue, supported by LMS resources can be accessed. There is a greater sense of *buy-in* to dialogue when anchored to shared artifacts in the Google Classroom. Users are conscious of the provisionality of these and this provides a sense of comfort as they know that their contributions can be altered as new information comes to light (Kershner et al., 2020), rather than being judged on their initial ideas. Artifacts generated within Google Classroom are malleable and can be revisited and amended over great periods of time, giving

students longer to consider their ideas and to contribute when they feel comfortable to do so. This affordance may be of particular importance to SEND students, for whom accessing dialogue through talk alone is challenging.

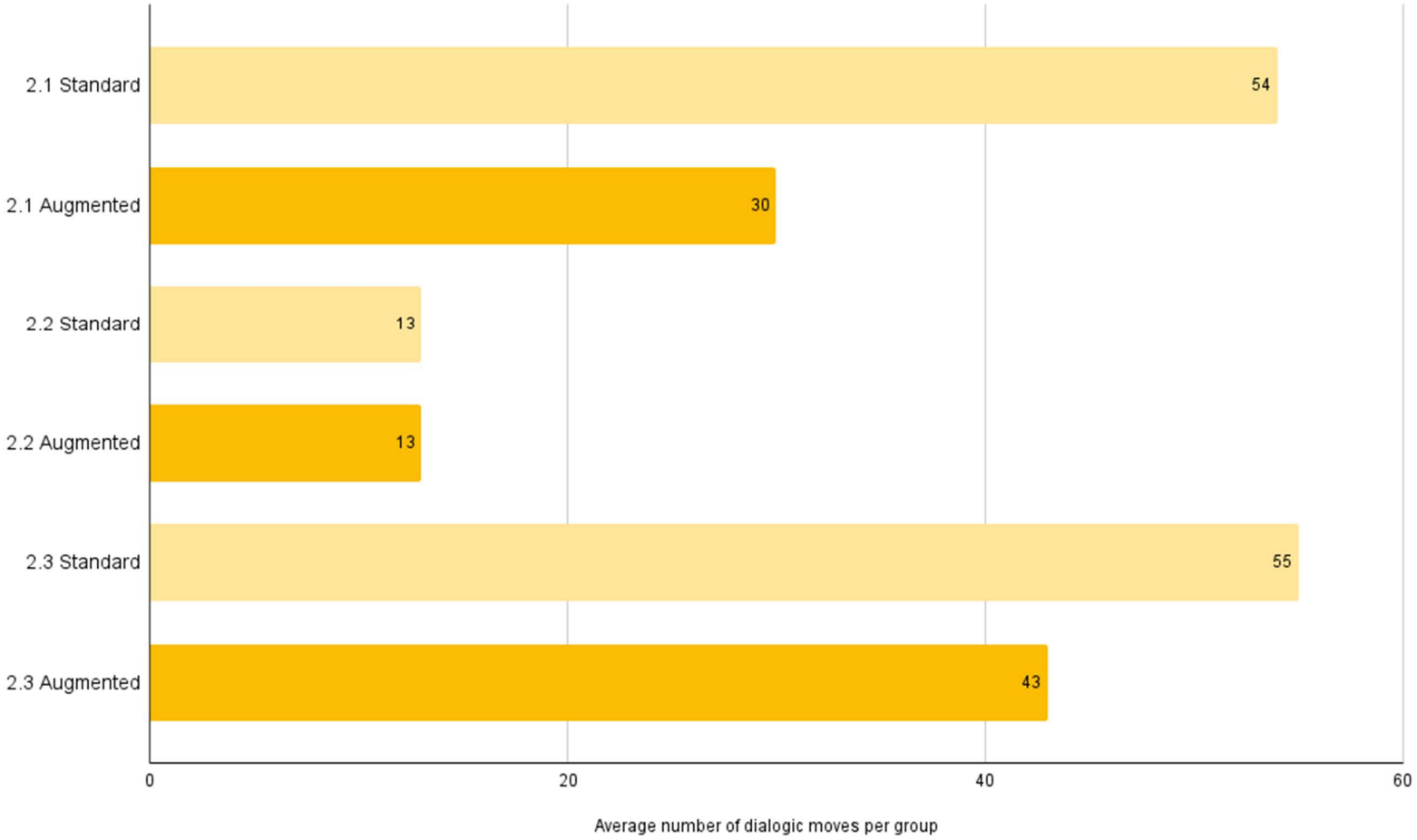


Figure 5.10: Average number of dialogic moves per group during the focus activities of Phase 2 lessons.

V.2.7 Refinements after Phase 2

In addition to those from Phase 1 (see Section V.1.7), the following refinements were brought forward to Phase 3 of the DBR project as means to better promote dialogue when using the Google Classroom. These were the result of the three joint planning exercises of Phase 2 and the analysis that followed:

- Display and refer to ground rules for talk.
- Limit discussion groups to a single shared device when accessing tasks on the Google Classroom.
- Limit the requirement to use Google Search.

Whilst Rebecca had trialled the use of Google Docs in her augmented lesson, using the *Share* function and a single shared slideshow seemed to be of greater benefit during the discussion tasks for Laura and I. This centralised forum means that children not only discuss ideas in their groups but are able to freely access those of others, as observed in both the art and science lessons of the second phase. Both Laura and I noted the cumulative effect of these contributions to the co-constructed presentation; as the children found and added more ideas and detail to the Slides, their understanding and confidence grew. In tandem with this, an awareness of the ideas and perspectives of others who were not in their discussion group was fostered.

In keeping with the *Thinking Together Programme* (Dawes, Mercer & Wegerif, 2004), ground rules based on those for exploratory talk were displayed in the classroom before and during all of the art and science lessons in this phase. The intention of this refinement was to promote dialogue as an important process in and of itself and not just to celebrate the knowledge artifacts that might result from it. Having the ground rules on display allowed both Laura and I the chance to refocus the efforts of the discussion groups as we circulated the classes and whilst the impact on the children's dialogue was unclear, we felt that it was a useful teaching aid that should be taken forward into Phase 3.

Similarly, all three teacher participants felt that limiting the number of resources or digital devices provided to each discussion group promoted greater collaboration. This was perhaps the result of necessity, as the children were required to coordinate their actions rather than having the agency to act as they pleased on their own machine or worksheet. Laura also felt that by providing her students with specific images to be discussed, rather than asking them to find their own examples using the Google search engine, the children's dialogue was more focused and resulted in a more productive lesson.

Phase 3

V.3.1 Introduction

In October 2019, responses to the teacher questionnaire conducted in 2017 (see Part IV: Preliminary Findings for details) were reviewed and one teacher ('Nicola') was identified as being a potential participant for the study having strongly agreed with the statement, "Promoting dialogue between the children is important in my subject(s)" and that educational technologies fit her subject. This participant was happy to be approached and accepted the invitation to take part in Phase 3 of the DBR project. Other respondents to the 2017 survey were not approached to contribute to this phase as either their responses did not align with the dialogic pedagogy central to this project or they no longer worked at the school. I was unable to be directly involved in the lesson observations in this phase as I no longer had a timetabled Year 7 class. Consequently, two colleagues who had joined the teaching staff since the 2017 survey were invited to participate and complete the joint planning group. Both had been observed applying a dialogic pedagogy to their teaching in lesson observations by myself and had expressed an interest in developing this approach in professional development meetings.

'Jessica' is a teacher of religious studies (RS) who was in her sixth year of teaching when Phase 3 began, having gained Qualified Teacher Status (QTS) whilst working

at the school in the previous academic year and working as an unqualified teacher prior to that. ‘Lucy’ is an experienced geography teacher, having taught the subject for twenty years to a range of age groups and was in her third year of working in the preparatory school. ‘Nicola’ has worked at the school in a variety of teaching roles for fifteen years and had become a teacher of personal, social, health and economic education (PSHEE) two years prior to taking part in this study. Nicola had also led on a number of school wide developments on the use of educational technology prior to volunteering for this study, however she had not been able to take part in the project before the 2019-20 academic year as this was the first time she had been timetabled with a Year 7 class. Whilst Jessica and Lucy make use of a range of digital and traditional media, Nicola’s PSHEE lessons are ‘paperless’.

V.3.2 Teacher interviews

In December 2019, the Phase 3 teacher participants took part in semi-structured interviews to explore their understanding and attitudes towards classroom dialogue and their use of digital tools (see Appendix 6). The interviews were recorded using a smartphone dictaphone app in a comfortable, office space that the participants were familiar with and regularly used. Interviews with all three took place before the first joint planning meeting. Audio files were then transcribed by the researcher using InqScribe (version 2.2.4.262) software and thematically coded (as outlined in Section III.9.1 of the Methodology). A summary of the major themes identified in the Phase 3 teacher interviews (and selected supporting evidence) can be seen in Table 5.13, followed by further exploration of each theme below.

Table 5.13: Summary of supporting evidence for themes reported in Phase 3 Teacher Interviews.

Theme	Description	Example Excerpt(s)	Supporting Data	Key Words
Accessibility	Digital access to a wide range of resources.	I mean my kids could come in, my Year 7 class could come in and we can put up straight away the United States geological Survey website and we can look at earthquakes that happened within the last 24 hours and that is just magical, absolutely magical. (Lucy: Line 52) I think it's really helpful for children to be able to find out information for themselves so they've got ownership of it. (Nicola: Line 53)	Lucy: Lines 52, 53, 57, 62, 69, 76, 84, 87 & 95 Nicola: Lines 38, 49, 53, 58 & 65	articles, choice, current, documentary, finding out, Google Classroom comments, independent, research, resources, share, suddenly, up to date, website, YouTube, videos
Collaboration and Community	The role of dialogue in fostering collaboration and a sense of community.	In my classroom, very literally it means that pupils feel that they are safe to say something, that it is a safe environment to say something and that things that they do say will be acknowledged as valid opinion. (Jessica: Line 42) A lot of it is kind of them realizing 'Oh yeah I have to do that as well, I have to make the bed' or 'I've got to follow these rules' or... it's quite often a two way thing and it's quite often then being able to share their own experiences with the rest of the class. And it kind of normalizes things. (Nicola: Line 33)	Jessica: Lines 27, 30, 34, 36, 42, 43, 47 & 54 Lucy: Lines 40, 43, 49, 76 & 85 Nicola: Lines 27, 32, 33, 44, 61, 62, 68 & 69	acknowledged, collaborative, compromise, conversation, cooperated, discussion, experiences, immersive, instinctive, joint projects, listening, organisation, Padlet, partners, peers, safe environment, share, Slides, tolerant, work together
Pedagogy of Emancipation	The role of dialogue in reducing authoritarianism and transforming social relations in the classroom.	Well, my aim would be that I am facilitating and that I lay the groundwork for something that the pupils can then manipulate and understand in their own way. And can collaborate with their peers to find out what they think and to kind of organically grow their understanding of something. (Jessica: Line 34) I think it's really helpful for children to be able to find out information for themselves so they've got ownership of it. I don't think I do	Jessica: Lines 34, 36, 42, 45, 47, 53 & 57 Nicola: Lines 49, 53, 58, 59 & 65	belief, benefiting, choice, facilitating, freedom, finding out for themselves, independent, less inhibited, make sense, own way, ownership, pride, valid opinion,

		as much collaborative work once they're actually on the computers as maybe they could do so I'd be interested in finding out more about that kind of stuff. (Nicola: Line 53)		

Lucy's interview included the *a priori* theme of **immediacy,** for which further supporting evidence was reported in the Phase 1 teacher interviews (see Section V.1.2). Lucy found the Google Classroom's ability to provide users with immediate feedback and information beneficial in her geography lessons, resulting in the opportunity for dialogues to be anchored upon current, real world events:

> I think technology used in the correct way is highly beneficial and that's why half of my lessons go totally off kilter; because you know one child will find a website which is absolutely amazing and suddenly it's up on the board and we're all discussing it. (Lucy: Line 40)

Religious studies teacher Jessica's interview also included a theme seen in teacher interviews of a previous phase, that of **barriers to dialogue** (see Section V.2.2). Jessica is conscious of the need for children to develop an age-appropriate understanding of the gravitas and complex practices of different world religions before she is confident that they are equipped to explore their ideas in dialogue with others. Consequently, Jessica finds that she works in a more didactic way with younger children and becomes increasingly dialogic in her approach with her older students:

> I just constantly enforce that opinions are fine so long as they can back them up. Most of the kids know that's my biggest bugbear, particularly in the tech age of Twitter when you can just throw out a hundred characters of opinion and not not have anything to back that up. (Jessica: Line 46)

All three teacher interviews of Phase 3 were characterised by the *a priori* theme of **different perspectives,** as reported upon in Phase 1 of this DBR project (see Section V.1.2) and lent weight to the possible affordance of Google Classroom to

expose participants to the views of others through dialogue; particularly through the sharing of artifacts, the invitation to add comments to them and the use of digital resources to prompt discussion activities in class.

All three interviews also shared the theme of **Dialogic Space-time,** a theme which had first emerged during the analysis of Laura's interview in Phase 2 (see Section V.2.5). This provided further evidence that Google Classroom can act as a means through which ongoing and expansive dialogue can take place; unbounded by physical space or time:

> It's really lovely watching that developing; where they've put the website up and then somebody has gone, "Oh that's a really good website, well done, but I've also found this one". So for dialoguing outside of the classroom, I think it's brilliant when they're not face to face or in the classroom itself. (Lucy: Line 77)

An emerging theme detected in both Jessica and Nicola's teacher interviews in this phase was the role of dialogue in reducing authoritarianism and transforming social relations in the classroom. This **pedagogy of emancipation** (also present in Laura's Phase 2 teacher interview) rejects monologic discourse or lecturing and challenges a teacher's authority over the knowledge of their students. In this way, dialogue is a vehicle for developing critical consciousness between participants (Kim & Wilkinson, 2019) and evidence from this phase suggests that Google Classroom offers means by which this can be mediated. In her Phase 3 interview, Jessica described herself as a facilitator of the children's learning and exploration of her subject. In her RS lessons, she stresses the importance of children critically considering their own opinions, whilst acknowledging the beliefs of others:

> ... I will often get children say, "I don't believe in God. Is that okay?", and I'll say, "Of course. You can say you don't believe in me if you can back up why you say that". (Jessica: Line 45)

The use of Google Classroom tools can also give the children the freedom to choose how they might best express their ideas and take ownership of the work they produce, further ceding control of the learning process from teachers. Both Jessica and Nicola described the way they set assignments on the LMS in such a way that the children can decide the type of artifact that they might like to create, giving them greater ownership of their learning.

> ...when we get to [homework] in Year 6, there are some children who prefer to draw, some children who prefer to do that in a Google Slides stock and it just gives them that freedom to produce work that they're proud of and that they're engaged with but doesn't necessarily have the fear of, "Oh my God I've got to draw something". (Jessica: Line 53)

The support that Google Classroom can provide for an emancipatory pedagogy, realised through dialogue, might particularly benefit students with special educational needs or disabilities (SEND), a theme elaborated upon in the student interviews of Phase 2 (see Section V.2.5). In allowing students to put their thoughts across in a coherent manner using their preferred medium, some will have access to dialogues that might otherwise be inaccessible to them.

An *a priori* theme common to both Lucy and Nicola's Phase 3 teacher interviews was **accessibility** (Hennessy, 2020), a theme also present in Rebecca's interview in Phase 2. The teachers described the range of different external resources that they might signpost (or children might find and use independently) through the platform including links to articles, documentaries, websites and YouTube videos. Google Classroom provides students with digital access to a wide range of resources and both the practitioners found that curating these was an important consideration when planning to teach using the LMS:

> There's a lot of stuff out there that's alright but I have to tweak it. I mean there's never been anything I found where it just works or it's just brilliant in its raw state, as it is. (Lucy: Line 95)

The teachers also described some of the different materials they create using Google Drive tools and distribute to their students. These included differentiated materials and tasks that once *assigned* the children have instant access to via the Google Classroom *stream*:

> They're not all getting the same piece of work. You can give them a choice of work that they are doing but they are all working within the same area without having loads of different worksheets and all that kind of thing. So they can be a lot more independent in their work and what they're doing but it's differentiated as well. (Nicola: Line 65)

Finally, as had been the case with the majority of teacher interviews (with the exception of George's in Phase 1), the three participants of Phase 3 all provided testimony to support the *a priori* theme of **collaboration and community** (Major et al., 2018b) as an affordance of Google Classroom to support dialogue; that through the use of certain functions of the LMS, dialogic practitioners can foster collaboration and a sense of community between participants. The means through which this is achieved include the use of the *share* function of the platform to collaborate in real-time and co-construct artifacts such as Google Slides presentations and other joint projects. Associated apps such as Padlet (a tool to create shared digital 'pinboards') were also highlighted by the teachers as means by which their Year 7 students can be exposed to the ideas and experiences of others, acknowledge them and discuss them further:

> My aim would be that I am facilitating and that I lay the groundwork for something that the pupils can then manipulate and understand in their own way. And can collaborate with their peers to find out what they think and to kind of organically grow their understanding of something. (Jessica: Line 34)

The three teachers interviewed in Phase 3 spoke of a learning culture at the setting in which the children look to share and collaborate with others, "instinctively" rather than waiting for teachers to prompt them. In her interview, Lucy expressed how this

tolerant and supportive environment has resulted in a change to her own practice; regularly allowing her students to discuss ideas at length between themselves (and to move freely around the classroom at times), something she would not have done nearly as often in other settings she has worked in. By leveraging the sense of community between the children in this way, Lucy not only ensures that they further their understanding of geography, but also strengthen their ability and willingness to collaborate; in a virtuous circle of dialogue.

V.3.3 Joint planning activities

In January 2020, the **first of three Phase 3 joint planning meetings** between the three teacher participants and myself (acting as a non-teaching co-researcher in this phase) took place. As in both previous phases, the research questions of the DBR project were outlined to the participants. In addition, the features of exploratory dialogue (Mercer & Littleton, 2007) were used to prompt an initial discussion as was the T-SEDA scheme and the ground rules for talk (adapted from Dawes et al., 2004) that were to be printed and placed on display in the classrooms of all three participants.

The refinements to be brought forward from both Phases 1 and 2 of the DBR project were also discussed (see Sections V.1.7 and V.2.7), as was the optimum group size to promote dialogue between the children. Previous lessons in this project had used a range of group sizes (from 2-4) but the Phase 3 teachers felt that, in their experience, triads worked best. Groups of three are not so large that they might break into sub-group discussions (rather than remaining as a cohesive unit) but not so small that if particular characters are asked to work together, no dialogue takes place at all; as can be the case in paired work. With this in mind, the group considered some of the triad discussion 'roles' suggested by Gaunt and Scott (2018) such as *Silent Summarizer, Questioner* and *Oracy Expert*. Jessica had volunteered a Year 7 religious studies (RS) lesson plan as the first for augmentation in Phase 3 and given the complexity of the issues at hand (to express their own attitudes

towards punishment and to examine those of others), the group decided against introducing any specific dialogue roles to the children at this point.

The group determined that a group discussion task, where children were asked to decide upon their own level of agreement with a series of statements on the topic of punishment, before discussing and comparing with peers, would be an ideal target for augmentation. In the standard lesson, children were to be divided into triads to discuss their opinions having first completed their own copy of the worksheet (see Fig. 5.11) before surveying their peers to compare and contrast their ideas. In the augmented lesson, the Google Slides presentation Jessica had prepared to explain tasks to the children on the interactive whiteboard was altered so that each group could directly edit their assigned slide; using coloured markers to represent their individual level of agreement with each statement (see Fig. 5.12). The participants hypothesised that in displaying their ideas on a resource that was not only shared with their discussion group but to all others in the class simultaneously, the views of the children would be made explicit and more readily available for discussion in plenary. Both of Jessica's lessons were delivered in the same week in early February 2020 to mixed attainment groups; within each class the children were placed into triads using an online random name generator. The focus activities for these RS lessons and others observed in the phase, along with further contextual information, are summarised in Table 5.14.

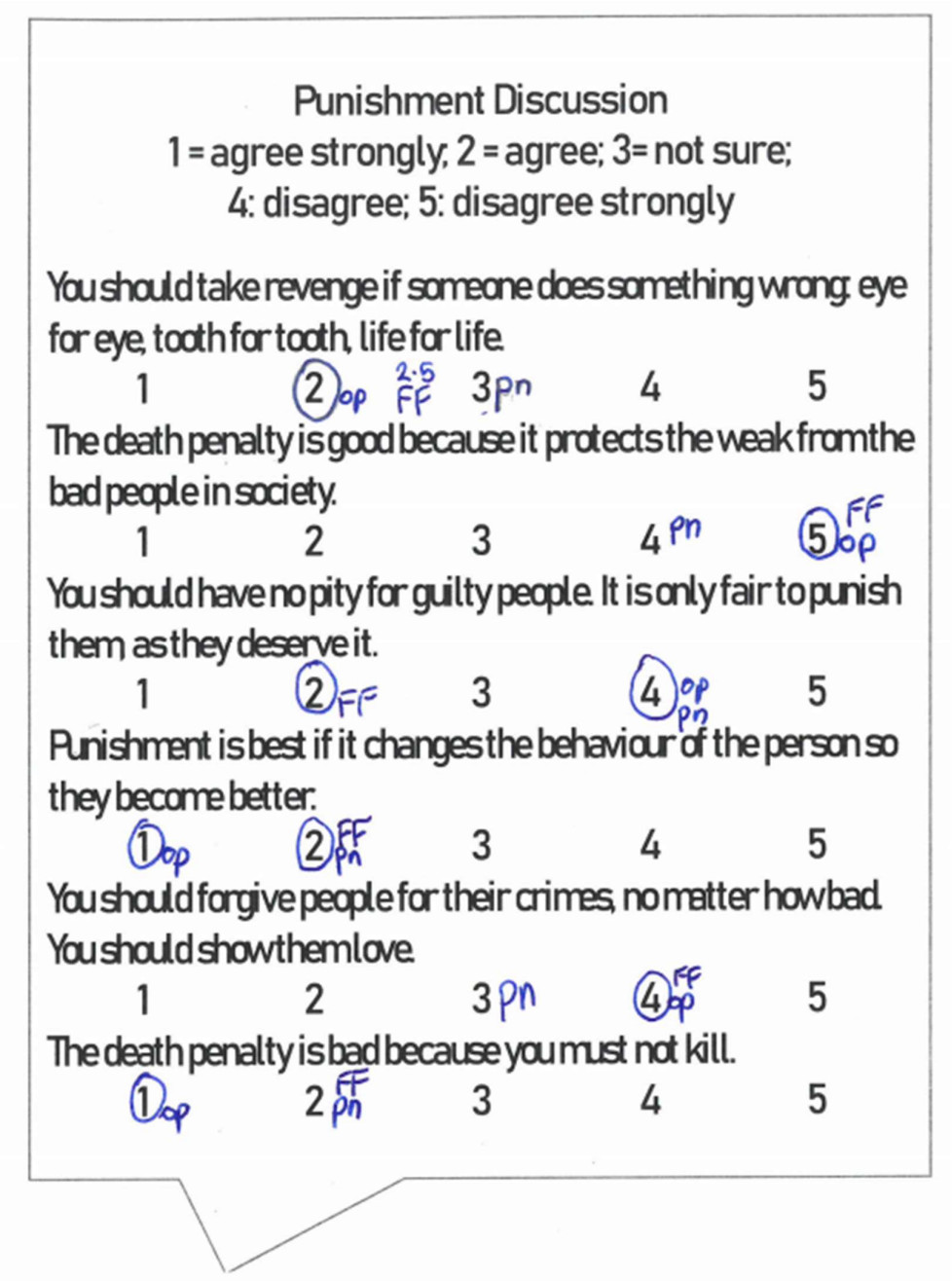


Figure 5.11: Worksheet with annotations from a Year 7 religious studies lesson.

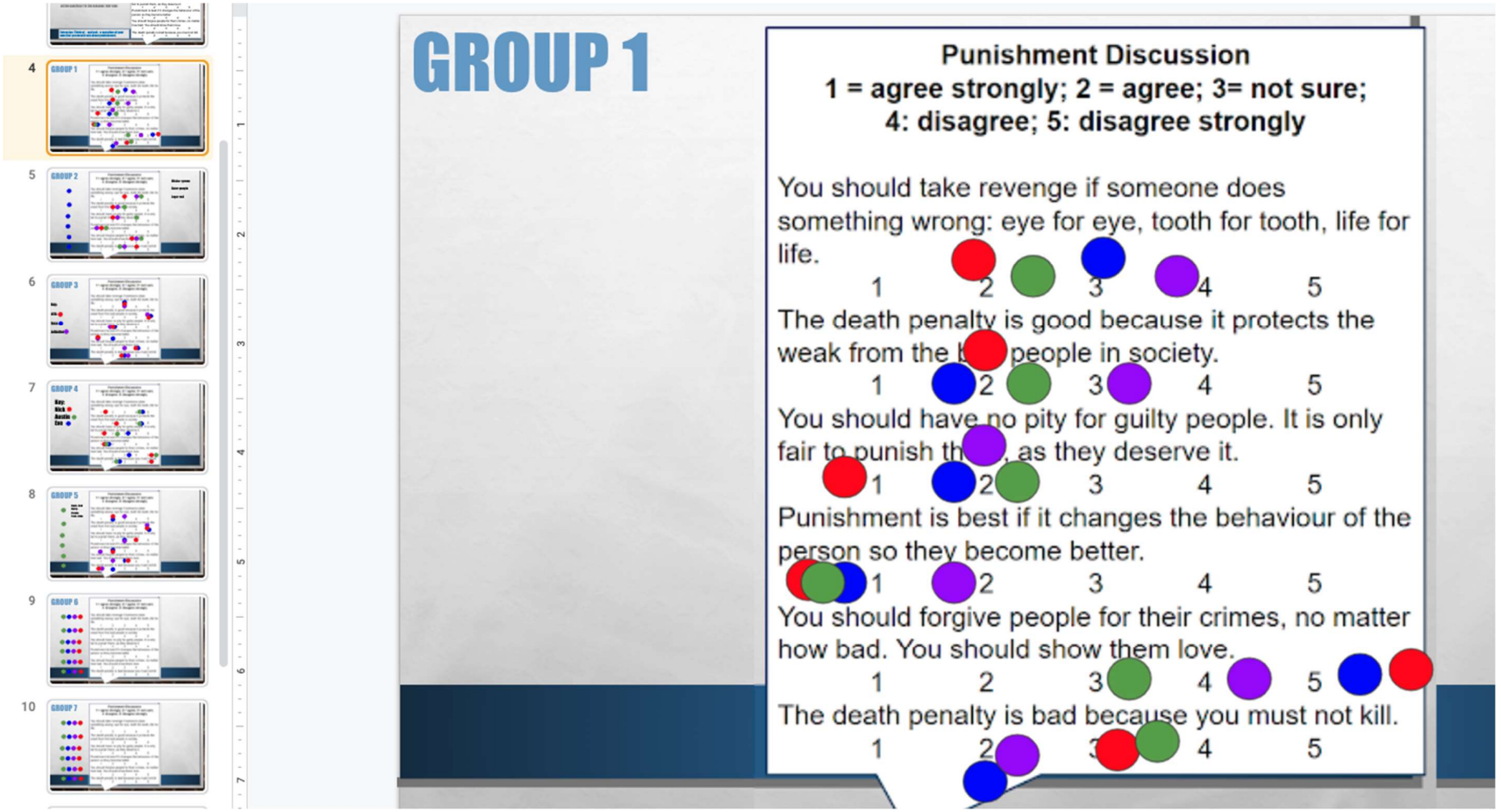


Figure 5.12: Google Slides presentation from a Year 7 religious studies lesson.

Table 5.14: Summary of focus activities observed in Phase 3 lessons.

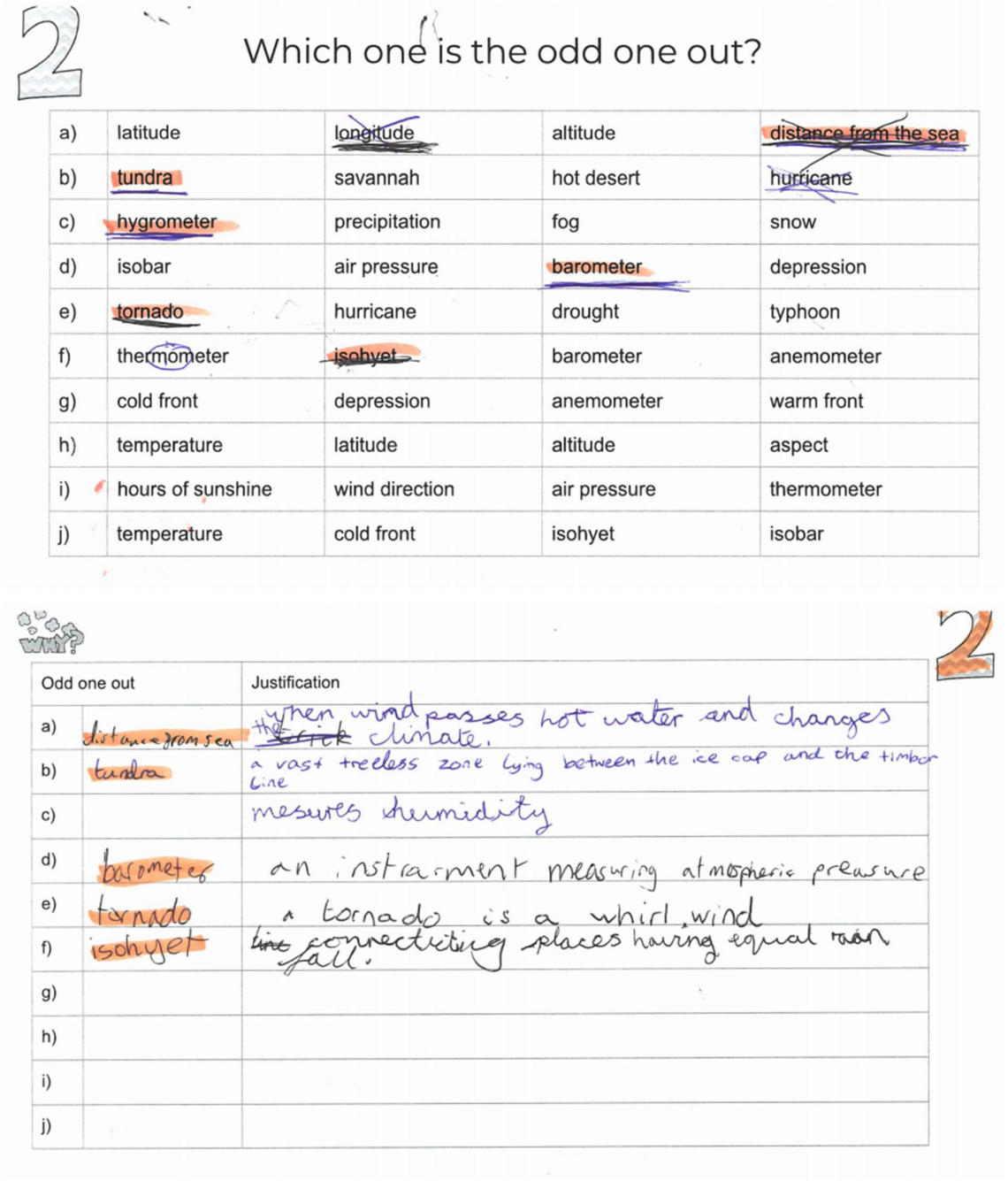
Teacher	Lesson	Subject	Date	Class Size	Setting Arrangement	Mean CAT Score	Focus Activity
Jessica	Standard	RS	03/02/20	17	'Top' set determined by science	126	Students were asked to decide upon their own level of agreement with a series of statements on the topic of punishment (provided on individual photocopied worksheets), before discussing and comparing with their discussion group.
Jessica	Augmented	RS	05/02/20	16	'Parallel' set (one of two below 'Top' set) determined by science	118	Students were provided with a central copy of a Google Slides presentation containing a series of statements on the topic of punishment. Each group worked on a shared Chromebook to access their copy of the statements on a particular Google slide, before moving digital coloured counters around the screen to illustrate their individual level of agreement.
Lucy	Standard	Geography	26/02/20	9	'Parallel' set (one of two below 'Top' sets) determined by English	110	Discussion groups were asked to agree upon the 'odd one out' from a series of word lists on the topic of 'weather and climate ' and justify their decisions on a photocopy of the worksheet, shared within each group. Students were able to refer to a subject textbook and a dictionary to support their work.
Lucy	Augmented	Geography	26/02/20	15	'Top' set (one of two) determined by English	113	Discussion groups were asked to agree upon the 'odd one out' from a series of word lists on the topic of 'weather and climate ' and justify their decisions on a shared Google Slides presentation, with each group working on a separate slide. Students were able to use the Search engine to support their ideas which they recorded using a shared Chromebook.
Nicola	Standard	PSHEE	10/06/20	17	'Mixed' set based on pastoral 'Form' grouping.	116	A 'True or False' discussion activity on the topic of 'smoking' was provided via a Google Slides presentation to each child individually. Discussion groups, working remotely, were then placed in separate Google Meets video calls to discuss the statements and decide upon their answers, which were recorded individually on their own copy of the slideshow.
Nicola	Augmented	PSHEE	10/06/20	17	'Mixed' set based on pastoral 'Form' grouping.	117	A 'True or False' discussion activity on the topic of 'smoking' was provided via a copy of a central Google Slides presentation, shared with the whole class. Students, working remotely, were then placed in separate Google Meets video calls with their groups to discuss the statements and agree upon their answers, which were recorded on their group's copy of the statements within the class' central Slides presentation.

In the **second joint planning meeting** (February 2020), Jessica shared her thoughts on the two lessons she had delivered. Jessica was encouraged by the level of discussion she had heard when circulating the room in both lessons and was confident that the children were engaged with the subject matter at hand. She felt that the plenary discussion at the end of the augmented lesson was particularly successful, as she was able to easily use evidence from the shared presentation to anchor the dialogue. This was in contrast to the standard lesson where the children were less likely to give detailed justifications for their opinion line choices in the plenary than they were in their triads. Both Jessica and I noted that the children in the augmented lesson, working from a shared Chromebook, had more 'open' body language with one another and indeed, altered their seating and positioning to better communicate with their group and share the digital resource. It was unclear if this same effect would have been seen in the standard lesson if children had not been given individual worksheets but had instead been required to collaborate on a central copy. Jessica also remarked that she had not seen such levels of engagement in discussion from one boy in particular, as she had in her augmented lesson. She opined that his comfort and familiarity with using digital devices may have given him a sense of security from which he felt able to contribute to the group, which would have been lacking if printed or written materials had been used instead.

Following this feedback, the participants considered how Lucy's Year 7 geography lesson plan might be augmented. This was a review of key vocabulary from the children's 'Weather and Climate' topic ahead of an end of unit assessment. In the standard lesson, Lucy planned to ask triads of children to identify the 'odd one out' from a series of word lists and justify their decisions. In the standard lesson, the children would be given a central worksheet to record their ideas and justify their answers (see Fig. 5.13). In support of this, each triad would have access to a dictionary and textbook to clarify the meaning of any unfamiliar words. In the augmented lesson, the participants decided that students should once again work on a single shared Google Slides presentation (see Fig. 5.14), with one slide assigned to each group and a single Chromebook provided to record their ideas. In a further change from Lucy's standard lesson plan, the children would not be given a

dictionary or textbook to refer to but would instead be allowed to use the Google search engine to explore and clarify the meanings of words.

Both of Lucy's lessons were delivered on the same day in late February 2020. Neither class was set according to attainment in geography, however the subject was timetabled according to English groups at this time. Lucy's standard lesson was delivered to a lower attaining group whilst the augmented lesson was delivered to a class with higher attainment in English. Within each class the children were placed into triads by the teacher using an online random name generator, decided in advance of the lessons.



2 Which one is the odd one out?

a)	latitude	longitude	altitude	distance from the sea
b)	tundra	savannah	hot desert	hurricane
c)	hygrometer	precipitation	fog	snow
d)	isobar	air pressure	barometer	depression
e)	tornado	hurricane	drought	typhoon
f)	thermometer	isohyet	barometer	anemometer
g)	cold front	depression	anemometer	warm front
h)	temperature	latitude	altitude	aspect
i)	hours of sunshine	wind direction	air pressure	thermometer
j)	temperature	cold front	isohyet	isobar

WHY?

2

	Odd one out	Justification
a)	distance from sea	the ~~brick~~ when wind passes hot water and changes climate.
b)	tundra	a vast treeless zone lying between the ice cap and the timber line
c)		measures thumidity
d)	barometer	an instrument measuring atmospheric preasure
e)	tornado	a tornado is a whirl wind
f)	isohyet	~~line~~ connecting places having equal rain fall.
g)		
h)		
i)		
j)		

Figure 5.13: Worksheet with annotations from a Year 7 geography lesson.

Odd one out		Justification
a)	Distance from the sea	Altitude, longitude and latitude are all associated with weather and climate but distance from the sea isn't.
b)	Hurricane	Hurricanes fit into the category of weather but all of the other words fit into the category of climate.
c)	Hygrometer	The other words are associated with weather but a hygrometer is a measuring device.
d)	Barometer	A barometer is a measuring device and the other words aren't measuring devices.
e)	Drought	All the other words are swirling forms of wind and/or air pressure but a drought is just extreme heat focused on one point of the land
f)	Isohyet	All of the other words are measuring devices but an isohyet is a type of geographical line
g)	Anemometer	The other words are to do with pressure whereas the anemometer is to do with wind speed

Figure 5.14: Google Slide from a Year 7 geography lesson.

In March 2020, the UK government announced the first national lockdown in response to the Covid-19 pandemic and all teaching and learning activities at the school were moved online (with the exception of provision for vulnerable children and those of key worker parents). The **third joint planning meeting** of this phase was therefore delayed until June 2020 and took place remotely using Google Meets. This video conferencing app had become the primary means by which colleagues at the preparatory school collaborated when working remotely; in tandem with Google Drive and its associated apps.

At this virtual meeting, Lucy provided feedback to the group about her geography lessons and stated a clear preference for the augmented version: "I know which one I would do if I could do it again". Lucy felt that the information was less immediate when being searched for amongst printed materials (even in books that were familiar to the children), resulting in long pauses and a reduction in dialogue when compared to her second lesson. Meanwhile, the use of Chromebooks in the augmented version seemed to result in more open body language and collaboration between the members of each triad.

For the third lesson of this phase, Nicola put forward a personal, social, health and economic education (PSHEE) lesson plan to the group. This was an introduction to the topic of 'Smoking' and her planned 'True or False' discussion activity was selected for augmentation by the group. This activity had already been adapted from the scheme of work so that it could be delivered online and Nicola had recently trialled the use of discussion 'rooms' by creating multiple Google Meets for the children to join in small groups. At this time, no 'breakout room' function was available for Google Meets and so Nicola would remotely police the discussions by muting the separate tabs and 'visiting' each group in turn. Google Meets had quickly become the main means of communication between teachers and students during this period of remote learning at the preparatory school; due in part to its integration into Google Classroom, with which the majority of the school community were now familiar. Each Meet was also recorded, in keeping with the school's safeguarding arrangements for online learning, meaning that the audiovisual data collected during Nicola's lessons could be considered naturalistic.

In the standard lesson, Nicola planned to ask the children to write on their own copy of a Google Slides presentation during their discussion. This was provided by Nicola who used the 'make a copy for each student' function when setting up the lesson on Google Classroom. In the augmented lesson, the participants decided that each group should write on a slide within a shared slideshow (see Fig. 5.15). This had proved successful in the previous augmented lessons of this phase and was made possible by Nicola allowing students to edit the central file when setting up the lesson on the LMS. Whilst the aim of this was to give all triads visibility of everyone's answers when writing collaboratively yet remotely; using a shared Google Meets space rather than a single Chromebook in person, represented a significant difference to previous tasks in this project.

Both of Nicola's lessons were delivered remotely on the same day in June 2020. As the groups were not being taught in their school classrooms, the ground rules for talk display was integrated into the Google Slides presentation that Nicola used for the introduction to her lessons. Children were asked not to research the answers to the

true or false questions, but to discuss them with one another and decide upon a shared answer before returning to the whole class video call to discuss them. The Year 7 classes were taught in mixed attainment groups and triads were determined in advance by Nicola using a random online name generator. At this time, teachers of Year 7 were expected to offer online support to students in 'core' subjects during what would have been usual lesson times. Whilst PSHEE was not amongst the subjects where this was mandatory, Nicola had regularly scheduled contact time with her students in this way. Prior to these lessons the children were reminded that she would be available from the start of the sessions to support their learning and all of the children attended.

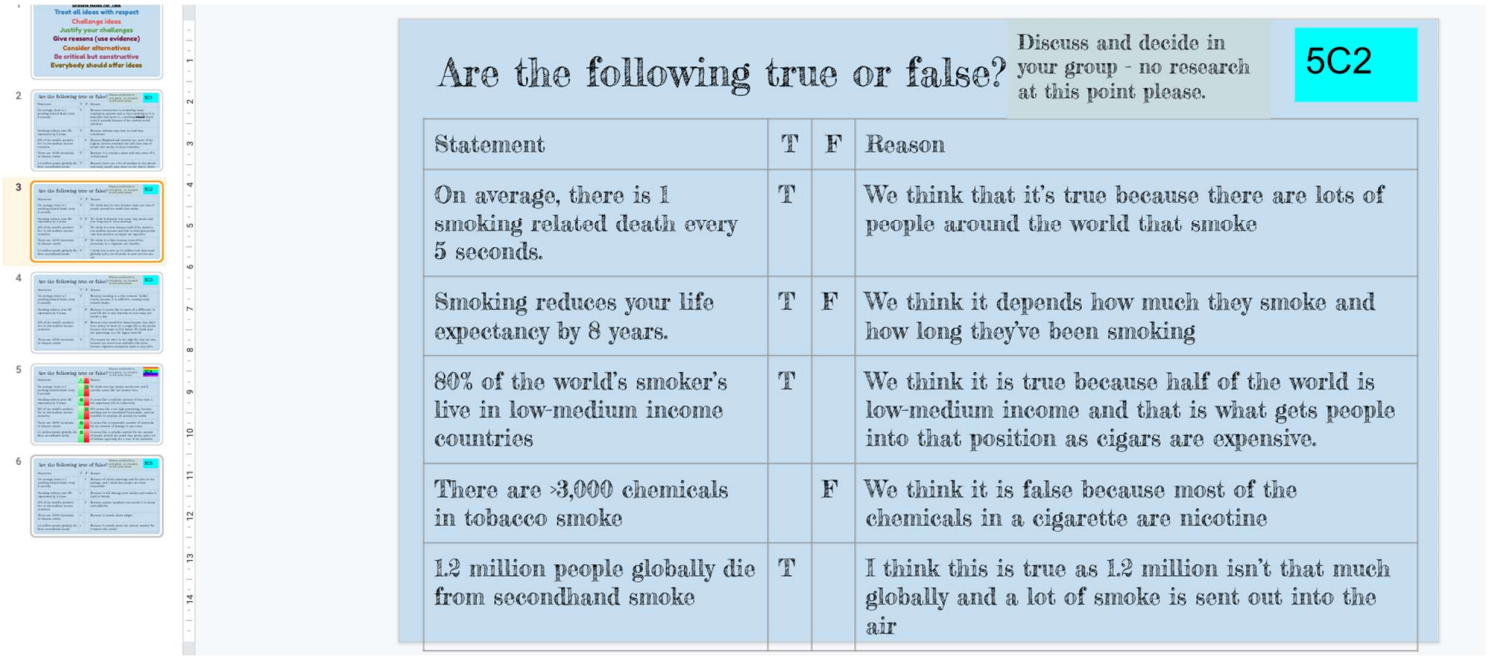


Figure 5.15: Google Slides presentation from a Year 7 personal, social, health and economic education (PSHEE) lesson.

Following her lessons, Nicola felt that the 'breakout' rooms had worked well and was pleased with the contributions the children made to the wider class discussion upon their return from their group work. However, she noted a difference in the level of discussion she observed when moving between the separate Google Meets; with less dialogue noted within the triads of the standard lesson. Those in the augmented

lesson, where a shared presentation was provided, also seemed to be more likely to have their cameras on as they worked through the statements and had a greater sense of comradery as a result.

V.3.4 Analysis of classroom dialogue

In Jessica and Lucy's lessons in Phase 3, digital dictaphones (Tascam DR-05 Audio Recorder models) were used to capture the verbal interactions of three triads of children whilst a video camera (Sony NX70 and Canon Legria HFG25 models) with external microphone was used to capture a recording of the wider classroom. Nicola's lessons took place remotely over the Google Meets video conferencing app; triads were provided with separate Meets over which they could communicate and all interactions were captured using the in-built recording feature of the app.

Following each lesson in this phase, audio from the focus activity that had been selected for augmentation during the joint planning meetings was transcribed. Transcripts of these verbal interactions, in addition to any artifacts generated by the children, were then coded as described in the Methodology (see Section III.9.2 for details). See Appendix 16 for an overview of the coding results for this phase.

The focus activity in the **first participant's lessons** was a discussion based on each student's level of agreement with a series of statements on the topic of punishment. In the standard lesson, delivered to a mixed ability group of Year 7 religious studies students in early February 2020, children were given an average of 9 minutes of discussion time for the focus activity. The children were instructed to make their own position clear for each statement on their own copy of the worksheet before discussing the positions of others in their triad and making a note of these on their worksheet (see Fig. 5.11). The augmented lesson plan was then delivered to another mixed ability Year 7 class later in the same week. For this second lesson, Jessica provided editing access to a central copy of a Google Slides presentation so that each group could move coloured markers to represent their individual level of agreement with each statement (see Fig. 5.12). In this second lesson, triads shared

a single Chromebook to access and edit the presentation (distributed using Google Classroom) and were given 11 minutes to complete the discussion task on the theme of punishment.

Table 5.15: Cluster level coding of dialogue during focus activities of Phase 3, Participant 1 lessons.

Lesson	Group	Inviting elaboration or reasoning	Making reasoning explicit	Building on ideas	Positioning and coordinating	Total Dialogic Moves
Standard	1	4	17	19	15	54
Standard	2	7	8	21	17	52
Standard	3	8	11	8	8	37
Standard	**Mean**	**6**	**12**	**16**	**13**	**48**
Augmented	1	5	12	7	8	32
Augmented	2	4	12	18	13	47
Augmented	3	3	3	5	9	20
Augmented	**Mean**	**4**	**9**	**10**	**10**	**33**

As described in the methodology (Section III.9.2), the numbers of dialogic moves per group were adjusted to account for the differences in the length of time given over to the focus activity in each lesson of the project. Frequencies are therefore reported rounded to the nearest whole number and represent the adjusted total per 12 minute episode. Once adjusted, the number of total dialogic moves reduced from 48 to 33 between the standard and augmented focus activities in Jessica's religious studies lessons. There was a small reduction in the number of dialogic moves that invite elaboration or reasoning, make reasoning explicit and in those used to position or coordinate ideas (see Table 5.15). The difference between the number of moves where participants build upon one another's ideas was more significant (Standard = 16, Augmented = 10).

Both of the **second participant's lessons** took place on the same day in late February 2020. Lucy taught two Year 7 geography lessons that reviewed key vocabulary from the children's 'Weather and Climate' topic. These classes were not

set according to attainment in the subject, but were grouped according to their attainment in English. Lucy's standard lesson was delivered to a lower attaining group whilst the augmented lesson was delivered to a class with higher attainment in English. In the standard lesson, students were given 21 minutes to identify the 'odd one out' from a series of word lists and justify their decisions within their triads using a single shared worksheet (see Fig. 5.13) with reference to dictionaries and textbooks. In the augmented lesson, the triads were given 17 minutes to complete the same task using a shared Chromebook to edit a single shared Google Slides presentation (see Fig. 5.14). On this occasion the children were allowed to use the Google search engine to explore and clarify the meanings of words, rather than using the printed materials available in the standard lesson.

Table 5.16: Cluster level coding of dialogue during focus activities of Phase 3, Participant 2 lessons.

Lesson	Group	Inviting elaboration or reasoning	Making reasoning explicit	Building on ideas	Positioning and coordinating	Total Dialogic Moves
Standard	1	1	8	14	5	28
Standard	2	4	5	7	4	19
Standard	3	1	6	10	8	25
Standard	**Mean**	**2**	**6**	**10**	**6**	**24**
Augmented	1	6	15	25	19	66
Augmented	2	1	15	15	18	48
Augmented	3	1	4	11	6	23
Augmented	**Mean**	**3**	**11**	**17**	**14**	**46**

The second lesson of Phase 3 represented the first time that the total dialogic moves had increased between a standard and augmented lesson in the project; from an average of 24 to 46 moves per episode. In this instance, the coded dialogue increased significantly in three of the four analysed clusters (see Table 5.16) and was in keeping with Lucy's observations that were reported to the group during the third joint planning meeting of the phase. Whilst similar numbers of moves that invite elaboration or reasoning were seen in the focus activity of both lessons, there was a

marked increase in the number of moves where participants make their reasoning explicit (Standard = 6, Augmented = 11) in the augmented lesson. An even greater difference was observed in moves where participants build upon (Standard = 10, Augmented = 17) and position and coordinate their ideas (Standard = 6, Augmented = 14).

The **third participant's lessons** were delivered remotely by Nicola to two mixed attainment Year 7 personal, social, health and economic education (PSHEE) classes on the same day in June 2020. These lessons were on the topic of 'Smoking' and in the focus activity, students were asked to decide if they felt a statement was true or false, having discussed the statements in their triads using the Google Meets video conferencing app. In the standard lesson, children were asked to write on their own copy of the true and false slide during the discussion. In the augmented lesson, students were asked to arrive at a joint answer with their discussion group and write their justifications on a shared Google Slides presentation, rather than an individual copy (see Fig. 5.14). In both lessons, the students were given 10 minutes to complete the focus activity.

Table 5.17: Cluster level coding of dialogue during focus activities of Phase 3, Participant 3 lessons.

Lesson	Group	Inviting elaboration or reasoning	Making reasoning explicit	Building on ideas	Positioning and coordinating	Total Dialogic Moves
Standard	1	0	12	10	3	25
Standard	2	1	3	1	3	8
Standard	3	6	8	15	13	42
Standard	**Mean**	**2**	**8**	**9**	**6**	**25**
Augmented	1	4	14	13	6	37
Augmented	2	0	19	23	13	55
Augmented	3	1	20	27	12	60
Standard	**Mean**	**2**	**18**	**21**	**10**	**50**

In the third participant's lessons of Phase 3, the total dialogic moves increased between the standard and augmented focus activities from an average of 25 to 50 moves per episode. In a similar pattern to that of Lucy's lessons, the coded dialogue increased significantly in three of the four analysed clusters (see Table 5.17) in the lessons that Nicola planned and delivered. Whilst the same number of moves that invite elaboration or reasoning were seen in the focus activity of both (2), there was a marked increase in the number of moves where participants make their reasoning explicit (Standard = 8, Augmented = 18), build upon ideas (Standard = 9, Augmented = 21) and position and coordinate their ideas (Standard = 6, Augmented = 10).

V.3.5 Student interviews

Following each of the three *augmented* lessons in this phase, a student was selected for interview on the basis of their standardised cognitive reasoning scores (CAT4, GL Assessment), which are completed annually at the school. These children were then asked to invite two friends from their class to accompany them in the joint interview. Following the lessons by Jessica, the child with the highest average score for the class, a girl with a 124 average cognitive ability test (CAT) score, was selected. A boy with the median CAT average (118) was selected from Lucy's class and following Nicola's augmented lesson, a girl with the lowest CAT score in the class (103) was invited to take part and invite two classmates to the interview. Whilst Nicola's lesson took place remotely due a national lockdown in response to the Covid-19 pandemic, this final student interview was conducted in person as changes to the restrictions meant that the Year 7 students were able to return to the school in person the following week. The three girls interviewed were all in the same 'bubble', enabling them to be interviewed in the same meeting room that was used for all of the previous student interviews in the project.

In keeping with the student interviews of the two previous phases, evidence for the *a priori* themes of **accessibility, immediacy** and **different perspectives** were seen in the student interviews of Phase 3 (expanded upon in Section V.1.5). Evidence for three other *a priori* themes (**co-construction, collaboration and community** and

metacognition) was seen in the student interviews of this phase and an additional theme (**pedagogy of emancipation**) emerged from their thematic analysis (see Table 5.18).

Table 5.18: Summary of supporting evidence for themes reported in Phase 3 Student Interviews.

Theme	Description	Example Excerpt(s)	Supporting Data	Key Words
Co-construction	Supporting participants to build knowledge together through dialogue, including the creation of shared digital artifacts.	I think it does because you can discuss your ideas. Whereas if it was all yourself and you had to just answer it on your own then you wouldn't have everyone else's ideas to combine into one answer. (3.1: Line 12)	Interview 3.1: Lines 8, 12, 20 & 38 Interview 3.2: Lines 29, 59 & 89	agreed, combine, decide, discussion, everyone's ideas, Padlet, what everyone thought
Collaboration and Community	The role of dialogue in fostering collaboration and a sense of community.	It's not necessarily with Google Classroom but Padlet I think that helps. To get out lots of people's ideas. (3.1: Line 38) Well a normal PSHE lesson is; we normally have a discussion as a group. Then like in pairs or maybe threes or four sometimes, we can complete some slides or just do some team work together but then have a class discussion as well. (3.3: Line 2) We get lots of ideas, a lot of ideas together. (3.3: Line 29)	Interview 3.1: Lines 5, 6, 10, 12 & 38 Interview 3.3: Lines 2, 19, 29, 51, 58, 84, 89, 92 & 133	between, bounce off each other, class, compare, everyone, friends, group, Google Meets, helpful, more ideas, pairs, persuaded, teamwork, together, with each other, working environment
Meta-cognition	Thinking about the thinking of others when contributing to a dialogue.	So that they know what you think and how you're thinking. (3.3: Line 28) Yeah I mean we did sort of half and half we thought of ours and then, we might look at someone else's and compare a be like, ‘Oh yeah, that's quite a good reason’. (3.3: Line 51)	Interview 3.3: Lines 28, 41, 49, 51, 54, 72, 75, 78 & 136	different reasons, how you think, learn differently, learned about myself, they know, think differently, what others think, what you think

Pedagogy of Emancipation	The role of dialogue in reducing authoritarianism and transforming social relations in the classroom.	Rather than getting told the exact thing you need to do. (3.2: Line 81) It's really effective. Because if you don't know how to talk, it's a massive skill in life to be social. If you gave us a chromebook and we just sat down in silence we would learn the geography and everything but we wouldn't really learn. (3.2: Line 99)	Interview 3.2: Lines 7, 29, 68, 81, 84 & 99	decide, do it yourself, effective, fun, not getting told

An emerging theme of the Phase 3 student interviews was the role dialogue can play in enabling a **pedagogy of emancipation** to exist, framed by the Google Classroom LMS. Students provided testimony that dialogue can play a role in reducing authoritarianism and transforming social relations in their classroom. This theme was also present in the teacher interviews of this phase, conducted prior to the observed lessons (see Section V.3.2).

The students interviewed in this phase described the enjoyment and value they place on being able to decide for themselves their own course of action and to develop their own opinions and answers rather than *getting told* what these should be. The effectiveness of this dialogic approach was also stressed by the children.

> It's really effective. I think it is. Because if you don't know how to talk, it's a massive skill in life to be social. If you gave us a chromebook and we just sat down in silence we would learn the geography and everything but we wouldn't *really* learn. (Student Interview 3.2: Line 99)

Three *a priori* themes also characterised the student interviews of this phase including **metacognition** (Major et al., 2018b) or t*hinking about the thinking of others when contributing to a dialogue*. The children described how the use of Google Classroom can not only make the different perspectives of participants known, but prompt them to think about how they and their classmates arrive at their ideas.

> So that they know what you think and how you're thinking. (Student Interview 3.3: Line 28)

When sharing digital artifacts and taking part in dialogue based on them, the children become aware of the different reasoning processes that are occurring in the classroom, learning how others think and in so doing, how they themselves arrive at ideas.

> … we knew what other people are thinking in the group so it sort of makes you think differently.... we might look at someone else's and compare and be like, 'Oh yeah, that's quite a good reason'. (Student Interview 3.3: Lines 49 & 51)

Thematic analysis of the Phase 3 student interviews, also provided evidence that the **co-construction** (Major et al., 2018b) of artifacts within Google Classroom is a means through which classroom dialogue can be supported. A range of features of the LMS can be used to support participants to build knowledge together through dialogue as they create and modify shared digital artifacts, most notably the *share* function which allows multiple users to view or work on a shared document in real-time. Interviewees spoke of various means by which this function is used to promote dialogue in their lessons, such as the creation of shared slideshows in science (Student Interview 3.2: Line 89) or contributing to 'digital pin boards' in geography (Student Interview 3.1: Line 38). The students value the opportunity to combine their ideas and *interthink* (Littleton & Mercer, 2013) when taking part in such activities.

> ...you can discuss your ideas. Whereas if it was all yourself and you had to just answer it on your own then you wouldn't have everyone else's ideas to combine into one answer. (Student Interview 3.1: Line 12)

Finally, as had been the case in the student (and teacher) interviews in all previous phases of the project, the theme of **collaboration and community** (Major et al., 2018) was evident in the student interviews of this phase. The affordance of Google Classroom to foster collaboration and a sense of community through dialogue was particularly evident when the children described tasks that are designed to expose

them to the different perspectives of others or to co-construct artifacts and knowledge. The Year 7 students described their learning environment as one in which they could freely share and bounce ideas off of one another, often working as a team to generate solutions. The children value the opportunity to work with friends but are willing to work in randomly assigned groups with other members of the class and in so doing, further cement their relationships and sense of community.

> I find it more helpful, discussing, than just going off by yourself and just researching all the questions because then you can get more ideas. (Student Interview 3.3: Line 92)

The three girls who took part in the final interview of this phase were particularly effusive about the value of collaboration and community, fostered through dialogue. These children had recently been taking part in lessons remotely due to a national lockdown, during which time Google Classroom and its video conferencing app (Google Meets) had played a major role in coordinating their learning. The children felt that this had helped to maintain their sense of belonging to the school community although they much preferred the *blended* approach of digital tools being used within their school classroom rather than in isolation at home.

> Yeah I definitely, definitely prefer physically being at school. That's what I have learned about myself during lockdown. That I really don't like being by myself because I love the environment and the atmosphere in the classroom. (Student Interview 3.3: Line 136)

V.3.6 Provisional theories

The data gathered in Phase 3 of this DBR project has provided initial evidence for the three research questions at hand and allowed for *provisional* theories to be postulated:

RQ 1. What affordances do LMS (specifically Google Classroom) provide for the teacher mediation of dialogic learning?

Data from the Phase 3 of this DBR study provides further evidence that **accessibility** (Hennessy, 2020) to a wide range of resources is an affordance of Google Classroom which can support classroom dialogue. In this phase, the teachers not only described the range of resources that they might signpost to the children through the Google Classroom *stream* (links to YouTube videos for instance), but also the resources that they themselves might create in advance of lessons. These include differentiated materials that can be *assigned* to all students, giving them access to different tasks or activities that cover the same learning objectives.

The teacher participants of this phase regularly make use of this 'Challenge by Choice' approach (Rohnke, 1989), providing their students with a range of different activities to choose from; both in terms of the level of difficulty they present and the means through which they can be completed. Whilst this approach has its roots in outdoor, *experiential* education, it is now widely used in a range of different educational settings and subject areas (Carlson & Evans, 2001) and leverages a student's intrinsic motivation to complete tasks that they have an informed choice over. Challenge by choice was introduced to the school in 2017 as a whole-school approach to the differentiation of learning and is based in part on the work of Paolo Freire. In his 1968 book, Pedagogy of the Oppressed, Paulo Freire was the first to use the term *Dialogic Teaching* and considered the practice to be at the core of any liberatory pedagogy. In dialogic teaching, teachers and students work together in mutual inquiry to "transform reality" (Shor & Freire, 1987, p.13) and emancipate learners from monologic discourse. In the teacher and student interviews of this phase, the role that Google Classroom might play in supporting a **pedagogy of emancipation** (Freire, 1996) emerged as a theme. Dialogic teaching rejects monologic discourse and challenges a teacher's authority over the knowledge of their students and evidence from this phase suggests that Google Classroom offers means by which this can be realised.

Freire was conscious that whilst teachers might disguise the power imbalance that exists between themselves and their students, they are still required to direct and *steward* the dialogue that takes place in their classrooms; as all education is directed to some degree (Freire & Macedo, 1995). Whilst the teacher remains responsible for the scope of a dialogic activity, and can use Google Classroom tools to promote the use of some online materials over others, they are still ultimately responsible for the direction that a dialogue takes. However, evidence from this phase shows that students at this setting are encouraged to post their own ideas or materials for others to explore, within the relative confines of the topic at hand. The students can therefore dictate their own lines of inquiry and stimulate dialogue between the group, allowing practitioners to move towards a more dialogic ideal in their classrooms. Lucy described how her geography lesson plans can often go "off kilter" as the children take greater control of the discourse having found tangential articles or ideas online that they wish to discuss. This is something she feels able to pursue due to the culture at the school, "I just think the kids have led my lesson, so my lesson plan has gone totally out the window. But in a really superb way." (Lucy: Line 54).

The teachers and students involved in this phase of the study provided further evidence that the *a priori* theme of **collaboration and community** (Major et al., 2018b) is an affordance of Google Classroom to support classroom dialogue. The three teachers interviewed in Phase 3 spoke of a learning culture at the school in which the children look to share and collaborate with others, "instinctively". This is perhaps entwined with the pedagogy of emancipation that the teachers in this phase aligned with, and part of a broader school culture of the sharing and tolerance of **different perspectives**. Jessica's description of dialogic teaching is testimony to this:

> In my classroom, very literally it means that pupils feel that they are safe to say something, that it is a safe environment to say something and that things that they do say will be acknowledged as valid opinion. (Jessica: Line 42)

The means through which this is achieved include the use of the *share* function of the platform to collaborate in real-time and **co-construct** artifacts such as Google Slides presentations and digital 'pin boards' (using the Padlet app). When working in this collaborative way, the students are exposed to the ideas of others, can acknowledge them and discuss them further. This promotes **metacognition** between participants as they become more aware of how others around them think and by contrast, how their own thought processes differ from their peers. When working in this collaborative way, the children not only further their subject knowledge but also strengthen their relationships and ability to dialogue effectively with one another in the future. This learning culture at the preparatory school is highly valued by the children themselves; particularly those who experienced displacement from it during periods of remote learning in the national lockdown.

RQ 2. Do LMS open up new spaces for dialogue?

Tasks that made use of shared Google Slides presentations which took into account the refinements put forward from Phases 1 and 2 (see Sections V.1.7 and V.2.7), continued to make participants' knowledge explicit in this third phase of the DBR project. There was also evidence that the Google Classroom *stream* is an important space for students to build upon one another's ideas and contribute to the dialogue of their class by providing asynchronous comments and materials on the message board of the LMS. Dialogue took place in these novel spaces as the students co-constructed and modified the digital artifacts. These can be revisited and remolded ad infinitum, providing an anchor for further dialogues to take place (Hennessy, 2011) and making dialogic space-time tangible for the participants. Whilst these spaces had been explored and described in previous phases of the project, the final participant's lessons in this phase made use of a new digital space within the LMS. Due to the remote learning taking place at the school in the summer of 2020, the Google Meets video conferencing app was used to provide *breakout* rooms for triads of children to conduct their dialogues and in so doing, maintain their sense of community and continue to provide a forum for different perspectives to be critiqued.

RQ 3. What is the nature of interaction within a LMS?

In the third Phase of this DBR project, some potential affordances of the Google Classroom to support dialogue (as described above) were identified and led to an increased number of total dialogic moves (see Fig. 5.16) in the augmented lessons for the second and third participants. These lessons represented the first time in the project that the augmented lessons had generated a greater number of total dialogic moves than their standard counterparts. The number of dialogic moves that invite elaboration or reasoning remained consistent between the standard and augmented lessons for all three participants of Phase 3 (see Appendix 16). However, a substantial difference was detected in moves where participants build upon one another's ideas. Whilst a decrease was detected in Jessica's lessons (Standard = 16, Augmented = 10) this cluster increased for both Lucy (Standard = 10, Augmented = 17) and Nicola (Standard = 9, Augmented = 21). Examples of students building upon or clarifying others' contributions (B1) and elaborating upon their own (B2) increased and may have been the result of Lucy and Nicola's focus tasks requiring the students to compromise on a joint answer; rather than deciding upon their own and then comparing, as was the case in Jessica's religious studies lessons.

A similar pattern was seen in those moves to which codes from the 'making reasoning explicit' cluster were applied. In Jessica's lessons this cluster decreased in frequency (Standard = 12, Augmented = 9) whilst for both Lucy (Standard = 6, Augmented = 11) and Nicola (Standard = 8, Augmented = 18) there was an increase. In both cases, this change was most significant in the 'explain or justify own contribution' code (R2); which may once again be due to the requirement for students to reach a joint answer in the focus activities. This might also account for the increase seen in the 'positioning and coordination' cluster for Lucy (Standard = 6, Augmented = 14) and Nicola (Standard = 6, Augmented = 10) whose augmented lessons saw an increase in the number of dialogic moves coded with 'propose resolution' (P3) in particular.

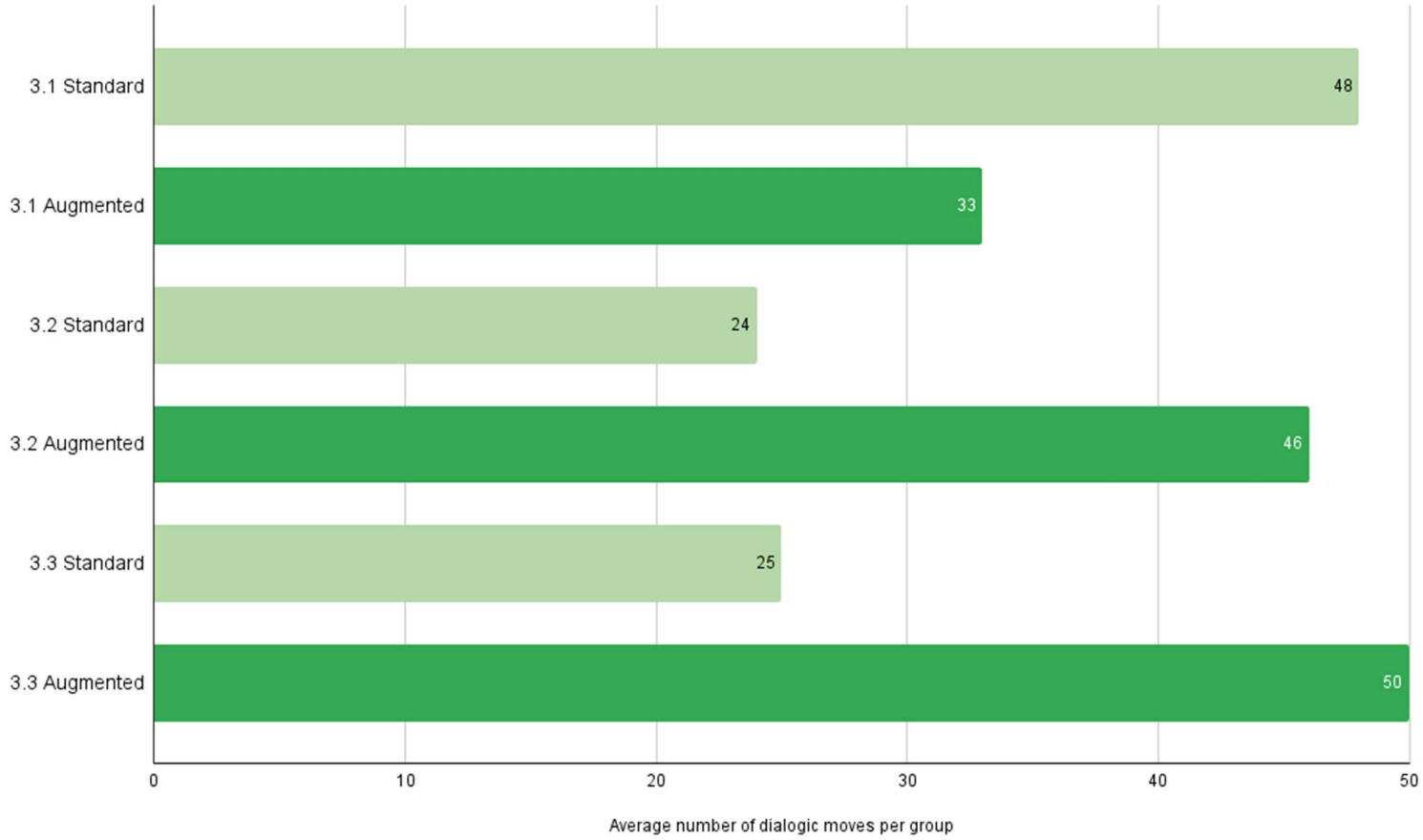


Figure 5.16: Average number of dialogic moves per group during the focus activities of Phase 3 lessons.

V.3.7 Refinements after Phase 3

In addition to those from Phases 1 (see Section V.1.7) and 2 (see Section V.2.7), the following refinements could inform future development of the DBR project. These were the result of the three joint planning exercises of Phase 3 and the analysis that followed:

- Arrange all discussion groups into triads.
- Design tasks that require students to decide upon a joint answer and make both their position and reasoning clear.
- If working remotely, provide *breakout* rooms for discussions to take place in and encourage all participants to keep their video feed on.

In Phase 3, all talk groups were arranged into triads. This meant that the groups were more likely to remain as a cohesive unit as they were not so large that they could splinter into smaller sub-group discussions; an issue that had been observed in some groups of four children in earlier phases. All of the teachers in this phase assigned the students to their talk groups randomly rather than allowing them to choose their partners or work within established groupings. Despite this, most engaged in dialogue in their triads, something that the teachers in this phase would not have expected to have been the case if the children were assigned to random pairs rather than threes. Should a fourth phase have taken place in this project, the establishment of triads would also have allowed for some discussion 'roles' (Gaunt & Scott, 2018) to be explored.

In this phase, the Google Slides presentations used in the augmented lessons were designed so that participants' positions were clearly represented on the screen. Whilst coloured counters had worked well in Jessica's lesson when using an 'opinion line', the binary choice of 'true or false' or selecting the 'odd one out' had made the children's positions equally clear in Lucy and Nicola's. In the augmented lessons of the second and third participants the tasks also required students to come to a joint

answer. Whilst these might seem to be dialectical rather than dialogic tasks; the additional requirement of participants to state their reasoning meant that the different perspectives amongst their group were made explicit. This resulted in *reflective dialogue* (Mercer & Wegerif, 1999) between the children, anchored upon the questions at hand.

In the third participant's lessons, *breakout rooms* were used to great effect to allow students working remotely to take part in productive classroom dialogue via the Google Meets video conferencing app. Whilst this was not a designed function of the platform when Phase 3 was underway, the LMS did allow for multiple Meets to be created simultaneously by a teacher, a potential that was recognised and leveraged by Nicola in the lead up to her observed PSHEE lessons. The children felt that working in this way helped to maintain their sense of belonging to their peer group and greatly appreciated the opportunity to collaborate on small group tasks as dialogue was not so productive when teachers arranged them into larger, often whole class groupings over a single Google Meet.

Part VI: Conclusions

VI.1 Introduction

The affordances of a Learning Management System (LMS) that support classroom dialogue are reported here following a design-based research (DBR) project which took place between April 2017 and June 2020. The setting for this study was an independent, co-educational preparatory school in East Anglia where the Google Classroom platform is used to manage digitally enhanced learning. This LMS now has more than 150 million student users (Google, 2021a) and is a free to use, web-based technology that allows teachers and students to access the G Suite for Education (formerly Google Apps for Education). However, despite the growing presence of Google Classroom and other LMS in educational settings, no published research has reported how the technology might prove disruptive to dialogic pedagogy or conversely, how the digital tools might actually be leveraged to promote this paradigm of teaching and learning. There is a growing interest in the potential of dialogue to transform education (Major et al., 2018a) but despite support for dialogic pedagogies within educational research, meaningful system-wide shifts in practice are yet to occur (Haneda, 2017). With the LMS tools designed to support collaboration and the co-construction of digital artifacts, Google Classroom would seem to be an ideal forum for its millions of users to be granted access to infinite dialogic space-time (Wegerif, 2013) and for educators to bring their dialogic intentions to bear.

This study explored how productive dialogue can be maintained and furthered by dialogic practitioners, when the digital tools of Google Classroom are available to them. The three-phase DBR approach that was applied (see Section III.3 for further details) centered around interventions designed in *joint planning meetings* between myself and fellow teachers at the school who acted as co-researchers. Within and between each of the three phases of the project, a series of refinements were put forward, impacting the design of subsequent interventions to enhance classroom dialogue and resulted in a set of design principles; transferable knowledge that can

be adapted to other settings (Cobb et al., 2003). The development of both the design principles and the provisional theories that support them were intertwined (as reported in Part V of this project) and informed by the data gathered during each phase. This included audiovisual data from a total of 18 observed lessons, teacher and student surveys, 7 teacher interviews, 9 student group interviews and the minutes from the 9 joint planning meetings which took place.

In this Part, the successive refinements made to the co-researchers' approach to using the LMS to support dialogue are charted. Summary statistics from the analysis of the audiovisual data, coded using the SEDA scheme, are presented to support these design principles that will be of interest to fellow educators wishing to pursue a dialogic pedagogy within a LMS themselves. Thematically coded, longitudinal interview data from both teachers and students, captured across the three phases of the project are also reported here to illustrate broader changes in the approaches to teaching and learning at the school, in terms of both pedagogy and the usage of Google Classroom over the period of data collection from 2017-2020. The potential wider implications of this shift in school culture are discussed in this Part and the provisional theories postulated during the DBR process consolidated, representing the project's theoretical contributions to this field of research. The joint planning activities undertaken within the DBR framework are appraised and represent a practitioner-researcher model of teacher professional development (TPD) that could be applied elsewhere, enabling teachers to design and evaluate their own dialogic activities within Google Classroom. Finally, the impact of the EdD course on my own professional practice and perspective as a social researcher are explored.

VI.2 Longitudinal changes in (Google) classroom culture

When I embarked upon this project in 2015, one year after the Learning Management System's launch, there were approximately 10 million Google Classroom users (Google for Education, 2015). In February 2021, Google announced that more than 150 million students were using the LMS (Google, 2021a). This is perhaps unsurprising given the global demand for remote learning

solutions during the Covid-19 pandemic, which saw an increase of 40 million Google Classroom users in the twelve months from February 2020. The adoption of the LMS within the independent preparatory school that acted as the setting for this project followed a similar trajectory. By the end of the period of data collection in June 2020, all teachers and children had taken part in remote learning activities due to the Covid 19 pandemic; with all lessons and resources delivered through Google Classroom in the summer term of 2020. This is in contrast to only 68% (17 of 25 respondents) reporting that they used the LMS when surveyed in January 2017. The story of how technology came to infuse practice across the school is summarised as follows.

In 2017, a pilot study was conducted at the school (see Part IV for details). At this time, the school already made use of a wide range of digital devices to support learning. Tablets (Apple iPads) were predominantly used with younger children (4-9 year olds) whilst laptops (Google Chromebooks) tended to be used with older students (9-13 year olds). By 2017, the school already had some ‘paperless’ subject departments delivering content exclusively via the Google Classroom, others that made little use of digital devices whilst a majority of teachers provided a mix of traditional paper-based tasks and digital activities for their students. Rather than parachute in one particular technology across the setting at a single point in time, the school had embarked upon a more gradual ‘Digitally Enhanced Learning’ development plan in the previous academic year. This had a focus on small-scale trials of different educational technologies, of which Google Classroom was one, with interested practitioners volunteering to take part. Where tools proved useful for a particular subject or age group, teachers were encouraged to share their findings with their colleagues in department meetings and staff briefings.

Ahead of the start of Phase 1 of this DBR project, a teacher questionnaire was conducted to elicit their feelings towards digital technology. 48% of respondents did not feel the use of digital tools “fits” the subject(s) they teach most often; however, 84% felt that educational technology (Google Classroom, iPads, IWBs, visualisers etc.) improves the quality of both teaching and learning. The barriers to greater use of Google Classroom at the school were therefore not due to a lack of alignment with

the ethos, but rather the time required to explore the digital tools and plan for their use in each practitioner's unique context. The provision of hardware and WiFi across the school was also uneven at the time, reducing access in some subject areas. At this juncture, Google Classroom was predominately used for administrative tasks such as setting homework tasks. The use of the LMS within lessons was limited to certain subject areas that had chosen to invest budget and resources into making suitable hardware permanently available to their students or on a less regular basis, those who had booked devices from one of the central banks that were made available by the school's ICT support. Despite the value placed on dialogue and collaborative activities by both staff and children, there was sporadic use of the *Share* function of Google documents during lessons or for homework tasks and children were rarely asked to co-construct digital artifacts with one another using the LMS.

In the teacher interviews of the first phase of data collection, both participants described their initial usage of the Google Classroom; primarily to set homework tasks and curate their students' work. Paul in particular was appreciative of the support and approach the school took in terms of allowing him to develop his own usage of Google Classroom to support his teaching which he had only recently begun to explore:

> I think the school has led me into it and gently and not had high expectations of everyone doing things. There wasn't a diktat that you must do this, you must do that. I think that was good because most of us have embraced it in the right spirit and it's helped. (Paul: Line 110)

Meanwhile, George had introduced a bank of Chromebook devices to the history department ahead of his participation in this project and found that the students were already, "very good at sharing what they've done with us", by transferring their use of the *Share* function of the LMS which they had found useful in other subject areas.

Phase 2 took place the following year, in the summer of 2018 and the teacher participants both referred to the evolution of the LMS usage in the school. Laura was not an experienced user of the platform, having not been required to use it to schedule homework for her art students. However, she had applied a 'flipped learning' model to a child-led topic and had asked the students to use the Google Drive to share photos and initial ideas for their project. Rebecca was a more regular user of the LMS, using it as part of a mixed media approach to her English lessons. Perhaps because use of the technology was becoming more common at the school by this time, the interview data collected in 2018 demonstrated that Google Classroom no longer had a novelty factor for users and whilst different affordances had come to light, the limitations and constraints of the system were also clearer. Consequently, the theme of **factors limiting digital technology use** emerged during both the teacher and student interviews of Phase 2 (see Sections V.2.2 and V.2.5 for details). Both Laura and Rebecca were able to articulate their reasoning for using the LMS to manage some aspects of their students' learning and to use more traditional resources for others. Responses from the students interviewed in this phase also highlighted the need for digital tools to meet a pedagogical imperative before being introduced into their lessons. Whilst some teachers might be missing the opportunity to integrate more technology in their classrooms, the students felt that the teachers who made extensive use of Google Classroom were not always selecting the best tool for the tasks at hand. They also felt that teachers were unaware of their frustrations, in particular with the repetitive nature of the task types and formats they were presented with in the LMS. The Year 7 students were also aware of some of their own limitations as users, such as their typing speed and the temptation to "mess around", "play games" and go "off task" when given access to digital tools.

Phase 3 took place two years later, in 2020. By this time, the three teachers interviewed spoke of a learning culture at the school in which the children actively look to share and collaborate with others, "instinctively" rather than waiting for teachers to prompt them. Google Classroom had been introduced to nearly all subjects in Year 7 by this time and the children were regularly encouraged to post

their own ideas or materials for others to consider. This enabled students to dictate some of their own lines of inquiry both on and offline. Whilst it was not used in all lessons, the majority of teachers at the school had made use of the system to create and share resources with colleagues and collect work from the students. This is entwined with the **pedagogy of emancipation** (Shor & Freire, 1987) that the teacher participants of this phase aligned with (see Section V.3.2). In 2020, the broader school culture was one where practitioners felt emboldened to allow their students to explore ideas that are of interest to them; rather than being held to account by a more rigid knowledge-based curriculum. This flexible and collaborative ethos was highly valued by the students interviewed in Phase 3, particularly those who had experienced displacement from it during periods of remote learning during the national lockdown.

After the data collection of Phase 3 had been concluded, Google added a 'breakout room' feature to the Meet app. This took place in early 2021 when G-Suite for Education became Google Workspace for education (Google, 2021b) and placed the feature behind a paywall. Whilst it was still possible for educators using the free '*Fundamentals*' package to make use of the Meets app in the same way Nicola had devised, 'breaking out' from a central meeting space in an integrated way was only available to schools with a '*teaching and learning upgrade*' to the LMS, at a cost of $48 per student per year. Whilst this is prohibitively expensive for many institutions, it does demonstrate the value of small group work and dialogue when teaching and learning online. It corroborates this design principle that emerged from the final phase of this DBR project.

When working with a single, large audience or class meeting online, teachers might feel a greater need to moderate and limit any conflicting talk to maintain order during a video conference. In 2021 Google announced that a 'mute all' feature would be added to the Meet app along with other safety and engagement features (Google, 2021c). These new features, including a digital 'hands up' option, would seem to afford teachers various means to maintain rigid control over a monologic discourse with a large number of students. However, this project has demonstrated that with

creative planning, even when working remotely, the LMS also allows teachers to cede control over dialogue. In so doing, students have the opportunity to productively engage in small group dialogue and co-construct their own ideas and knowledge artifacts. As I had provisionally reported in the practitioner journal of the Chartered College of Teaching (Igglesden, 2019), this study demonstrates that whilst Google Classroom has opened up the possibility of new forms of dialogue, the realisation of this is still brokered by teachers. The project confirms that reflective dialogue is not a natural consequence of having any particular technology to hand, it must still be planned for by educators with explicit dialogic intentions (Warwick et al., 2020) if the technology is to have transformative effects. Google Classroom is set to have a far reaching impact on the management of learning resources for millions of students, particularly those studying remotely; but it is vital that institutions consider how best to do so whilst maintaining a culture that promotes reflective dialogue (Wegerif, 2013).

VI.3 Evolution of dialogic practices and design principles

Design principles are the product of DBR; evidence-based heuristics that prove effective within the context in which they have emerged (The Design-Based Research Collective, 2003). The evolution of the design principles that leverage Google Classroom to better support classroom dialogue is described here. The design principles were generated during the joint planning meetings of each phase, starting as refinements to lesson plans which were subsequently trialled and either rejected or *moved forward* to subsequent lessons and phases of the project (see Table 6.1 for summary). For fellow teachers with dialogic intentions, these strategies for promoting classroom dialogue should be of interest and applicable to a wide range of educational settings.

The augmented lessons of the first participants in Phase 1 had a focus on the use of the *share* function of the LMS, so that students could collaborate in real time on documents and pause, discuss and review video and other digital resources independently of the teacher. It was in this phase of the project that a Google Slides

activity was first added to the augmented lessons. Initially, presentations were shared between talk partners, prompting them to negotiate their answers and design choices. In the second participant's lesson, the Google Slides task was further refined; all students were provided with the same, single shared presentation via the Google Classroom, rather than separate copies for each group. Each talk group was instead directed to work on a specific slide within the central resource, meaning that the participants did not have to open separate documents to see the ideas and perspectives of those in other groups. Instead, their ideas were made public in real time as they were added to the presentation. This also allowed the teacher to display the co-constructed slideshow as a single digital artifact on the interactive whiteboard, ceding control of the content on display and encouraging students to consider the perspectives of others. Later in this phase, limitations were also placed on the number of slides and images the students could add to the presentation to convey their ideas. This increased opportunities for dialogue by creating more actions that required the opinions of others to be considered.

The co-researchers of Phase 2 further decided that ground rules for exploratory talk (Dawes et al., 2004) should be displayed before and during the observed lessons in order to promote dialogue as an important process in and of itself to the students. Having the ground rules on display also helped teachers to refocus the efforts of the discussion groups if necessary. In the second participant's augmented lesson, the students were limited to one digital device per discussion group, as opposed to the individual devices that had been provided up to this point in the project. Consequently the students seemed to engage in more verbal interactions within their discussion groups as the limited number of devices meant that groups had to coordinate their use of the resource. In this phase, limiting the need for children to search for information or images using the Google search engine was also put in place and helped to maintain the focus of the dialogue on the resources and tasks provided by the teacher.

The teachers participating in Phase 3 decided to arrange all discussion groups into triads which were more likely to remain as cohesive units when collaborating. In this

phase, activities that encouraged the students to declare and discuss the reasons for their positions were devised. In the second and third participants' lessons, these included the requirement to reach a joint answer to be put forward on the shared Google Slides presentation. Whilst a true consensus was not necessarily reached, the act of compromising and coordinating their responses promoted dialogue and further consideration of the positions of others (Mercer & Howe, 2012). In this phase, the final participant's lessons were held online during a period of remote learning, due to the Covid 19 pandemic. Google Meet 'breakout' rooms were created to allow small group discussions to take place. Those in the augmented lesson, where a shared presentation was provided, were more likely to have their cameras on as they worked through the statements and collaborated more effectively as a result.

Table 6.1: Evolution of refinements made to augmented lesson plans.

Phase	Joint Planning Activity	Refinement	Taken forward to next Phase?	Rationale
1	1	Use of the *Share* function of the LMS, so that students could pause, discuss and review video independently of the teacher.	Yes	Use of share function encouraged participation and made knowledge and ideas explicit.
1	1	Addition of a Google Slides activity; students capture and annotate screenshots in a presentation shared with their partner, having first negotiated their choices.	Yes	Teacher cedes control over digital media, giving students choice over extracts to be used and greater control over content displayed on the interactive whiteboard.
1	1	Students were encouraged to add *Comments* and expand or challenge the ideas of others.	No	Students did not engage with this instruction in the observed lesson.
1	2	A single Google Slides presentation shared with class. Groups directed to write their agreed answer on a specific slide within the shared presentation.	Yes	Students' ideas are made public in real-time.
1	2	Limitations were placed on the number of slides and images the students could add to the presentation to convey their ideas.	Yes	Increased opportunities for dialogue by creating more actions that required the opinions of others to be considered.
1	3	Further limitations placed upon slide design with the students restricted to one slide, 20 words and two images per group.	No	Placing specific limitations on slide design was not transferable to subsequent discussion tasks.
2	1	Students provided with a digital, Google Doc worksheet to annotate and highlight.	No	Google Docs placed greater limitations on the means by which students could present their ideas on the screen.

2	1	Ground rules for talk (adapted from Dawes et al., 2004) to be displayed before and during observed lessons.	Yes	Visual aid can be referred to throughout to refocus discussion activities. The poster also promotes the importance of dialogue as a process, not just a means to an end.
2	2	Students were asked to work with the specific images provided, rather than searching for their own examples of an artist they had not previously studied.	Yes	Removing the need for students to use a search engine focused the lesson and increased the opportunity for dialogue to take place.
2	2	Discussion groups were limited to one digital device between them.	Yes	Groups were required to coordinate their use of the digital devices, increasing the need for dialogue.
2	3	Sorting task recreated with text boxes to enable students to readily move and reorder words on the screen.	No	Specific refinement not transferable to subsequent discussion tasks.
3	1	Arrange discussion groups into triads.	Yes	Discussion groups of three are more likely to remain as a cohesive unit.
3	1	Google Slide design allowed children to move digital ‘counters’ along an opinion line.	No	Activity design made both the position and reasoning of the students clear and readily available for discussion but this specific refinement was not transferable to other discussion tasks.
3	2	Children given limited permission to use the Google search engine, to explore and clarify the meanings of words.	Yes	Limited use of the search engine gave students access to information in a way that they have become accustomed to, reducing search time and increasing opportunity for dialogue.
3	3	Breakout rooms created using Google Meet for triads to discuss their ideas remotely.	Yes	When working remotely, separate Meets for small group discussions enable students to collaborate and inter-think without direct moderation by the teacher.

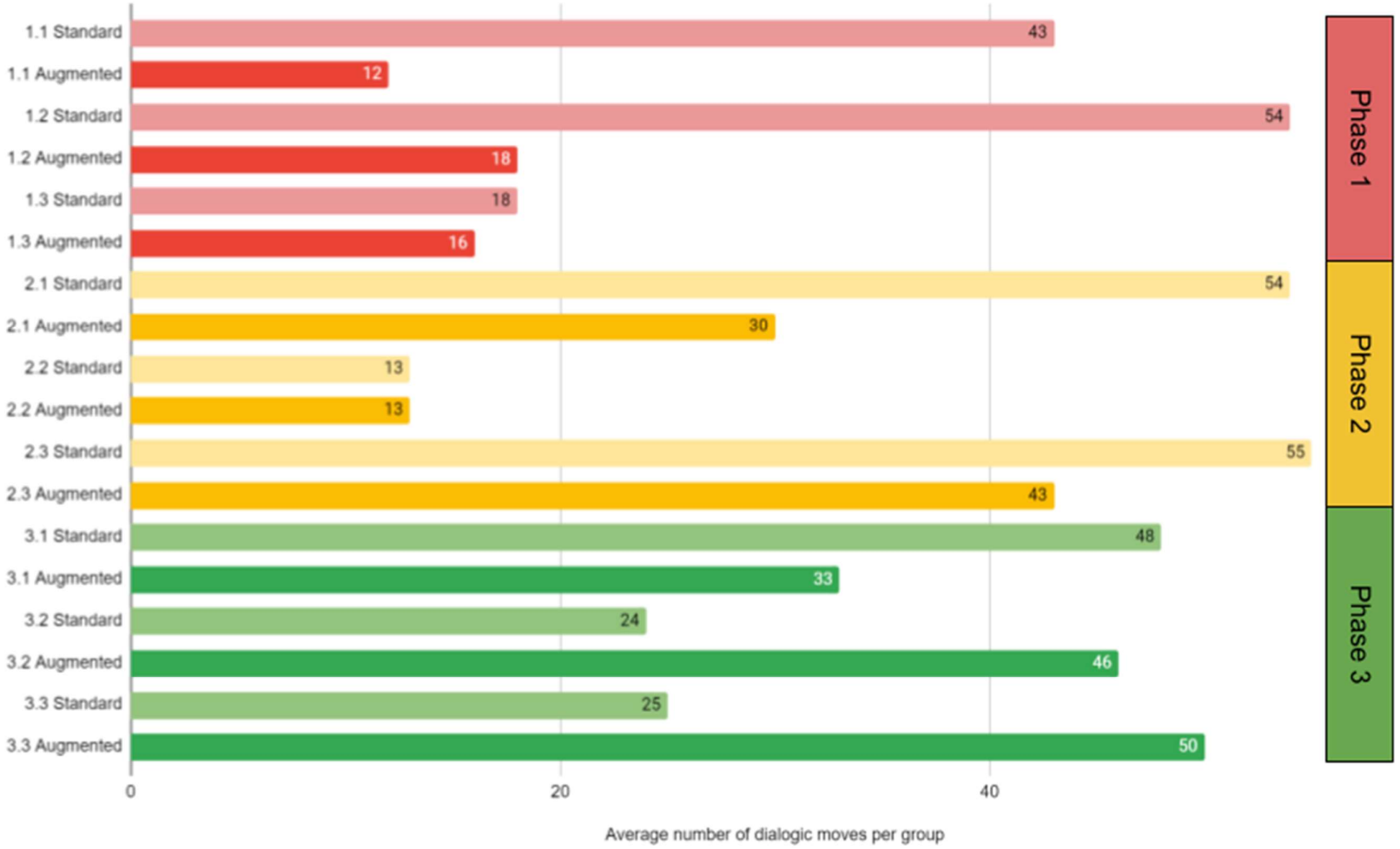


Figure 6.1: Average number of dialogic moves per group during the focus activities of Phase 1-3 lessons.

Whilst analysis of the audiovisual data (see Section III.9.2 for details) collected during each phase was not available during the joint planning meetings, the data does corroborate the decisions that were made with regards to the refinements that were moved forward to subsequent lessons and phases. Over the course of the three phases, the average number of dialogic moves made per group during a typical 12-minute focus activity episode in the standard lessons remained consistent, within a small range of 32-41 (see Table 6.2) moves per task. However, the number of dialogic moves was markedly reduced in the augmented lessons of Phase 1 (Mean=15, Standard Deviation=5.5) compared to the standard lessons (M=38, SD=23.2), a difference that was statistically significant; $t(9)=2.87$, $p=0.019$. As the design principles underwent refinement, the frequency of dialogic moves increased in the augmented lessons of Phase 2 (M=27, SD=12.6), reducing the gap between this and the number seen in the standard lessons of the phase (M=41, SD=22.6). In Phase 3, the average number of dialogic moves increased further (M=43, SD=16.2) and was greater than the number observed in the standard lessons (M=32, SD=15.3), although the difference was not statistically significant; $t(16)=-1.47$, $p=0.161$.

Table 6.2: Average numbers of dialogic moves made during focus activities (per group) in the standard and augmented lessons of each phase.

Phase	Standard	Augmented
1	38	15
2	41	27
3	32	43

The refinements that proved successful in promoting dialogue in Year 7 lessons when using Google Classroom are summarised below (see Table 6.1 for further details). These represent the **design principles** generated by this DBR project and could be applied in similar contexts by fellow dialogic practitioners:

- Display and refer to ground rules for talk before and during discussion activities.
- Arrange all discussion groups into triads.
- Limit discussion groups to a single shared device when accessing tasks on the Google Classroom.
- Make use of the share function to provide a central, shared Google Slides presentation for the class.
- Assign a single slide (within the shared Google Slides presentation) to each discussion group and place a design limitation on the students' use of this (eg. number of images or word count).
- Design tasks that require students to come to a joint answer and make both their position and reasoning clear.
- Design tasks that encourage students' independent manipulation of digital media.
- Limit the requirement to use Google Search.
- If working remotely, provide breakout rooms for discussions to take place in and encourage all participants to keep their video feed on.

These design principles are not wholly generalizable as they were molded by the conditions in which they were generated (Anderson & Shattuck, 2012). However, they are actions that could be easily modified (Cobb et al., 2003) to support classroom dialogue in settings where similar digital technology is available to teachers and students. As these principles include limiting access to digital devices to one between three, dialogic practitioners at settings with limited hardware or bring-your-own-device policies can still benefit from the collaborative features of this free to use LMS. Theories that support and underpin each of these design principles are summarised in Table 6.3, where the design principles are also categorised as *characteristics* or *procedures* (van den Akker, 1999).

Table 6.3: Design principles for dialogic tasks using Google Classroom tools (and their theoretical underpinnings).

Type	Principle(s)	Theory
Characteristic	Require students to come to a joint answer and make both their position and reasoning clear.	As the different perspectives and reasoning of participants are made explicit, *reflective dialogue* (Mercer & Wegerif, 1999) occurs. The acts of coordinating responses and proposing resolutions further promotes this dialogue (Mercer & Howe, 2012).
Characteristic	Encourage students' independent manipulation of digital media.	The manipulation of digital media is a novel task, made possible by the LMS, rather than the digitisation of a traditional activity (Crook et al., 2010). The provisionality of digital media enables teachers to cede some ownership of classroom discourse to their students (Shor & Freire, 1987) who appreciate that their contributions can be altered as new information emerges (Kershner et al., 2020).
Characteristic	Limit the requirement to use Google Search.	By providing the digital artifacts a discussion is to be based upon (rather than requiring students to conduct their own searches to find examples), dialogues remain anchored to culturally important ideas (Wells, 2007).
Procedure	Display and refer to ground rules for talk before and during discussion activities.	This visual aid promotes the importance of dialogue as a process, not just a means to an end (Dawes et al., 2004) and makes the dialogic intentions of the teacher explicit (Warwick et al., 2020). Where ground rules for are explicitly referenced, they increase participation and facilitate students' exploration of one anothers' thinking (Frøytlog & Rasmussen, 2020), particularly in the context of disruptive digital technologies which increase the demands on students' attention (Rasmussen et al., 2019).

Procedure	Arrange all discussion groups into triads.	Groups of three tend to remain as a cohesive unit (Gaunt and Scott, 2018). They are not so large that they break into sub-group discussions but not so small that if particular characters are asked to work together, limited dialogue takes place.
Procedure	Limit discussion groups to a single shared device	Students engage in more dialogue within their groups as the limited number of devices require them to coordinate their actions. The acts of coordinating responses and proposing resolutions further promotes this dialogue (Mercer & Howe, 2012).
Procedure	Provide a central, shared Google Slides presentation for the class. Assign a single slide to each discussion group and place a design limitation on the students' use of this.	Students can select their own means of illustrating their thoughts, as opposed to a teacher moderating their contributions (Shor & Freire, 1987). Groups are able to co-construct artifacts and as the ideas of different groups accumulate, different perspectives are made explicit, fostering collaboration and community (Major et al., 2018).
Procedure	If working remotely, provide breakout rooms for discussions to take place in.	Small group discussions maintain a sense of community which is both strengthened by, and the foundation of, dialogue. Breakout rooms provide a forum for these, enabling perspectives to be made explicit (Alexander, 2001) and critiqued without having to do so in front of a larger audience when working remotely.

VI.4 Contributions to the field

The data gathered in the three phases of this DBR project have provided evidence to answer the three research questions at hand and allowed the initial conjectures (see Section III.6 for details) to be confirmed. These represent this project's key contributions to the field of research.

RQ 1. What affordances do LMS (specifically Google Classroom) provide for the teacher mediation of dialogic learning?

Evidence from the main study of this DBR project confirmed the conjecture that **Google Classroom has affordances supporting the teacher mediation of dialogic learning.** Despite more than 150 million users making use of the platform for teaching and learning (Google, 2021a), this is the first time this Learning Management System's affordances to support dialogic pedagogy have been reported. For instance, in more than 70 studies included in a scoping review of classroom dialogue and digital technologies (Major et al., 2018b) none referred to this popular platform.

A major affordance of the LMS is the range of means by which the awareness of the different perspectives can be made explicit between participants and foster a sense of collaboration and community. The *share* function within Google Classroom is particularly valuable in this regard, allowing for ideas and digital artifacts generated to be more readily accessed by others. Both students and teachers identified the positive outcomes of being exposed to the perspectives of others in this way, not least an increase in engagement and interest they feel when this takes place. Dialogue anchored upon artifacts in the Google Classroom can introduce students to prescribed, authoritative knowledge whilst simultaneously enabling them to make their own contributions and further the ongoing dialogue. For those practitioners who engage in the emancipatory pedagogy of dialogue (Shor & Freire, 1987), Google Classroom provides tools which can help to cede some of their ownership of classroom discourse to their students and move away from monologic instruction;

allowing them to promote collaboration and community between students and themselves.

The data collected during the three phases of this DBR project also demonstrate that **Google Classroom affords dialogic practitioners the opportunity to further students' metacognition and intersubjectivity**. By providing opportunities for students to co-construct knowledge and digital artifacts within the LMS, they are encouraged to "think about their own thinking and the thinking of others'" (Major et al., 2018b, p.2005). A shared subjectivity and empathy for the position of others can then evolve, as participants become more aware of how others around them think and by contrast, how their own thought processes differ from their peers. When working in this collaborative way, the children not only further their subject knowledge but also strengthen their relationships and ability to dialogue effectively with one another in the future. Both student and teacher interviewees spoke of the advantages to working within groups where a shared subjectivity and empathy exist and hearing ideas in the voice of a peer is of great value to students. The efficacy of this approach might perhaps be explained by the idea of the *zone of proximal development* or ZPD (Vygotsky, 1978 p.86). When working in dialogue with their peers, the gap between their learning levels is smaller than when receiving instruction from an adult in the role of expert and is more likely to result in cognitive change.

Students with special educational needs and disabilities (SEND) are also afforded greater access to classroom dialogues through Google Classroom and make contributions with greater confidence. In addition to reducing the demands on the participants with regards to their secretarial skills and handwriting, the platform may reduce the cognitive load placed upon those who experience phonological processing, short-term verbal working memory and visual recall difficulties. When resources to support dialogue are provided using the LMS, students are able to "think more freely" and feel they have greater time to do so than when taking part in dialogues without such tools to support them.

The accessibility, immediacy, co-construction and provisionality of knowledge artifacts within Google Classroom were means through which this culture of collaboration and dialogue could be built. Accessibility to resources (Hennessy, 2020) is still somewhat limited by teachers, who often prepare or select pertinent content, and signpost students towards it via *assignments* and the Google Classroom *stream.* However, the immediacy of access to these resources and feedback through the LMS enables participants to take into account a wider range of ideas and voices and for teachers to provide access to more differentiated materials. Provisionality, the ability to shape, debate, reposition and improve these materials is an important affordance of the LMS to support dialogue. The mutable nature of digital documents such as Google Docs and Slides presentations emboldens students to take greater risks during their collaborative work, as ideas and artifacts are not static and can be further refined as necessary. This provisionality is what makes it possible for dialogic space-time (Wegerif, 2013) to be revisited and remolded by participants within Google Classroom.

Whilst some of the affordances described here were *a priori* themes (see Section III.9.1 for details), evidence for others that were predicted to be relevant to the Google Classroom was limited. Multimodality (the ability to engage in and with multiple modes of digital activity concurrently), direct manipulation (engagement with concepts through interactive, digital representations) and dynamism (the use of moving images and models of dynamic processes) are all common affordances of technology for dialogue (Hennessy, 2020) and are possible within Google Classroom but were not leveraged in the observed lessons or raised as themes in the interviews with teachers and students during this study.

RQ 2. Do LMS open up new spaces for dialogue?

Evidence from the main study of this DBR project confirmed the conjecture that **Google Classroom opens up new spaces for reflective dialogue to occur in.** Educational dialogue is not limited to verbal interactions within a classroom but the lived experience of a shared (Kershner et al., 2020) or ‘dialogic space’ (Mercer et al.,

2010) and the LMS represents a means through which ongoing and expansive dialogue can take place; unbounded by physical space or time. The term ‘dialogic space-time’ (Wegerif, 2013) describes this property of Web 2.0 technologies such as Google Classroom, and accounts for the asynchronous nature of dialogues that take place within this platform. For instance, when using the *share* function of the platform to distribute digital artifacts between students, such as the Google Slides presentations used in many of the observed lessons of this project, the ideas and outcomes of all discussion groups can be made available for consideration and comment in real time. However, the digital artifacts within the LMS also provide a record of past dialogues and knowledge construction that can be reengaged with and refined endlessly, making dialogic space-time tangible for the participants. Students engaging in dialogic activities in this space value the opportunity to engage in multiple dialogues with their peers, not just those talk partners in their immediate time and space. In this way, novel ideas and knowledge that is not anticipated or pre-determined by the teacher can be generated within this digital space.

In the final phase of data collection, due to the remote learning taking place at the school in the summer of 2020, the Google Meet video conferencing app was used and represented another new space for dialogue to take place within the confines of the LMS. The use of *breakout* rooms for triads of students to complete their discussion tasks proved effective. Making use of this new digital technology helped to preserve their sense of community and continue to provide a forum for different perspectives to be critiqued.

RQ 3. What is the nature of interaction within a LMS?

Evidence from the main study of this DBR project confirmed the conjecture that **interactions within Google Classroom are *infinalisable* (the gap between perspectives remains open) and demonstrate *interthinking.*** Students reported a greater sense of equality when using Google Classroom to *share* artifacts and *comment* upon the work of others and the *stream* as ‘valid’ utterances were no longer limited to those successfully vetted by the teacher. Google Classroom allows

ideas to be more widely broadcast and for students to engage with multiple perspectives. The nature of dialogue within the LMS was further altered by the children's ability to manipulate the media directly – as opposed to a teacher moderating their contributions and summarising their ideas verbally or on a whiteboard display. This removed the traditional power structure as the children were able to circumnavigate the teacher's *filter* of ideas, opening up novel routes for dialogues to take. Dialogue observed in the data collection of this project was infinalisabile, and existed as a malleable and open-ended discourse within the dialogic space-time (Wegerif, 2013) of the Google Classroom.

The disruptive capacity of the Google Classroom technology was particularly evident in the frequency of dialogic moves that took place in the augmented lessons of both Phase 1 and 2 of the project. Whilst some of the affordances of the Google Classroom to support dialogue had been identified by participants, the attempts to leverage these did not lead to an increased number of total dialogic moves. It was not until Phase 3 that the number of dialogic moves was greater in the augmented lessons than those which followed a standard lesson plan (see Fig. 6.1). The task designs in the first augmented lessons of the project required students to collaborate; however the children were provided with individual digital devices with which to do so. During Phase 2 the children shared devices for the first time, necessitating further coordination of their actions. This refinement reduced the physical barriers and distractions that might have stymied dialogue in earlier lessons. However, even when reduced in frequency, **students reported a greater confidence and *buy-in* to dialogues that were anchored to shared artifacts in the Google Classroom.** Users are conscious of the provisionality of these and appreciate that their contributions can be altered as new information emerges (Kershner et al., 2020) rather than being held to account by their initial ideas.

By the time the third phase of this DBR project had concluded, the joint planning activities between the co-researchers and myself had led to the development of design principles (described in Section VI.2) which leveraged the tools of Google Classroom to increase the frequency of dialogic moves compared to *standard*

lessons (see Fig. 6.1). Not only could these design principles be applied elsewhere, the collaborative practitioner-researcher planning activities that led to them (see Section III.8) could be recreated by fellow dialogic practitioners wishing to develop their own context specific use of the LMS.

VI.5 Appraisal of the DBR framework

Resource based interventions alone have been shown to add little value to education and the use of digital tools in schools continues to be characterised by a focus on the technology itself, rather than the pedagogy it is intended to support (Hennessy et al., 2017). If teachers are not given the time and space to explore new and disruptive technologies, it is inevitable that their use of digital tools, such as Google Classroom, will result in the digitisation of existing activities rather than the creation of new and transformative practices that might better serve the needs of students today. Professional learning communities (PLC) are a means of achieving this transformation and are most likely to be successful when they focus on collaboration, have a shared vision, focus on students' learning and engage in reflective dialogue (Doğan & Adams, 2018). All features of the joint planning meetings that were designed for this project. This PLC planning process provided effective professional development for those involved; giving practitioners time and peer support to develop their use of the Google Classroom tools.

The cyclical DBR framework employed by this study led to an evolution of design principles that ultimately led to an increase in the number of dialogic moves in Google Classroom based activities at the school. By working with colleagues to develop interventions that serve their own dialogic intentions (Warwick et al., 2020), the teachers supported the professional development of one another and ultimately, developed tools that they were willing and able to adopt (Penuel et al., 2011). The participatory nature of the joint planning activities in which these principles were generated also allowed for a detailed account of the context of the study to be provided. Participating colleagues, who might otherwise be classed as research *subjects* in an alternative framework, were actively involved in the decision-making and conduct of the research itself (Creswell & Plano Clark, 2011), providing an

intimate knowledge of the context that gave the design principles their validity (Anderson & Shattuck, 2012). This contextual information also makes it possible for fellow practitioners to modify the design principles for application in their own settings (Anderson & Shattuck, 2012) and as such, they have user generalisability (Winterbottom, 2017).

Beyond its role as a means of data collection, the cycle of joint planning activities represented a novel teacher professional development (TPD) model for those teachers who participated in the project. Within this framework, members of the joint planning groups of each phase acted as co-*designers* (Wang & Hannafin, 2005), systematically working towards the generation of transferable knowledge that could be put to immediate use in their own classrooms and transferrable to that of fellow practitioners in their own setting and beyond. Whilst co-researchers had shared dialogic intentions, the teacher professional development model helped to realise these in a range of different subject areas.

The joint activities of each phase were inspired by the Japanese TPD model of Lesson Study (see Section III.8) which provided a model for TPD and the development of context-specific designs for dialogue within Google Classroom (see Figure 6.2):

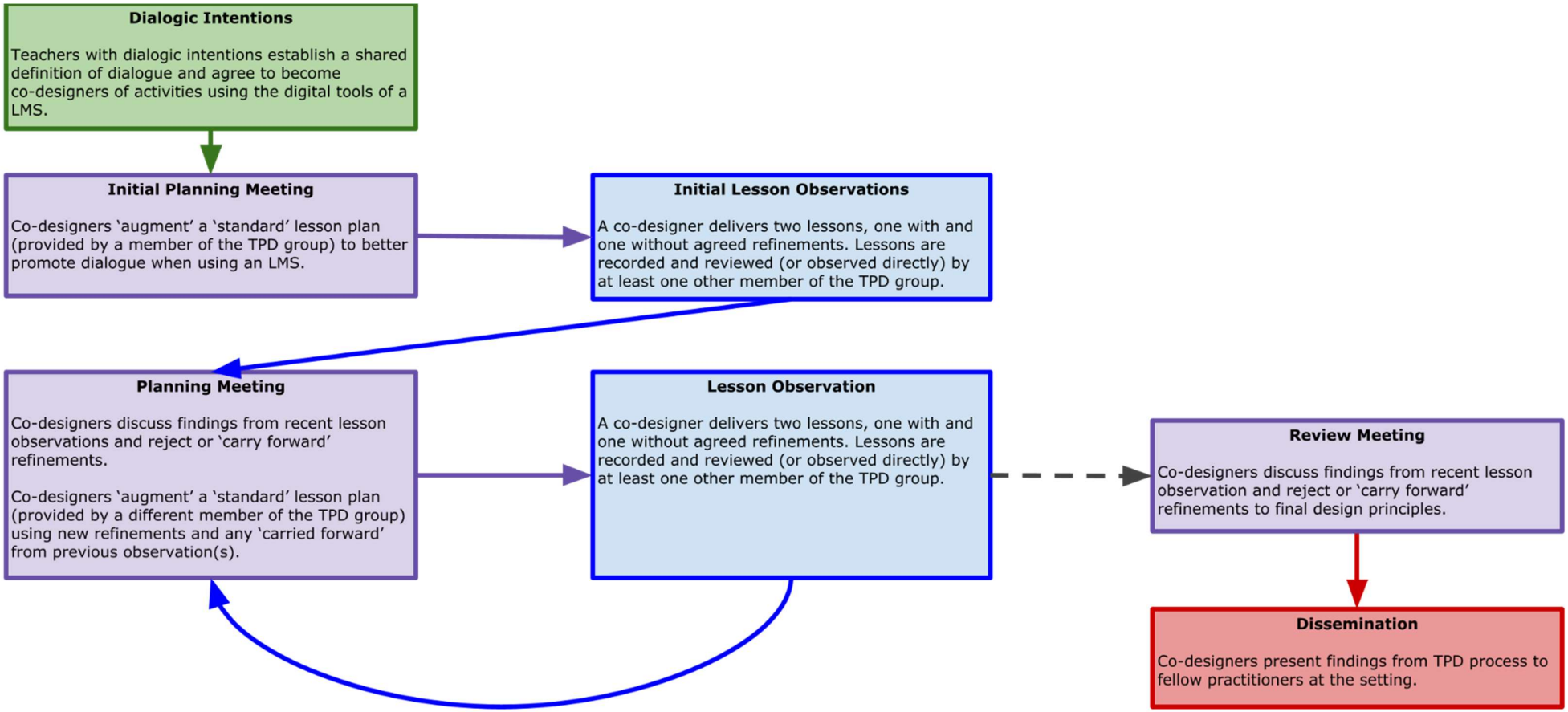


Figure 6.2: A model for TPD and the development of context-specific designs for dialogue within a LMS.

In this project, the framework outlined in Figure 6.2 was used to design activities to promote a particular pedagogical approach (dialogic) with a specific technology (Google Classroom) to hand. However, the model could be applied by practitioner-researchers wishing to explore the affordances of any tool. Whilst heuristic design principles that work within the context they are generated could be produced elsewhere using this framework; these are less likely to have user generalisability unless the group includes a *practitioner-researcher* au fait with relevant theory and data collection.

It should be noted that DBR, upon which this framework is based, has primarily been used to generate and test small-scale interventions, often involving digital technology (Anderson & Shattuck, 2012). Practitioners wishing to develop their understanding of non-digital tools might consider if alternative methods might better suit their needs. Members of the TPD group, or professional learning community (PLC), should also consider the validity of the instruments by which they base their design decisions. The temptation may well be to use standardised testing data which provides valid data but is not necessarily aligned to the pedagogy being developed (Wayne et al., 2008). If exploring dialogic practices, The Teacher Scheme for Educational Dialogue Analysis (T-SEDA) (Vrikki et al., 2018) would be a suitable tool. This adapted version of the full SEDA coding scheme (Hennessy, et al., 2016) used in this project is specifically designed for practitioner use. Whilst this was used as a discussion aid between participants in Phase 2 and 3; had it been available ahead of Phase 1, it might have proven to be an effective means of confirming the groups' design decisions with coded data during each phase rather than retrospectively.

Unlike traditional Lesson Study, only the teacher delivering an 'observed' lesson need be present in this model of TPD, although footage of the lesson would need to be reviewed by at least one other *co-designer* from the group if not directly observed. This reduces the timetabling issues that many practitioners face when hoping to engage in peer observation. Another difference to Lesson Study is that the *co-designers* are encouraged to deliver a *standard* and *augmented* version of their lessons. This quasi-experimental structure allows for comparisons to be made in the

effectiveness of the refinements they have co-constructed; rather than the direct observation of *case pupils* (Dudley, 2014) within a single lesson that Lesson Study calls for. The structure of the planning sessions used in this project also differed from that of Lesson Study, as reflection and planning activities are conducted in the same meeting rather than separately. Whilst this limits the opportunity for *co-designers* to research relevant theory, it does reduce the bureaucratic demands on the members of the group. Collective inquiry of this nature can lead to context-specific solutions and increased pedagogical knowledge. However, it is dependent on collaborative working structures being in place at educational settings and a leadership team that is willing to make time available for practitioners to reflect on their practice and relevant theory (Wilson & Sharimova, 2019).

VI.6 Doctoral journey

Before embarking upon this EdD journey, I had been a science educator for more than ten years and in that time I had worked in state, independent and international settings. At the time of applying to the EdD programme in 2015, I was the head of science at the independent preparatory school in which this project was based and had recently completed the National Professional Qualification for Senior Leadership (and Independent Schools Inspectorate Middle Leaders Program); in 2018 I became a member of the senior leadership team at the same setting.

Completing the EdD course in parallel with this move into school leadership has provided me with greater opportunities to engage with contemporary educational theory whilst continuing to refine my own practice and positively influence that of others. The EdD course has fundamentally shifted my research stance and enhanced my knowledge and experience of alternative methods for social research. Not least was my shift in my ontological perspective away from the post-positivist (Creswell & Plano Clark, 2011) stance I had held since completing my studies in the natural sciences and practicing as a science teacher for more than ten years. The meta-position of the ‘scholar-practitioner’ (Burnard et al., 2016) I adopted during this study, simultaneously theorising and performing pedagogy, led me to place greater

value on qualitative instruments and towards a greater interpretivism (Wilson, 2017b). An EdD taught session on *arts-based research* proved to be particularly enlightening as my *miscognition* before embarking on the various tasks was revealed through the act of making. During a practical collage task (see Fig.6.3) the *unknown knowledge* (Tavin, 2010) that had emerged during the initial stages of my doctoral journey became explicit (Heaton et al., 2020) as I attempted to represent the broader change from monologism to dialogism in education in the collage. By choosing to use mass printed media and inking techniques I hoped to represent the disruptive nature of the Gutenberg press, the advent of which reduced knowledge to static artifacts and promoted the vertical transmission of knowledge as the dominant mode of education (Wegerif, 2013). In doing so, I was prompted to consider how digital tools such as Google Classroom may disrupt education, allowing for a return to Socratic dialogue that is further enriched and anchored by flexible digital media.

Figure 6.3: Mixed media collage (created in response to the challenge of 'reflect your own research through a/r/tographic lenses').

By engaging with the EdD taught sessions and literature I have become more conversant with the 'occupied territory' (Kamler & Thomson, 2014) of my area of study and my reverence for the established tenets of the field is no longer as stifling as it was when I first set out. Consequently, I felt able to contribute to the Cambridge Educational Dialogue Research (CEDiR) group, joining the editorial board for a working paper on the work of the group that was itself co-authored through a unique, dialogic format using an online discussion forum (Major et al., 2018a). I planned and delivered a workshop on the SEDA scheme to fellow members. I have also acted as an advisor for the 'eDelphi Virtual Internships' study with fellow members of the Faculty of Education. My epistemological stance has been crystallised over the course of my studies and I placed social constructivism (eg. Bakhtin, 1981) at the center of this project as a result. This in turn guided the selection of a design-based research framework for the methodology, a form of participatory research (Creswell & Plano Clark, 2011) with colleagues that resulted in design principles that were able to improve the educational practice in our own, real world setting (Cobb et al. 2003). The EdD programme has placed a spotlight on the limitations of my own classroom practice and has informed the changes I have made to it. Specifically, a rejection of monologism and an appreciation of voices that are not necessarily aligned with the official voice of the curriculum (Segal et al., 2017).

Whilst studying for this doctorate, I transitioned from my position as the head of science to a role in the senior leadership team at the same setting, responsible for overseeing teaching and learning at the school. The knowledge I have gained through completing my EdD studies has enabled me to support teachers at the school to explore their own use of dialogue in the classroom and to feel emboldened to do so. Detailed knowledge of the constraints and affordances of the Google Classroom to support dialogic pedagogy proved to be particularly pertinent when, during the third phase of data collection, the UK government announced a national lockdown in response to the Covid-19 pandemic. As a result, all teaching and learning activities at the school were moved online and delivered remotely through the LMS. Due to my experiences with Google Classroom, I was better positioned to develop an effective 'Remote Learning Policy' for the school with a view to promoting

dialogue and intersubjectivity between the children whilst they worked remotely. In doing so, the school was better able to maintain its sense of community and the childrens' relationships between teachers and one another. This experience, in particular, fortified my belief that a dialogic pedagogy is an important means of engaging learners in an increasingly digitised world. "Dialogic is like an electric spark across differences" (Wegerif, 2016), much like the potential difference between two charged points in an electrical circuit it is required to *power* the social construction of knowledge.

VI.7 Summary of key findings

This study has demonstrated for the first time that Google Classroom can be used by teachers to engage their students in reflective dialogue. By adhering to the design principles that emerged from the study, Google Classroom, a disruptive LMS technology, was used to support dialogue by promoting an awareness of the different perspectives between students whilst fostering collaboration and community. Google Classroom also afforded dialogic practitioners with the opportunity to further their students' meta-cognition and inter-subjectivity. The malleable nature of digital artifacts in this environment would seem to be a primary means through which this is possible; giving students access to expanded dialogic space-time.

The demand for remote learning, accelerated by the Covid-19 pandemic, has led to the introduction of the Google Classroom learning management system (LMS) into the lives of over 150 million students (Google, 2021). However, most teachers have had little time to evaluate the potential of this technology to support, develop and transform their practice before its introduction in their setting. The design principles that emerged from this study (listed below) have user-generalisability and with some modification, could prove equally effective in other settings where Google Classroom has been introduced. The embedded nature of this form of practitioner research increased the validity of these principles.

- **Limit discussion groups to a single shared digital device:** When the number of devices is limited, students engage in more dialogue as they are required to coordinate their actions. The acts of coordinating responses and proposing resolutions further promotes this dialogue (Mercer & Howe, 2012).

- **Provide a central, shared Google Slides presentation for the class and assign a single slide to each discussion group:** Groups of students can select their own means of illustrating and reporting their ideas in real-time on their slide. As the ideas of different groups accumulate on the shared presentation, different perspectives are made explicit, fostering collaboration and community (Major et al., 2018).

- **If working remotely, provide breakout rooms for discussions to take place in:** Small group discussions maintain a sense of community which is both strengthened by, and the foundation of, dialogue. Breakout rooms provide a forum for these, enabling perspectives to be made explicit and critiqued without having to do so in front of a larger audience when working remotely.

- **Limit the requirement to use Google Search:** By providing a limited range of digital resources for students to consider (rather than requiring students to conduct their own extensive searches during a discussion activity), dialogues remain anchored to the subject at hand.

- **Arrange all discussion groups into triads:** Groups of three tend to remain as a cohesive unit (Gaunt and Stott, 2018). They are not so large that they break into sub-group discussions but not so small that if particular characters are asked to work together, limited dialogue takes place.

- **Display and refer to ground rules for talk before and during discussion activities:** This visual aid promotes the importance of dialogue as a process, not just a means to an end (Dawes et al., 2004) and makes the dialogic intentions of the teacher explicit (Warwick et al., 2020).

The PLC planning process used to generate and refine the design principles provided effective professional development for those involved; giving practitioners time and peer support to develop their use of the Google Classroom tools. This model could be used to promote dialogue using digital technology in other settings; alternatively, it could be adapted to investigate the potential of any new tool to further a means of instruction that is valued by groups of practitioners.

References

Ak, Ş. (2015). The role of technology-based scaffolding in problem-based online asynchronous discussion. *British Journal of Educational Technology, 47*(4), 680-693.

Alexander, R. J. (2001). *Culture and pedagogy: International comparisons in primary education*. Blackwell publishing.

Alexander, R. J. (2008a). *Towards Dialogic Teaching: rethinking classroom talk (4th edition)*. Dialogos.

Alexander, R. J. (2008b). Culture, dialogue and learning: Notes on an emerging pedagogy. *Exploring talk in school*, 91-114.

Alexander, R. (2012). *Improving Oracy And Classroom Talk In English Schools: Achievements And Challenges.* Retrieved from http://www.robinalexander.org.uk/wp-content/uploads/2012/06/DfE-oracy-120220-Alexander-FINAL.pdf

Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research?. *Educational Researcher, 41*(1), 16-25.

Apple Ltd. (2013). *iTunes U Content Tops One Billion Downloads.* Retrieved from https://www.apple.com/uk/pr/library/2013/02/28iTunes-U-Content-Tops-One-Billion-Downloads.html

Asterhan, C. S. (2013). Epistemic and interpersonal dimensions of peer argumentation. *Affective learning together: Social and emotional dimensions of collaborative learning*, 251.

Asterhan, C. S., & Hever, R. (2015). Learning from reading argumentative group discussions in Facebook: Rhetoric style matters (again). *Computers in Human*

Behavior, *53*, 570-576.

Azmitia, M. (1988). Peer Interaction and Problem Solving - When are Two Heads Better than One? *Child Development,* 59, 87-96.

Bakhtin, M. M. (1935). Discourse in the Novel. *The Novel: An Anthology of Criticism And Theory 1900–2000*, 481-510.

Bakhtin, M. M. (1981). *The dialogic imagination: four essays (trans. Emerson C. & Holquist, M.).* Austin: University of Texas Press.

Bakhtin, M. M. (1986). *Speech genres and other late essays (trans. McGee., V. Ed. Emerson, C. & Holquist, M.).* Austin: University of Texas Press.

Baker, C., & Johnson, G. (1998). Interview talk as professional practice. *Language and Education* 12 (4). 229-242.

Barak, M. (2016). Science Teacher Education in the Twenty-First Century: a Pedagogical Framework for Technology-Integrated Social Constructivism. *Research in Science Education,* 1-21.

Barnes, D. (2008). Exploratory talk for learning. In *Exploring talk in school: Inspired by the work of Douglas Barnes (Mercer, N. & Hodgkinson, S.)*. Sage.

Bassey, M. (1999). *Case study research in educational settings*. McGraw-Hill Education (UK).

BBC News (2015). *US schools seek refund over $1.3bn iPad project*. Retrieved from http://www.bbc.co.uk/news/technology-32347651

Bennett, S., Maton, K., Kervin, L. (2008). The ‘digital natives’ debate: A critical review of the evidence. *British Journal of Educational Technology*. 39 (5), 775-786.
Berland, L. K., & Reiser, B. J. (2009). Making sense of argumentation and explanation. *Science Education*, *93*(1), 26-55.

Brandist, C. (2002). *The Bakhtin circle: Philosophy, culture and politics.* Pluto press.

Breakwell, G. M. (2006). Interviewing methods. In Breakwell, G. M., Hammond, S. M., Fife-Schaw, C. & Smith, J. A. (Ed.s), *Research methods in psychology (3rd Edition)*. Los Angeles: Sage, 232-253.

British Educational Research Association. (2011). *Ethical guidelines for educational research*. Retrieved from https://www.bera.ac.uk/wp-content/uploads/2014/02/BERA-Ethical-Guidelines-2011.pdf

Brown, A. L. (1992). Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings. *Journal of the Learning Sciences*, 2(2), 141–178.

Bryman, A. (2008). *Social research methods* (3rd Edition). Oxford university press.

Buber, M. (1958). The I-thou theme, contemporary psychotherapy, and psychodrama. *Pastoral Psychology, 9*(5), 57-58.

Burden, K., & Kearney, M. (2016). Future scenarios for mobile science learning. *Research in Science Education*, 1-22.

Burkhardt, H., & Schoenfeld, A. H. (2003). Improving educational research: toward a more useful, more influential, and better-funded enterprise. *Educational Researcher, 32*(9), 3–14.

Burnard, P., et al. (Ed.s.). (2016). *Transformative Doctoral Research Practices for Professionals, Chapter 2*. Springer.

Carlson, J. A., & Evans, K. (2001). Whose choice is it? Contemplating challenge-by-choice and diverse-abilities. *Journal of Experiential Education, 24*(1), 58-63.

Choi, A., Hand, B., & Norton-Meier, L. (2014). Grade 5 Students' Online Argumentation about Their In-Class Inquiry Investigations. *Research in Science Education*, *44*(2), 267–287.

Chong, W. H., & Kong, C. A. (2012). Teacher collaborative learning and teacher self-efficacy: The case of lesson study. *The journal of experimental education, 80*(3), 263-283.

Christodoulou, A., & Osborne, J. (2014). The science classroom as a site of epistemic talk: A case study of a teacher's attempts to teach science based on argument. *Journal of Research in Science Teaching*, *51*(10), 1275-1300.

CNET (2021). *Apple will discontinue iTunes U in favor of Classroom and Schoolwork apps.* Retrieved from https://www.cnet.com/tech/services-and-software/apple-will-discontinue-itunes-u-in-favor-of-classroom-and-schoolwork-apps/

CNN (2012). *London 2012 Olympic Park- First sustainable olympics ever.* Retrieved from https://www.youtube.com/watch?v=wmOmS-vHdzo

Cobb, P., et al. (2003). Design experiments in educational research. *Educational Researcher, 32*(1), 9–13.

Coffin, C., & O'Halloran, K. (2008). Researching argumentation in educational contexts: new directions, new methods. *International Journal of Research & Method in Education. 31*(3), 219-227.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20*(1), 37-46.

Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education (8th edition).* Routledge.

Collins, A. (1999). The changing infrastructure of education research. In E. C. Lageman & L. S. Shulman (Eds.), *Issues in education research: Problems and possibilities.* San Francisco: Jossey-Bass.

Conole, G., & Dyke, M. (2004a). What are the affordances of information and communication technologies?. *Research in Learning Technology,* 12(2), 113-124.

Conole, G., & Dyke, M. (2004b). Understanding and using technological affordances: a response to Boyle and Cook. *Research in Learning Technology,* 12(3), 301-308.

Cook, V., Warwick, P., Vrikki, M., Major, L., & Wegerif, R. (2019). Developing material-dialogic space in geography learning and teaching: Combining a dialogic pedagogy with the use of a microblogging tool. *Thinking Skills and Creativity, 31,* 217-231.

Creswell, J.W., & Plano Clark, V.L. (2011). *Designing and Conducting Mixed Methods Research (2nd Edition).* Sage Publications: Los Angeles.

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological bulletin, 52*(4), 281.

Crook, C. (1998). Children as computer users: the case of collaborative learning. *Computers & Education,* 30(3), 237-247.

Crook, C., et al. (2010). *The impact of technology: Value-added classroom practice.* BECTA.

Curran, V., et al. (2017). A review of digital, social, and mobile technologies in health professional education. *Journal of Continuing Education in the Health Professions, 37*(3), 195-206.

Curwood, J. S. (2011). Teachers as learners: What makes technology-focused professional development effective?. *English in Australia, 46*(3), 68-75.

Daniel, M., & Auriac, E. (2011). Philosophy, Critical Thinking and Philosophy for Children. *Educational Philosophy and Theory*, *43*(5), 415-435.

Daniels, H. (2001). *Vygotsky and pedagogy*. London; New York: Routledge/Falmer.

Dawes, L., Mercer, N., & Wegerif, R. (2004). *Thinking together: A programme of activities for developing speaking, listening and thinking skills for children aged 8-11*. Imaginative Minds.

DeLuca, C., Bolden, B., & Chan, J. (2017). Systemic professional learning through collaborative inquiry: Examining teachers' perspectives. *Teaching and Teacher Education, 67*, 67-78.

Denscombe, M. (2007) *The good research guide: for small-scale social research projects (3rd edition).* Open University Press.

Dey, I. (2003). *Qualitative data analysis: A user friendly guide for social scientists*. Routledge.

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education, 40,* 314-321.

Doğan, S., & Adams, A. (2018). Effect of professional learning communities on teachers and students: reporting updated results and raising questions about research design. *School effectiveness and school improvement, 29*(4), 634-659.

Downes, C. (2015). Using information and communication technologies to promote participation and peer co-operation during collaborative literacy tasks for English-language learners. *Journal of Student Engagement: Education Matters, 5*(1), 2-11.

Dudley, P. (2013). Teacher learning in Lesson Study: What interaction-level discourse analysis revealed about how teachers utilised imagination, tacit knowledge of teaching and fresh evidence of students learning, to develop practice knowledge

and so enhance their students' learning. *Teaching and Teacher Education, 34*, 107–121.

Dudley, P. (2014). *Lesson Study: a handbook*. Cambridge: LSUK. Retrieved from https://lessonstudy.co.uk/wp-content/uploads/2012/03/new-handbook-revisedMay14.pdf

Dudley, P. (2015). *Lesson study: professional learning for our time.* Routledge.

Elliott, J., & Adelman, C. (1976). Innovation at the classroom level: a case study of the Ford Teaching Project. *Open University Course E203: Curriculum Design and Development*. Open University.

Edwards, A. (2005). Let's get beyond community and practice: the many meanings of learning by participating. *Curriculum Journal*, *16*(1), 49-65.

Enriquez, J., et al. (2008). Turn-taking and Mode-switching in grounding text-based communication in the classroom. *Proceedings of the 8th international conference on International conference for the learning sciences*, 3, 27-28.

Eraslan Yalcin, M., & Kutlu, B. (2019). Examination of students' acceptance of and intention to use learning management systems using extended TAM. *British Journal of Educational Technology, 50*(5), 2414-2432.

Fernández-Cárdenas, J. M. (2015) Dialogism: Sequentiality, positioning, plurality and historicity in the analysis of educational practice. *Revista Electrónica de Educación.*

Feyzi Behnagh, R., & Yasrebi, S. (2020). An examination of constructivist educational technologies: Key affordances and conditions. *British Journal of Educational Technology, 51*(6), 1907-1919.

Fowler, C. (2015). Virtual reality and learning: Where is the pedagogy?. *British journal of educational technology*, *46*(2), 412-422.

Freire, P. (1996). *Pedagogy of the oppressed (revised).* New York: Continuum.

Freire, P., & Macedo, D. (1995). A dialogue: Culture, language, and race. *Harvard* Educational Review, 65(3), 377-403.

Frøytlog, J. I. J., & Rasmussen, I. (2020). The distribution and productivity of whole-class dialogues: Exploring the potential of microblogging. *International Journal of Educational Research, 99,* 101501.

Galton, M., Hargreaves, L., & Pell, T. (2009). Group work and whole class teaching with 11 to 14 year olds compared. *Cambridge Journal of Education*, *39*(1), 119-140.

Gao, F., Zhang, T., & Franklin, T. (2013). Designing asynchronous online discussion environments: Recent progress and possible future directions. *British Journal of Educational Technology, 44*(3), 469-483.

Gaunt, A., & Stott, A. (2018). Transform Teaching and Learning Through Talk: The Oracy Imperative. *Rowman & Littlefield.*

Gibson, J. J. (1979). The theory of affordances. In Gieseking, J., Mangold, W., Katz, C., Low, S. & Saegert, S (Ed.s), *The People, Place, and Space Reader*. London: Routledge.

Gilbert, J. (2016). Transforming Science Education for the Anthropocene — Is It Possible? *Research in Science Education, 46*, 187–201.

Google. (2021a). *A peek at what's next for Google Classroom*. Retrieved from https://blog.google/outreach-initiatives/education/classroom-roadmap/

Google. (2021b). *More options for learning with Google Workspace for Education*. Retrieved from https://blog.google/outreach-initiatives/education/classroom-roadmap/

Google. (2021c). *New safety and engagement features in Google Meet*. Retrieved from https://blog.google/outreach-initiatives/education/classroom-roadmap/

Google for Education. (2015). *A new kind of Classroom for 10 million students and teachers*. Retrieved from http://googleforeducation.blogspot.com/2015/10/a-new-kind-of-Classroom-for-10-million-students-and-teachers.html

Greene, J. C. (2008). Is mixed methods social inquiry a distinctive methodology? *Journal of Mixed Methods Research, 2*(1), 7-22.

Greeno, J. (1994). Gibson's Affordances. *Psychological Review, 101*, 336-342.

Guldberg, K., et al. (2017). Challenging the knowledge□transfer orthodoxy: Knowledge co□construction in technology□enhanced learning for children with autism. *British Educational Research Journal, 43*(2), 394-413.

Haßler, B., et al. (2016). *A short guide on the use of technology in learning: Perspectives and Toolkit for Discussion*. Faculty of Education, University of Cambridge.

Halliday, M. (1993). Towards a language-based theory of learning. *Linguistics and Education*, *5*(2), 93-116.

Haneda, M. (2017). Dialogic learning and teaching across diverse contexts: Promises and challenges, *Language and Education*, *31:1*, 1-5.

Hattie, J. (2009). *Visible Learning. A Synthesis of over 800 Meta-analyses Relating to Achievement.* London & New York: Routledge.

HBO. (2002). Old Cases (Television Series Episode) In Colesberry, R. F. (Executive Producer), Simon, D. (Writer), Burns, E. (Writer) & Virgo, C. (Director), *The Wire* New York, NY: Home Box Office.

Heaton, R., Burnard, P., & Nikolova, A. (2020). Artography as creative pedagogy: A living inquiry with professional doctoral students. *Australian art education, 41*(1), 53-74.

Hegel, G. W. F. (1975). *The logic of Hegel (W. Wallace, Trans.).* Oxford: Clarendon Press.

Helsper, E., Eynon, R. (2010). Digital natives: Where is the evidence? *British Journal of Educational Technology*, 36(3), 503-520.

Hennessy, S. (2006). Integrating technology into teaching and learning of school science: a situated perspective on pedagogical issues in research. *Studies in Science Education, 42*(1), 1-48.

Hennessy, S. (2011). The role of digital artefacts on the interactive whiteboard in mediating dialogic teaching and learning. *Journal of Computer Assisted Learning, 27(*6), 463–586.

Hennessy, S. (2020). Methods for researching technology-mediated dialogue. In Kershner, R., Hennessy, S., Wegerif, R., & Ahmed, A. (Ed.s). *Research Methods for Educational Dialogue.* Bloomsbury Publishing.

Hennessy, S., Deaney, R., & Ruthven, K. (2005). Emerging teacher strategies for mediating 'Technology-integrated Instructional Conversations': a socio-cultural perspective. *Curriculum Journal*, *16*(3), 265-292.

Hennessy, S., Dragovic, T., & Warwick, P. (2017). A research-informed, school-based professional development workshop programme to promote dialogic teaching with interactive technologies. *Professional Development in Education*, 1-24.

Hennessy, S., et al. (2016). Developing an analytic coding scheme for classroom dialogue across educational contexts. *Learning, Culture and Social Interaction, 9,* 16-44.

Hennessy, S., et al. (2020). Coding classroom dialogue: Methodological considerations for researchers. *Learning, Culture and Social Interaction, 25*, 100404.

Hennessy, S., & London, L. (2013). *Learning from international experiences with interactive whiteboards: The role of professional development in integrating the technology.* Paris: OECD Publishing. Retrieved from http://tinyurl.com/OECDIWBS

Herrington, J., & Kervin, L. (2007). Authentic learning supported by technology: Ten suggestions and cases of integration in classrooms. *Educational Media International, 44*(3), 219-236.

Herrington, J., & Parker, J. (2013). Emerging technologies as cognitive tools for authentic learning. *British Journal of Educational Technology, 44*(4), 607-615.

Higgins, S., Xiao, Z., & Katsipataki, M. (2012). *The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation.* Durham University.

Hockey, J. 1993. Research methods—researching peers and familiar settings. *Research Papers in Education, 8*(2): 199–225.

Hopkins, D. (2014). *A teacher's guide to classroom research (4th Edition)*. Open University Press, McGraw-Hill Education, Maidenhead.

Howe, C., & Abedin, M. (2013). Classroom dialogue: a systematic review across four decades of research. *Cambridge Journal of Education, 43*(3), 325–356.

Howe, C., et al. (2019). Teacher–student dialogue during classroom teaching: Does it really impact on student outcomes?. *Journal of the Learning Sciences, 28*(4-5), 462-512.

Hymes, D. (1972). Toward ethnographies of communication: The analysis of communicative events. *Language and Social Context,* 21-44.

Igglesden, T. (2019). Dialogic Teaching in Google Classrooms. *Impact: Journal of the Chartered College of Teaching.* Retrieved from https://impact.chartered.college/article/dialogic-teaching-google-classrooms/

Janzen, M. (2014). Seven things you need to know about Google Classroom. *Teaching and Learning with Technology.* Penn State.

Jefferson, G. (2004). Glossary of transcript symbols with an introduction. In G. H. Lerner (Ed). *Conversation Analysis: Studies from the First Generation*. Amsterdam: John Benjamins.

Jeong, H., & Hmelo-Silver, C. E. (2016). Seven affordances of computer-supported collaborative learning: How to support collaborative learning? How can technologies help?. *Educational Psychologist, 51*(2), 247-265.

Jung, I., & Latchem, C. (2011). A model for e□education: Extended teaching spaces and extended learning spaces. *British Journal of Educational Technology*, *42*(1), 6-18.

Kamler, B., & Thomson, P. (2014). *Helping doctoral students write: Pedagogies for supervision*. *Chapter 4.* Routledge.

Kelly, A. (2004). Design research in education: Yes, but is it methodological?. *The journal of the learning sciences, 13*(1), 115-128.

Kershner, R., et al. (2020). Methodological developments in research on educational dialogue: mapping the field. In Kershner, R., et al. (Ed.s). *Research Methods for Educational Dialogue.* Bloomsbury Publishing. 47-73.

Kiemer, K., et al. (2015). Effects of a classroom discourse intervention on teachers' practice and students' motivation to learn mathematics and science. *Learning and Instruction*, *35*, 94-103.

Kim, M. Y., & Wilkinson, I. A. (2019). What is dialogic teaching? Constructing, deconstructing, and reconstructing a pedagogy of classroom talk. *Learning, Culture and Social Interaction, 21,* 70-86.

Kong, S. C., & Song, Y. (2013). A principle□based pedagogical design framework for developing constructivist learning in a seamless learning environment: A teacher development model for learning and teaching in digital classrooms. *British Journal of Educational Technology*, *44*(6), 209-212.

Koshy, V. (2010). *Action research for improving educational practice a step-by-step guide (2nd edition)*. London, SAGE.

Krosnick, J. A., & Presser, S. (2010). Question and questionnaire design. In P. V. Marsden & J. V. Wright (Ed.s). *Handbook of Survey research* (pp 263-313). Bingley, UK: Emerald Group Publishing Ltd.

Kuhn, D. (1991). *The skills of argument*. Cambridge University Press.

Larrain, A., Freire, P., & Howe, C. (2014). Science Teaching and Argumentation: One-sided versus dialectical argumentation in Chilean middle-school science lessons. *International Journal of Science Education*, *36*(6), 1017-1036.

Laurillard, D. (2004). Rethinking the teaching of science. *Mediating science learning through information and communications technology*, 27-50. London, Routledge Falmer.

Lavrakas, P. J. (2008). *Encyclopedia of survey research methods.* Thousand Oaks, California: Sage Publications.

Littleton, K., & Howe, C. (2010). *Educational dialogues: Understanding and promoting productive interaction*. Routledge.

Littleton, K., & Mercer, N. (2013). *Interthinking: Putting talk to work*. Routledge.

Lee, M. & McLoughlin, C. (2010). Beyond distance and time constraints: applying social networking tools and Web 2.0 approaches in distance education. In G. Veletsianos (Ed.). *Emerging technologies in distance education*. Edmonton, Canada: Athabasca University Press. 61-87.

Lefstein, A. (2006). Dialogue in schools: Towards a pragmatic approach. *Working articles in urban literacies.* King's College London.

Lefstein, A., Snell, J., & Israeli, M. (2015). From moves to sequences: expanding the unit of analysis in the study of classroom discourse. *British Educational Research Journal*, *41*(5), 866-885.

Lewis, C. (2009). What is the nature of knowledge development in lesson study?. *Educational Action Research, 17*(1), 95-110.

Lewis, C., Perry, R., & Hurd, J. (2009). Improving mathematics instruction through lesson study: A theoretical model and North American case. *Journal of Mathematics Teacher Education, 12*(4), 285-304.

Leitão, S. (2008). Arguing and learning. *Challenges and strategies for studying human development in cultural contexts*, 251-252.

Liao, Y.C. (2007). Effects of Computer-Assisted Instruction on Students' Achievement in Taiwan: A Meta-Analysis. *Computers and Education, 48*(2). 216-233.

Light, P., et al. (1994). Social and communicative processes in computer-based problem solving. European Journal of Psychology of Education, 9(2), 93-109.

Lindh, M., & Nolin, J. (2016). Information We Collect: Surveillance and Privacy in the Implementation of Google Apps for Education. *European Educational Research Journal*.

Linell, P. (1998). *Approaching dialogue: Talk, interaction and contexts in dialogical perspectives (Vol. 3).* John Benjamins Publishing.

Linell, P. (2002). *What is dialogism?: aspects and elements of a dialogical approach to language, communication and cognition.* Univ., Tema Kommunikation.

Littleton, K., & Howe, C. (2010). *Educational dialogues: Understanding and promoting productive interaction.* Routledge.

Littleton, K., & Mercer, N. (2013). *Interthinking: Putting talk to work*. Routledge.

Major, L., et al. (2018a). *A Dialogue About Educational Dialogue: Reflections on the Field and the Work of The Cambridge Educational Dialogue Research (CEDiR) Group.* Retrieved from https://www.researchgate.net/publication/329415942_A_Dialogue_About_Educational_Dialogue_Reflections_on_the_Field_and_the_Work_of_The_Cambridge_Educational_Dialogue_Research_CEDiR

Major, L., et al. (2018b). Classroom dialogue and digital technologies: A scoping review. *Education and Information Technologies, 23*(5), 1995-2028.

Major, L., Watson, S., & Kimber, E. (2015). Developing instructional and pedagogical design for the Cambridge Mathematics Education Project: A Design-based research approach. *Proceedings of British Society for Research into Learning Mathematics (BSRLM)*, 35(2).

Mansour, N., et al. (2015). Investigating and Promoting Trainee Science Teachers' Conceptual Change of the Nature of Science with Digital Dialogue Games 'InterLoc'. *Research in Science Education,* 1-18.

Marková, I. (2003). Constitution of the self: Intersubjectivity and dialogicality. *Culture & Psychology*, *9*(3), 249-259.

Marková, I., & Linell, P. (1996). Coding elementary contributions to dialogue: Individual acts versus dialogical interactions. *Journal for the Theory of Social Behaviour*, 26(4), 353-373.

McFarlane, A. (2003). *Information technology and authentic learning: Realising the potential of computers in the primary classroom*. Routledge.

McFarlane, A. (2010). Editing versus Cheating and How You Learn the Difference. *Digital Content Creation: Perceptions, Practices, & Perspectives*, *46*, 149.

McGregor, J. (2003). Making spaces: Teacher workplace topologies. *Pedagogy, culture and society*, *11*(3), 353-377.

McHugh, M. L. (2012). Interrater reliability: the kappa statistic. *Biochemia medica, 22*(3), 276-282.

Mercer, N. (1995). *The guided construction of knowledge: Talk amongst teachers and learners*. Multilingual matters.

Mercer, N. (2000). *Words and minds: How we use language to think together*. Psychology Press.

Mercer, N. (2004). Sociocultural discourse analysis: analysing classroom talk as a social mode of thinking. *Journal of Applied Linguistics, 1*(2), 137-168.

Mercer, N. (2008). The seeds of time: Why classroom dialogue needs a temporal analysis. *The Journal of the Learning Sciences, 17*(1), 33-59.

Mercer, N. (2010). The analysis of classroom talk: Methods and methodologies. *British Journal of Educational Psychology,* 80, 1–14.

Mercer, N., & Dawes, L. (2008). The value of exploratory talk. *Exploring talk in school*: *Inspired by the work of Douglas Barnes (Mercer, N. & Hodgkinson, S.).* Sage.

Mercer, N., Hennessy, S., & Warwick, P. (2017). Dialogue, thinking together and digital technology in the classroom: Some educational implications of a continuing line of inquiry. *International Journal of Educational Research.*

Mercer, N., & Howe, C. (2012). Explaining the dialogic processes of teaching and learning: The value and potential of sociocultural theory. *Learning, Culture and Social Interaction, 1*(1), 12-21.

Mercer, N., & Littleton, K. (2007). *Dialogue and the development of children's thinking: A sociocultural approach*. Routledge.

Mercer, N., & Wegerif, R. (1999). Is 'exploratory talk' productive talk? *Learning with computers: Analyzing productive interaction*. Psychology Press.

Merton, R. (1972). Insiders and outsiders: a chapter in the sociology of knowledge. *American Journal of Sociology, 78*: 9–47.

Moreno, V., Cavazotte, F., & Alves, I. (2016). Explaining university students' effective use of e□learning platforms. *British Journal of Educational Technology*.

Mortimer, E., & Scott, P. (2003). *Meaning Making In Secondary Science Classrooms*. McGraw-Hill Education (UK).

Nel, L. (2017). Students as collaborators in creating meaningful learning experiences in technology□enhanced classrooms: An engaged scholarship approach. *British Journal of Educational Technology, 48*(5), 1131-1142.

Nesta. (2012). *Decoding Learning: The Proof, Promise and Potential of Digital Education*. Retrieved from http://www.nesta.org.uk/publications/decoding-learning

Nikulin, D. (2010). *Dialectic and dialogue.* Stanford University Press.

Norman, D. A. (1988). *The psychology of everyday things.* Basic books.

Novakovich, J. (2016). Fostering critical thinking and reflection through blog□ mediated peer feedback. *Journal of Computer Assisted Learning*, *32*(1), 16-30.

Nystrand, M., et al. (1997). *Opening dialogue.* New York: Teachers College Press.

O'Connor, C., & Joffe, H. (2020). Intercoder reliability in qualitative research: debates and practical guidelines. *International Journal of Qualitative Methods, 19.*

O'Connor, C., & Michaels, S. (2007). When is dialogue 'dialogic'?. *Human Development*, 50(5), 275-285.

OECD (2015). *Students, Computers and Learning: Making the Connection*. PISA, OECD Publishing.

Ong, W. (1982). *Orality and literacy: The technologization of the word.* London: Methuen.

O'Reilly, T. (2005). *What is Web 2.0: Design patterns and business models for the next generation of software.* Retrieved from http://www. oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

Osborne, J., et al. (2013). Learning to argue: A study of four schools and their attempt to develop the use of argumentation as a common instructional practice and its impact on students. *Journal of Research in Science Teaching*, *50*(3), 315-347.

Packer, M. (2011). *The Science of Qualitative Research*. Cambridge, Cambridge University Press.

Pea, R. D. (1993). Practices of distributed intelligence and designs for education. *Distributed cognitions: Psychological and educational considerations*, *11*. Cambridge, Cambridge University Press.

Penuel, W. R., et al. (2011). Organizing research and development at the intersection of learning, implementation, and design. *Educational Researcher*, *40*(7), 331-337.

Perkins, D.N. (1993). Person-plus: A distributed view of thinking and learning. In G. Salomon (Ed.), *Distributed Cognitions: Psychological and educational considerations,* 88-110. Cambridge University Press.

Piaget, J. (1965). The stages of the intellectual development of the child. *Educational psychology in context: Readings for future teachers*, 98-106.

Pota, V., et al. (2021). Turning to technology: A global survey of teachers' responses to the Covid-19 pandemic. T4 Education and EdTech Hub report. Retrieved from https://t4.education/t4-insights/

Puentedura, R. (2014). *SAMR: A Contextualized Introduction*. Retrieved from http://hippasus.com/rrpweblog/archives/2014/01/15/SAMRABriefContextualizedIntroduction.pdf

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon*, 9(5), 1-6.

Rahimi, E., Berg, J., & Veen, W. (2015). A learning model for enhancing the student's control in educational process using Web 2.0 personal learning environments. *British Journal of Educational Technology*, *46*(4), 780-792.

Rasmussen, I., Amundrud, A., & Ludvigsen, S. (2019). Establishing and maintaining joint attention in classroom dialogues: Digital technology, microblogging and ground rules. In *The Routledge International Handbook of Research on Dialogic Education,* 411-424. Routledge.

Reznitskaya, A., et al. (2015). Argumentation Rating Tool: Assessing the Quality of Discussions in Elementary School Classrooms. *Paper Presented at the XVII*

Conference of the International Council for Philosophical Inquiry with Children, June, Vancouver, Canada.

Rogoff, B. (1995). Observing sociocultural activity on three planes: Participatory appropriation, guided participation, and apprenticeship. In J. V. Wertsch, P. del Rio, & A. Alvarez (Eds.). *Sociocultural studies of mind.* Cambridge, UK: Cambridge University Press. 139–164.

education. In G. Veletsianos (Ed.). *Emerging technologies in distance education*. Edmonton, Canada: Athabasca University Press. 61-87.

Rohnke, K. (1989). *Cowstails and Cobras II: A Guide to Games, Initiatives, Ropes Courses, & Adventure Curriculum.* Iowa: Kendall Hunt Publishing.

Rojas-Drummond, S., et al. (2013). 'Dialogic scaffolding': Enhancing learning and understanding in collaborative contexts. *Learning, Culture and Social Interaction*, *2*(1), 11-21.

Rommetveit, R. (1992). Outlines of a dialogically based social-cognitive approach to human cognition and communication. *The dialogical alternative: Towards a theory of language and mind*, 19-44.

Rommetveit, R. (1998). Intersubjective attunement and linguistically mediated meaning in discourse. *Intersubjective communication and emotion in early ontogeny*, 354-371.

Rop, C. J. (2003). Spontaneous inquiry questions in high school chemistry classrooms: Perceptions of a group of motivated learners. *International Journal of Science Education*, *25*(1), 13-33.

Ryan, G. W., & Bernard, H. R. (2003). Techniques to identify themes. *Field methods*, *15*(1), 85-109.

Salomon, G. (Ed.). (1993). *Distributed cognitions: Psychological and educational considerations.* Cambridge: Cambridge University Press.

Schwarz, B. B., & Baker, M. J. (2016). *Dialogue, argumentation and education: History, theory and practice.* Cambridge: Cambridge University Press.

Scott, P. (2008). Talking a way to understanding in science classrooms. *Exploring talk in school*, 17-36.

Segal, A., Pollak, I., & Lefstein, A. (2017) Democracy, voice and dialogic pedagogy: the struggle to be heard and heeded, *Language and Education, 31*(1), 6-25.

Shor, I., & Freire, P. (1987). *A pedagogy for liberation: Dialogues on transforming education*. Greenwood Publishing Group.

Sibbald, T. (2009). The relationship between lesson study and self□efficacy. *School Science and Mathematics, 109*(8), 450-460.

Sigurðardóttir, A. K. (2010). Professional learning community in relation to school effectiveness. *Scandinavian Journal of Educational Research, 54*(5), 395-412.

Simon, S., Erduran, S., & Osborne, J. (2006). Learning to teach argumentation: Research and development in the science classroom. *International Journal of Science Education*, *28*(2-3), 235-260.

Simons, H. (1996). The paradox of case study. *Cambridge Journal of Education, 26*(2), 225-240.

Sinclair, J., & Coulthard, M. (1975). *Toward an Analysis of Discourse: the English Used by Teachers and Pupils, 1975.* Oxford University Press.

Šorgo, A., et al. (2016). Attributes of digital natives as predictors of information literacy in higher education. *British Journal of Educational Technology*.

Sweller, J. (2011). *Cognitive load theory*. In Mestre, J. & Ross, B. (Eds.), *The psychology of learning and motivation: Volume 55* (37–76). Elsevier Academic Press.

Taber, K. (2013). *Classroom-based research and evidence-based practice: An introduction.* Sage Publications Limited.

Tamim, R., et al. (2011). What Forty Years of Research Says about the Impact of Technology on Learning: A Second-Order Meta-Analysis and Validation Study. *Review of Educational Research, 81*, 4-28.

Tang, Y., & Hew, K. F. (2017). Is mobile instant messaging (MIM) useful in education? Examining its technological, pedagogical, and social affordances. *Educational Research Review, 21,* 85-104.

Tangen, R. (2014). Balancing Ethics and Quality in Educational Research—the Ethical Matrix Method. *Scandinavian Journal of Educational Research*, *58*(6), 678-694.

Tashakkori, A., & Teddlie, C. (2010). Putting the human back in ‘‘human research methodology’’: The researcher in mixed methods research. *Journal of Mixed Methods Research*, *4*(4), 271-277.

Tavin, K. M. (2010). Six acts of miscognition: Implications for art education. *Studies in Art Education*, *52*(1), 55-68.

Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences*. Sage.

Teo, P. (2019). Teaching for the 21st century: A case for dialogic pedagogy. *Learning, Culture and Social Interaction, 21*, 170-178.

The Design-Based Research Collective. (2003). Design-Based Research: An Emerging Paradigm for Educational Inquiry. *Educational Researcher, 32*(1), 5-8.

Toulmin, S. E. (1958). *The philosophy of science* (Vol. 14). Genesis Publishing.

Toulmin, S., Rieke, R., & Janik, A. (1979). *An introduction to reasoning.* New York: Macmillan.

Van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher–student interaction: A decade of research. *Educational Psychology Review*, *22*(3), 271-296.

Voet, M., & De Wever, B. (2016). Towards a differentiated and domain□specific view of educational technology: An exploratory study of history teachers' technology use. *British Journal of Educational Technology*.

Vygotsky, L. S. (1978). *Mind & Society: The Development of Higher Psychological Processes.* Cambridge: Harvard.

Vrikki, M., et al. (2018). The teacher scheme for educational dialogue analysis (T-SEDA): developing a research-based observation tool for supporting teacher inquiry into pupils' participation in classroom dialogue. *International Journal of Research & Method in Education, 42*(2), 185-203.

Wagner, D., et al. (2005). *Monitoring and evaluation of ICT in education projects. A Handbook for Developing Countries*. Washington DC: InfoDev/World Bank. Retrieved from http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/09/27/000310607_20060927165429/Rendered/PDF/375220ICT1Education01PUBLIC1.pdf

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development, 53*(4), 5-23.

Warwick, P., & Chaplain, R. (2017). Research with younger children: Issues and approaches. In Wilson, E. (Ed.). *School-based research: a guide for education students*. Sage. 154-172.

Warwick, P., et al. (2010). In the mind and in the technology: The vicarious presence of the teacher in pupil's learning of science in collaborative group activity at the interactive whiteboard. *Computers & Education*, *55*(1), 350-362.

Warwick, P., et al. (2016). Connecting Observations of Student and Teacher Learning: An Examination of Dialogic Processes in Lesson Study Discussions in Mathematics. *ZDM Mathematics Education, 48*: 555–569.

Warwick, P., et al. (2020). Realising 'dialogic intentions' when working with a microblogging tool in secondary school classrooms. *Learning, Culture and Social Interaction, 24,* 100376.

Wayne, A. J., et al. (2008). Experimenting with teacher professional development: Motives and methods. *Educational researcher, 37*(8), 469-479.

Wegerif, R. (2005). Reason and creativity in classroom dialogues. *Language and Education, 19(3),* 223-237.

Wegerif, R. (2007). *Dialogic education and technology: expanding the space of learning* (Vol. 7). New York, NY: Springer.

Wegerif, R. (2008). Dialogic or dialectic? The significance of ontological assumptions in research on educational dialogue. *British Educational Research Journal, 34*(3), 347-361.

Wegerif, R. (2011). 'From dialectic to dialogic'. In T. Koschmann (Ed.), *Theories of Learning and Studies of Instructional Practice,* 201–21. New York: Springer Science.

Wegerif, R. (2013). *Dialogic: Education for the Internet age*. Routledge.

Wegerif, R. (2016). *From monologic to dialogic.* Paper presented at the Cambridge Educational Dialogue Group (CEDiR) meeting on Principles of interfaith and secular educational dialogue, Cambridge.

Wells, G. (1999). *Dialogic inquiry: Towards a socio-cultural practice and theory of education*. Cambridge University Press.

Wells, G. (2007). Semiotic mediation, dialogue and the construction of knowledge. *Human Development,* 50(5), 244-274.

Wertsch, J. (1985). *The social formation of mind.* Cambridge: Harvard UP.

Wertsch, J. (1991). *Voices of the mind: A sociological approach to mediated action.* Cambridge: Harvard UP.

Wertsch, J., Tulviste, P., & Hagstrom, F. (1993). A sociocultural approach to agency. *Contexts for learning: Sociocultural dynamics in children's development*, *23*, 336-356.

Wilson, E. (2017a). Why should teachers do school-based research? In Wilson, E. (Ed.). *School-based research: a guide for education students*. Sage. 1-10.

Wilson, E. (2017b). Becoming a reflexive teacher. In Wilson, E. (Ed.). *School-based research: a guide for education students*. Sage. 1-10.

Wilson, E., & Sharimova, A. (2019). Conceptualizing the implementation of Lesson Study in Kazakhstan within a social theory framework. *International Journal for Lesson and Learning Studies.*

Winterbottom, M. (2017). Taking a quantitative approach. In Wilson, E. (Ed.). *School-based research: a guide for education students*. Sage. 218-238.

Wolfe, S., & Alexander, R. (2008). Argumentation and dialogic teaching: alternative pedagogies for a changing world. *Beyond Current Horizons Project*. Retrieved from http://www.robinalexander.org.uk/wp-content/uploads/2012/05/wolfealexander.pdf

Wu, Y., & Wang, L. (2016). Research trends in technology-enhanced knowledge building pedagogies: a review of selected empirical research from 2006 to 2015. *Journal of Computers in Education*, 1-23.

Ylonen, A., & Norwich, B. (2012). Using lesson study to develop teaching approaches for secondary school pupils with moderate learning difficulties: Teachers' concepts, attitudes and pedagogic strategies. *European Journal of Special Needs Education, 27*(3), 301-317.

You, H. C., & Chen, K. (2007). Applications of affordance and semantics in product design. *Design Studies*, 28(1), 23-38.

Appendix 1. Teacher questionnaire

1. Background

- ❑ Year groups taught
- ❑ Subjects taught

2. Teaching Approach

Scale: Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), Strongly Disagree (1).

- ❑ Promoting dialogue between the children is important in my subject(s)
- ❑ Educational technology (Google Classroom, iPads, IWBs, visualisers etc) is helpful when creating collaborative activities for children
- ❑ Educational technologies improve the quality of my teaching
- ❑ Educational technologies improve the quality of my students' learning
- ❑ Educational technologies correspond with my teaching philosophy
- ❑ Educational technologies enhance my communication with students
- ❑ Educational technologies enhance communication between students
- ❑ Educational technologies do not fit the subjects that I most often teach
- ❑ Technology has altered the educational content of my lessons
- ❑ Educational technologies have transformed the activities in my lessons
- ❑ I have the technical knowledge to effectively integrate ICT into my teaching
- ❑ I have sufficient knowledge of pedagogy (teaching and learning) to effectively integrate ICT into my teaching

3. How often do you use the following to teach (or prepare) for a lesson?

Scale: Always (5), More than ⅔ of lessons (4), More than ⅓ of lessons (3), Less than ⅓ of lessons (2), Never (1).

- ❑ Learning management systems (such as Google Classroom) - to upload learning materials for students to view and use.
- ❑ Online forums for threaded group discussions (such as message boards and the Google Classroom stream).
- ❑ Online forums for the real-time exchanges of ideas (such as Padlet).
- ❑ Online simulations of real-world situations.
- ❑ Wikis, web pages or blogs to generate and co-edit comments.

- ❑ Social networks to share information and receive feedback .
- ❑ Google Drive for online (simultaneous) collaboration.
- ❑ Youtube and video apps.
- ❑ Online search Engines

If there are other digital technologies that you use when teaching (or preparing for) a lesson please describe them here:

4. How often do you expect children to independently use the following technologies during your lessons?

Scale: Always (5), More than ⅔ of lessons (4), More than ⅓ of lessons (3), Less than ⅓ of lessons (2), Never (1).

- ❑ Learning management systems (such as Google Classroom) - to upload learning materials for other students to view and use.
- ❑ Online forums for threaded group discussions (such as message boards and the Google Classroom stream).
- ❑ Online forums for the real-time exchanges of ideas (such as Padlet).
- ❑ Online simulations to introduce real-world situations.
- ❑ Wikis, web pages or blogs to generate and co-edit comments.
- ❑ Social networks to share information and receive feedback.
- ❑ Google drive for online (simultaneous) collaboration.
- ❑ Youtube and video apps.
- ❑ Online search engines.

If there are other digital technologies that you expect students to use during your lessons please describe them here:

5. If you would like to add any further comments about the role of technology in education please do so here:

Are you happy to be approached to take part in a short interview, collaborative planning activity and lesson observation? Yes / No

Appendix 2. Example of minutes taken during a joint planning meeting

Phase 1 Joint Planning Session 3

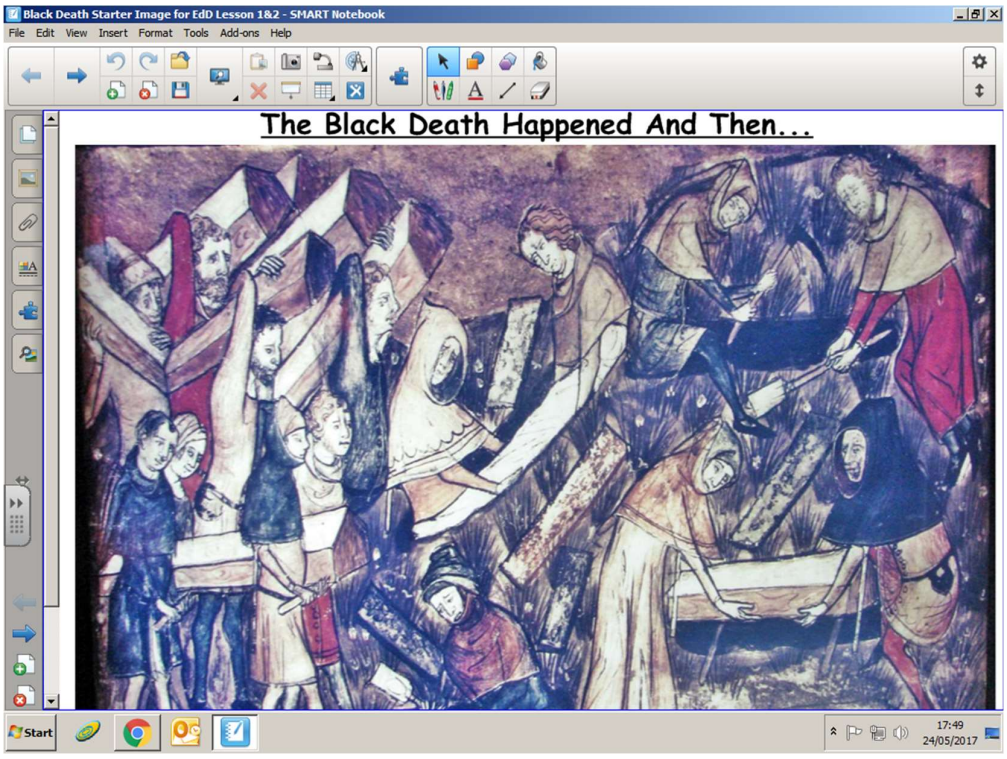
24.05.17

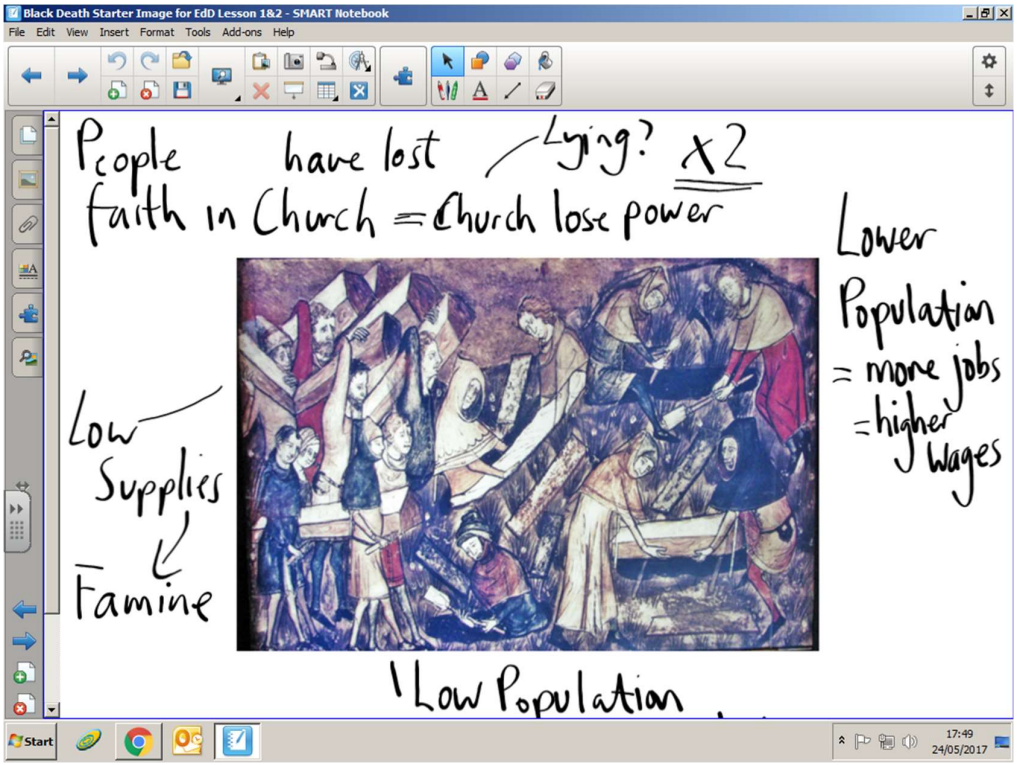
16.15 - 17.15

1) **George's Reflections**

Standard Lesson

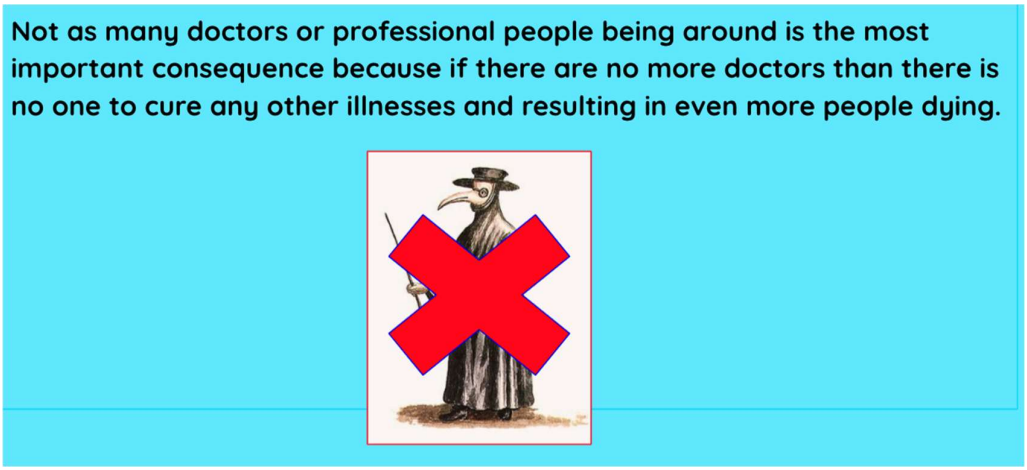
- George was pleased with how it went.
- Lots of dialogue and chat throughout the lesson.
- Good group to do it with; curious, give ideas, want to find out.
- George felt he had to 'bully' them to choose at one point - A and B continued arguments (a positive!).
- Some groups gave the same idea about the Church.
- Children made connections.
- C linked lower population to higher wages.
- Lovely small group.
- Tristan observed that D was thrilled when George acknowledged her group's idea, even though she had not been the one to utter it.
- George provided a copy of IWB presentation (see overleaf):


Black Death Starter Image for EdD Lesson 1&2 - SMART Notebook
File Edit View Insert Format Tools Add-ons Help
The Black Death Happened And Then...
Start
17:49
24/05/2017


Black Death Starter Image for EdD Lesson 1&2 - SMART Notebook
File Edit View Insert Format Tools Add-ons Help
People have lost faith in Church = Church lose power
Lying? x2
Lower Population = more jobs = higher wages
Low Supplies
Famine
Low Population
Start
17:49
24/05/2017

Augmented lesson

- George felt he needed to spend longer on the introduction.
- More children in the group - activity took longer therefore George did not start “living graph” (cut and paste) activity as planned.
- George felt it didn’t go as well as the standard lesson.
- George reported ‘dead silence’ once Chromebooks were distributed. Tristan shared a quote from the recording, “We’re not talking about it; we’ve opened our Chromebooks and we’ve all gone quiet”.
- Just mechanics causing pause? Once underway, George felt discussions went well.
- Examples from the completed Google Slides task shared:



- ‘Leadership collapse’ slide perhaps represented new knowledge (George had not expected or seen this idea before), connected to the children’s prior learning about the Feudal system.
- George felt that E was ‘fixated’ with this idea and that F went along.
- On slides - children more fully share their thoughts and ideas. Activity gave them a longer time to consider answers and the ability to illustrate them.
- Consensus that ‘slide’ intervention has led to MORE explicit reasoning, connections and positioning (and coordination) of ideas.
- Limitations / regulations placed on slides improve quality of Dialogue - more tasks requiring consensus to be reached i.e. Which image, what words etc.
- Revisited Features of ‘Exploratory Dialogue (Mercer and Littleton, 2007):

Participants engage critically but constructively with one another’s ideas.
Everyone participates.
Tentative ideas are treated with respect.
Ideas may be challenged.
Challenges are justified, reasons are given and alternative ideas or understandings are offered.
Opinions are considered before decisions are made and agreement is sought.
Knowledge is made publicly accountable and so reasoning is visible in the talk.

2) Tristan Lesson Planning

- Identified main activity in standard lesson plan as opportunity to enrich dialogue in ways highlighted above.
- Tristan suggested single slide approach once more.
- Paul suggested Q&A task, rather than ‘presentation’ would promote more dialogue (in both sessions).
- Augmented lesson plan also included ‘Q&A’ session (instead of mini presentation) supported by a slide to enable comparison.

3) AOB

- Post history and geography lesson (& pilot) student interviews conducted.
- Issues with timetable this term mean Tristan cannot conduct observation lessons on the same day as intended (ad hoc election assembly!).
- T-SEDA Scheme discussion: https://www.educ.cam.ac.uk/research/programmes/tseda/T-SEDA_V8a_240321.pdf
- Discussed general themes of study thus far and potential Phase 2 ideas:

a) Disconnect between Teachers feeling able to use Google Classroom, recognising potential for collaborative activities and valuing dialogue AND feeling that 'does not fit their subject' - Perhaps Phase 2 candidates could be Teachers who fit this profile? Is this due to lack of time or INCLINATION to change?

b) Students tend to feel dialogue and / or education technology is not suitable in lessons where they do not experience it. Is this self-fulfilling?

Appendix 3. Example transcript from a student interview

Interviewer: Tristan Igglesden [TJI]

Tape: S Int 2.3.m4a

Date of interview: 10.07.18

Date transcribed: 25.07.18

Transcriber: Tristan Igglesden

Line	Time Stamp	Agent	Utterance
1	00:00:44	TJI	So now this is a strange question coming from your science teacher which of course I am. Would you say there's a typical pattern to one of our science lessons? If you think of a typical science lesson does it tend to fall into a certain pattern or structure?
2	00:01:04	A	Probably because we're always doing something based on the topic and we normally do experiments in lessons, except on Thursdays when we do SOLE lessons.
3	00:01:23	TJI	Okay yeah.
4	00:01:23	B	Thursday's are usually SOLE lessons, it's shorter in a half hour period.
5	00:01:28	TJI	And within one of the double lessons have you spotted any trends, have you spotted any patterns?
6	00:01:33	C	We always start with a starter. To almost get our brains warmed up for the lesson ahead.
7	00:01:43	TJI	Okay great, that's a good way of looking at it. Now I do try to encourage you to talk to each other. Do you think that's a good approach for science teachers? Do you think that's effective?
8	00:01:56	A	Yeah. Because let's say someone is not sure of an answer and then they go like, instead of asking you while you're busy with someone else maybe, you go and ask help from a neighbour opposite you.
9	00:02:18	TJI	Anything else about talking in Science? Do you think it's useful?
10	00:02:22	B	Yeah. Because you give like other opinions. Depends, let's say you think you are 100% sure of something, somebody else tells you it's wrong, you start to second guess yourself and say "is that actually correct?". It helps you to learn. If you are always a 100% sure you are never going to learn if it is wrong.

11	00:02:47	TJI	So think about this particular activity that I observed and you were asked to put these items into order with your partner. Do you think it encouraged you to talk?
12	00:03:07	C	Yeah I think it did encourage us to talk a bit.
13	00:03:12	TJI	So which one was yours?
14	00:03:15	C	I think we were five, yeah we were five.
15	00:03:20	TJI	Okay. so you were looking at these ones. So you think it got you talking, how did it achieve that?
16	00:03:29	C	Well we have to discuss, what was the biggest, what was the smallest.
17	00:03:40	B	It made us think about what order it was in. And then after we had done it people could comment on what we did and if it was wrong and then it kind of helped us learn what order it was. So having people talk to you is really useful to build the blocks for learning everything because it helps....
18	00:04:05	TJI	I'm just trying to see if we can look at the comments that were made.
19	00:04:11	C	[IL] commented on ours.
20	00:04:15	B	That's group 3. It might be in resolved comments.
21	00:04:21	TJI	I saw it on the original.
22	00:04:26	B	Yeah, it's group 3 I think.
23	00:04:37	TJI	So we can't see them here but we saw them in the lesson didn't we.
24	00:04:41	A	And we chatted about it at the end with you.
25	00:04:43	TJI	Yes, so that sort of prompted you to think about your own ideas. When you were talking in this particular activity, do you think the talk was productive? Do you understand what I mean by that?
26	00:04:58	B	Yeah, I think we got quite a lot, everyone managed to do it. Well they thought they had put it in the right order certainly. So everyone did do it with the help of everyone else. So I think yeah, more than one person working on it is easier. Too many people working on something makes it really difficult because they are saying, that's wrong, that's wrong, that's wrong. But if you have a couple of people...
27	00:05:20	TJI	So you thought a paired approach worked well?
28	00:05:23	B	Yeah, a pair or maybe a three or a four works quite well. If you have seven, it's not going to work as well. Seven is a bit bit
29	00:05:31	A	Yeah seven....
30	00:05:34	TJI	So why wouldn't seven work [A]?

31	00:05:35	A	It wouldn't work because it's not an even number so you can't really get a majority. Or you can get the majority but you can't... because seven, if you have that many people some people could get upset if it's not their choice.
32	00:06:02	TJI	Right. So if it was a voting situation you mean?
33	00:06:04	C	There's lots of different opinions coming at once.
34	00:06:07	TJI	But if there was no right or wrong answer, or if it wasn't a vote and you had lots of people talking, why wouldn't that work as well as a pair?
35	00:06:14	B	Too many conflicting ideas that don't match together and if you put something down they would say it was wrong and you would never get enough people happy with the one answer. Because you can't help. If you have 4 people you can tailor the situation to all of their needs, but if you have like seven people it is more difficult. That's why we have smaller class sizes. It's easier to help students, if you have a smaller class you get better teaching because you get more time with the teacher, unless you have classes like 30 it's going to be more and you get less learning. So say, Science groups, if you get four people it's easier to be in a group where you can talk to each other. Whereas if you have seven people it's quite difficult to convey your ideas amongst every single person.
36	00:07:02	TJI	Do you think you actually ended up changing or building ideas when you were doing this activity or did you just put down your initial ideas and then that was it?
37	00:07:17	C	Well, our group, me and [IL], we changed ours a bit. Because we were discussing it with the class and we realised people giving different opinions and then we changed our mind.
38	00:07:33	TJI	Okay, let's think about technology for a little bit. Now we use Chromebooks a lot in science but we don't have to. Do you think it's important that science teachers use technology?
39	00:07:53	A	Yeah, because if you are writing it you have to... like for this kind of activity it would have taken a lot longer but on the Chromebook you can just swipe it to the space where you want it.
40	00:08:10	TJI	What do you find most useful? Why do you think using technology in science is important? Can you give some examples of....
41	00:08:19	C	We can... it's easier to save rather than putting it onto a piece of paper. When you are writing down recordings it's easier to look at them rather than a piece of paper.
42	00:08:29	A	Or the internet.
43	00:08:30	TJI	The internet? Do you want to tell me more about that?
44	00:08:34	A	Because when on paper, say you don't know what a mitochondria is you can search it up on the internet.

45	00:08:42	TJI	And that's helpful is it?
46	00:08:45	A	Yeah.
47	00:08:45	TJI	Great. If we think specifically about Google Classroom, which of course is how we send out information to you guys, do you think it's affected the way we talk in lessons? Because obviously there are some lessons where you don't use Google Classroom a lot. Are they different in any way?
48	00:09:09	B	Yes, I think so. Because if you are doing a SOLE lesson, you are not on Google Classroom so it's less well known. So like everyone in a Classroom has access to everyone in the class so everyone can access what they want to. But if you are in a SOLE lesson you have to actually search through all of the sites so you have to file through all of the sites.
49	00:09:39	TJI	But think about the subjects as well as Science at this point. So in other subjects where you might not use Google Classroom as often. Do you think the talk in those lessons is different in any way?
50	00:09:53	B	I think, like in Art, you don't use the internet at all in Art, very rarely, we use the iPads very rarely. I think the talk is longer at the beginning. So you have to get all of the information out instead of saying it's on Google Classroom already.
51	00:10:10	TJI	Do you mean the teacher talk?
52	00:10:11	B	The teacher talk at the beginning is quite a lot longer as they have to give you the lesson brief for the lesson instead of like, where they can just say "it's on Google Classroom" so you can just read the brief and get on with the work.
53	00:10:24	TJI	Do you feel like you have more opportunity to talk in lessons where the information is given to you in Google Classroom rather than having to have someone explain it?
54	00:10:36	B	Yeah I think so. Because you have more time to talk, because you can't talk when the teacher is talking, you are losing time for talk. You can talk whilst reading, you have quite a lot of added time because a lesson brief takes like ten minutes? Ten, fifteen minutes. In Google Classroom like, two? So you are saving quite a lot of time by just having Google Classroom for the lesson brief. It's quite useful, you have more chance to do the lesson and learn.
55	00:11:16	TJI	So, did anyone else have any comments about, or questions about talk. Is there anything else you want to say about talking in general in subjects?
56	00:11:31	B	Some people talk too much which is a problem.
57	00:11:32	TJI	Do they talk too much about the wrong things or do they....

58	00:11:40	B	Some people talk too much about the wrong things and some people talk too much about the right things. They both end up with the same outcome, not getting much done. If they talk and don't get anything written down. You have to have a pause from talking and actually do some work. But you can also work whilst talking I guess.
59	00:11:57	TJI	Can talking not be work?
60	00:12:00	B	I suppose, depends what lesson you are doing.
61	00:12:02	C	You are still working just because you are not writing it down, you are still discussing it. That still counts as learning. Like a SOLE lesson.
62	00:12:11	TJI	Yeah, like a SOLE lesson I guess.
63	00:12:14	B	But you are still technically writing stuff down on the whiteboard.
64	00:12:16	TJI	You don't have to. That is optional. What about technology and not just in science, do you have any feelings or thoughts about technology that we use in school?
65	00:12:28	A	In English we use it, but in [ARO]'s set we didn't do that much writing because we did it on the Chromebooks.
66	00:12:39	TJI	So do you think that is a good thing or a bad thing [A]?
67	00:12:43	A	It can be optional, because it can be a good thing because we can go on to spell check and learn from our mistakes with spelling and the bad thing is we do not practice our handwriting.
68	00:13:06	C	Yes, it's not really giving you the chance to practice your handwriting.
69	00:13:11	B	It does save paper though.
70	00:13:14	TJI	It's a compromise isn't it. Unless there is anything else anyone wants to add? Lovely. Well thank you very much for taking part. That is the end of the interview.

Appendix 4. Example transcript from a teacher interview

Interviewer: Tristan Igglesden [TJI]

Tape: Jessica.m4a

Date of interview: 21.01.20

Date transcribed: 22.01.20

Transcriber: Tristan Igglesden

Line	Time Stamp	Agent	Utterance
3	00:00:46	TJI	Okay. Super. So would you mind stating your age to begin?
4	00:00:52	Jessica	33
5	00:00:54	TJI	And how long have you been teaching? How long would you consider yourself to have been teaching?
6	00:01:02	Jessica	I think six years in various different capacities.
7	00:01:10	TJI	And what is your specialism now?
8	00:01:10	Jessica	Religious Studies and Philosophy.
9	00:01:14	TJI	And how long have you been teaching at this middle school level?
10	00:01:18	Jessica	Two years.
11	00:01:20	TJI	Prior to being a teacher. What was your highest level education?
12	00:01:20	Jessica	University.
13	00:01:30	TJI	What course did you do?
14	00:01:32	Jessica	Philosophy
15	00:01:33	TJI	A bachelors' degree?

16	00:01:35	Jessica	Yes. Although I have an M.A. but that's just because I existed for three years after graduating.
17	00:01:41	TJI	So you went to one of the Oxbridge...
18	00:01:45	Jessica	I went to college at Cambridge.
19	00:01:45	TJI	And have you completed a formal teacher training program?
20	00:01:51	Jessica	I have. I am in my NQT year at the moment.
21	00:01:55	TJI	What was the driver behind you becoming a... What was the main driver of you becoming a specialist RS teacher?
22	00:02:10	Jessica	That's a good question. I would say actually R.S. is not the main driver, but if I were to consider moving to a higher level of teaching, in terms of age, I would be required to teach R.S. at GCSE and it becomes philosophy more, or more distinctly philosophy at A level. So the qualification is in R.S. but that allows me to teach, like the thing that I really love, which is philosophy and ethics.
23	00:02:46	TJI	Okay, so that's enough on background. I thought we'd think about your teaching approach a little bit now. When teaching, if we can focus in on R.S. particularly, because that's the lessons I will be looking at, when teaching R.S. do you think there is an approach that is particularly effective?
24	00:03:12	Jessica	Not collaborative but definitely not didactic. In so far as when you're teaching R.S.... well, the thing is R.S. I think needs to be split into kind of two camps which is world religions and learning and coming to understand the world religions themselves, and then wider ethical issues and what those, how those World Religions might approach those wider ethical issues.
25	00:03:51	Jessica	I think that to learn the content of a religion, there needs to be a slightly more didactic approach because, I think particularly at the age level where I teach it's too complicated, the concepts are too complicated for the pupils to kind of approach them from their own angles.
26		Jessica	However, coming to understand how religion functions and how it interacts with society I think is a really important thing for the children to find out because I find that there are often preconceptions or just a total lack of knowledge or understanding about world religions.
27	00:04:30	Jessica	So I think that's important for the children to find out in a facilitated way essentially. The bigger ideas are things we approach like the death penalty and things like that. That's much more kind of

			collaborative for the children to find out what they think about something, find out what a religion might think about something and it's better to do that immersively I think.
28		Jessica	Because I find that the children are often slightly removed from big questions like that and it's only when you begin to immerse them in it that they actually come to understand the gravitas of what they're learning.
29	00:05:14	TJI	If you had to summarize the strengths of that latter approach, what's the strengths of that?
30	00:05:22	Jessica	I find that the children gain a deeper understanding of what they are learning because they form very quickly their own opinions of things, but often as they come to immerse themselves in the topic they might become more flexible in their opinions or become more tolerant of other opinions.
31	00:05:47	TJI	Conversely, what's the weakness of that approach?
32	00:05:52	Jessica	That minutiae of detail can become lost I suppose. The kind of specifics can perhaps become lost.
33	00:06:10	TJI	If you are teaching a typical lesson in R.S. What would your activities be in an average lesson? What would you be doing?
34	00:06:32	Jessica	Well, my aim would be that I am facilitating and that I lay the groundwork for something that the pupils can then manipulate and understand in their own way. And can collaborate with their peers to find out what they think and to kind of organically grow the understanding something.
35	00:07:05	TJI	Is that through working with small groups, individuals
36	00:07:11	Jessica	Sometimes yes. Often it would be because I would set a choice of tasks so children can approach it in a way that makes sense to them. Collaborative, small collaborative work I use quite a lot of to help that. But also, just big class discussion. That would be facilitated by me but essentially is the children discussing between themselves.
37	00:07:43	TJI	So acting as a moderator?
38	00:07:44	Jessica	Yeah a moderator and an eye opener. If I find that children are particularly linear or blinkered in their opinions and that's coming across as a class that I might throw in a "yes but.." to make them think about something from a different angle or from someone a different like someone else's perspective essentially.
39	00:08:13	TJI	So in your opinion, is promoting dialogue between students themselves a good approach for R.S. teachers?

40	00:08:23	Jessica	Yes. So long as the pupils have an understanding, a concrete understanding or a concrete knowledge, of what they're talking about before they start throwing opinions around.
41	00:08:38	TJI	Okay. And sticking with that, how would you define dialogue? What is it? What does it mean to you?
42	00:08:46	Jessica	In my classroom, very literally it means that pupils feel that they are safe to say something, that it is a safe environment to say something and that things that they do say will be acknowledged as valid opinion.
43		Jessica	That children are constantly encouraged to encounter and to see different viewpoints and to acknowledge and dismiss, if that's what they want to, but to explain why they've dismissed it essentially.
44	00:09:36	TJI	And you feel that your lessons promote this. Can you give an example of how we might go about promoting it?
45	00:09:47	Jessica	So for example when children come to me in form 3, year 5 I will often get children say, "I don't believe in God. Is that okay?", and I'll say, "Of course. You can say you don't believe in me if you can back up why you say that."
46	00:10:09	Jessica	And I just constantly enforce that opinions are fine so long as they can back them up. Most of the kids know that's my biggest bugbear particularly in the tech age of Twitter when you can just throw out a hundred characters of opinion and not not have anything to back that up.
47		Jessica	And then I find that as we go through, as I go through the years the children become less and less inhibited in their opinions and questions and interpretations of things but also become better at talking about them and explaining themselves.
48	00:10:51	TJI	Thank you. So one aspect of our study is to do with our use of technology. Do you think it's important for teachers or R.S. to use technology in the classroom?
49	00:11:05	Jessica	I don't know if I would use the word important. I think that teaching without the use of technology..... it's not a requisite or a prerequisite to teach religious studies effectively.
50		Jessica	And I found actually in the lower years that it's, particularly in terms of research, it's actually an inhibitor because they're not yet capable of using the Internet to its full degree. And I actually did an experiment with it when I first started teaching with Year five.
51		Jessica	I ran a SOLE lesson and it became very clear very quickly that it just wasn't possible for them because the question had an answer to a certain extent but they couldn't find it because there was too

			much.
52	00:12:09	Jessica	However it is useful in collaborative work. Things where they might need to edit and re-edit, things like that. I have also found it very useful in terms of giving children a choice of how they present work.
53		Jessica	So when we get to prep in Year 6, there are some children who prefer to draw some children who prefer to do that in a Google slide stock and it just gives them that freedom to produce work that they're proud of and that they're engaged with but doesn't necessarily have the fear of, "Oh my God I've got to draw something".
54	00:12:50	Jessica	And then as they get older again the collaborative work and the research becomes easier. So you can set them research tasks and it doesn't seem insurmountable. I don't think it's a requirement.
55	00:13:09	TJI	How often do you use computing technology in your lessons?
56	00:13:21	Jessica	Less than I did last year actually. I kind of went all out last year and realized that actually a lot of the time I was using it just in place of a book rather than for something that would improve the process for the children or improve the learning for the children.
57		Jessica	So less than I did last year. But what I found is that then when the children do use the technology it means that it's actually really benefiting them and they feel that.
58	00:13:53	TJI	So how often?
59	00:13:53	Jessica	In year 5 and year six. Year 5 not at all, I don't think. In Year Six they have the choice to use it for prep every other week. But we don't really use them in class time. But that might just be because I haven't really invested time in finding a way to use them more effectively in class time. In year seven and year eight, I don't know, once a week? Once every two weeks?
60	00:14:35	TJI	If we think specifically about Google Classroom, and any other apps you access or use with it. In what ways have you found it useful?
61	00:14:53	Jessica	I find it useful for the kids, particularly if they are doing a research task that the kids use it to share ideas. Things like, "Oh I found a useful website here". The kids also find it useful in terms of organization, asking each other questions, "Is this due then?". Between each other, but also asking me questions.
62	00:15:19	Jessica	I fear the use of that a little bit because it means that children, because they have that connectivity the whole time that they

			think, "oh I'll just fire [Jessica] an email". They won't think, "actually I can solve this problem on my own." So I do fear that a little bit although it is a lot easier.
63	00:15:46	Jessica	I find it logistically easier for me. Because it means I'm not lugging books around if my Year 7s have written an essay and it means I can give them feedback and then they can amend the essay itself rather than doing a "close the gap task at the end". They can amend the work itself and then the final piece that they produce is of a better quality overall.
64	00:16:05	Jessica	So it has its uses and it has its worries I think.
65	00:16:12	TJI	Has it affected, for better or worse, has it affected the dialogue in your classroom? Going back to how you defined that earlier on.
66	00:16:22	Jessica	No, I wouldn't say that it has. If they're doing, if the pupils are doing a collaborative piece of work I find that the dialogue is the same whether they're doing that on a piece of paper or whether they're doing it on a Chromebook. But the logistics of it are easier for the children because they can work together on one document and then copy and paste it across. So they both have their resources in their respective houses and things like that.
67	00:16:58	TJI	So in terms of the functions that you might find in Google classroom, in terms of promoting dialogue, the share function, is that what you're just describing?
68	00:17:10	Jessica	Yeah yeah.
69	00:17:10	TJI	Are there any others?
70	00:17:16	Jessica	So for example if you have a collaborative document the whole class is working on ,or that a group is working on, that they're seeing that kind of in real time and able to edit it in real time so that they haven't shared it between them, there's just one document that they're working on. I find that it's quite useful.
71	00:17:35	TJI	Thinking about your use of technology, is there anything in particular that stimulates you or inspires you to use it when you do?
72	00:17:53	Jessica	Do you classify use of technology in terms of showing a video that I think would be useful for the children.
73	00:18:07	TJI	Sure. What inspires you? Because not everyone uses digital technology in their classroom. And certainly not as much as you do. So what do you think it is about you that makes you more likely to use it?

74	00:18:19	Jessica	In terms of showing videos and things like that, I find that just to change tack for the kids rather than having slides on the board and me talking them through the slides. If we show a video that's got some animation it's helpful for the children that don't cope so well with just a teacher talking at them.
75		Jessica	Also yeah in terms of when you're teaching less and just having a change of tack for them to engage with something and then to come back to what they were doing.
76		Jessica	Also, often it means that you can make something relevant. So you're using resources that are relevant to the pupils but also relevant to the to the kind of socio economic climate and things like that.
77	00:19:14	Jessica	I don't know, I've never really thought of myself being inspired to use technology. it just seems a natural part of what I do in the classroom I think. I don't think I can be more specific.
78	00:19:28	TJI	Are there any barriers to using digital technology?
79	00:19:34	Jessica	My own understanding of some of the apps. I feel like for example we had some training on ClickView the other day and I was using ClickView in a way that I thought was effective. But it transpired that I wasn't using it to its fullest capacity at all.
80	00:19:57	Jessica	Also very simple stuff. When the tech doesn't work.
81	00:20:00	TJI	That'll do it.
82	00:20:05	Jessica	And also in this day and age often the children seem more technologically advanced than me. So then I find that's a real problem in the class because if something doesn't work for me half of the class will want to tell me how they can or cannot do it. Whereas in days gone by you would have just said, "well this isn't working let's move on" the children don't seem to want to let it go. You can't get the tech to work I guess.
83	00:20:28	TJI	Okay. Well, do you have any questions or comments you want to make?
84	00:20:31	Jessica	I don't think so.
85	00:20:38	TJI	Fine. That concludes the interview, thanks very much.

Appendix 5. Semi-structured protocol for student interviews

Introduction

- ❑ Thank students for their participation.
- ❑ Explain that the aim of the study is to investigate the interactions between students and teachers in the school and the use of technology in the classroom.
- ❑ Emphasize interest in students' opinions and that there are no right or wrong answers.
- ❑ Ask permission to tape the interview and reiterate that all data will be treated confidentially; no data will be passed on and will be anonymised (prior to any publication). Explain that recordings and transcripts will be stored securely by the researcher and reiterate the option for participants to withdraw their participation and data at any time.

Teaching

- ❑ What are you expected to do during a typical [specialist subject] lesson? Is there a typical pattern to the lessons?
- ❑ In your opinion, is encouraging students to talk a good approach for teachers of [specialist subject]? Why (not)?
- ❑ Thinking about the [description] activity I observed in your [specialist subject] lesson; do you think it encouraged people to talk about the topic? Why (not)?
- ❑ Do you think that your talk was productive during this activity? Did it help you to build upon one another's ideas? How (or why)?

Technology

- ❑ Do you think it is important that teachers of [specialist subject] use technology in the classroom? Why? What kinds / for what purposes?
- ❑ Does this technology support learning in your lessons? How?
- ❑ Thinking specifically about Google Classroom (and Google Apps); has its use affected the talk in any of your lessons? [If yes] Can you give an example?

End

- ❑ Ask if students have additional comments or questions related to the topics of the interview.
- ❑ State: 'This concludes the interview and thank students for their participation.'

Appendix 6. Semi-structured protocol for teacher interviews

1. Introduction

- ❑ Thank teacher for their participation.
- ❑ Explain that the aim of the study is to investigate the interactions between students and teachers in the school.
- ❑ Emphasize interest in teacher's opinions and that there are no right or wrong answers.
- ❑ Ask permission to tape the interview and reiterate that all data will be treated confidentially; that no data will be passed on to a third party and will be anonymised prior to any publication. Explain that recordings and transcripts will be stored by the researcher and reiterate the option for participants to withdraw their participation and data at any time.

2. Background

- ❑ Would you mind stating your age?
- ❑ How long have you been teaching?
- ❑ What is your specialism?
- ❑ How long have you been teaching this subject at middle school level?
- ❑ What higher education courses did you complete prior to becoming a teacher?
- ❑ Did you complete a formal teacher training program?
- ❑ What ultimately led to you becoming a teacher of [specialist subject]?

3. Teaching approach

- ❑ What approach to teaching [specialist subject] is particularly effective?
- ❑ What is the main strength of this approach?
- ❑ Are their weaknesses to this approach?
- ❑ Could you describe your own teaching activities during a typical [specialist subject] lesson?
- ❑ What are the pupils expected to do during a typical lesson?
- ❑ In your opinion, is promoting dialogue between students a good approach for teachers of [specialist subject]? Why (not)?
- ❑ How do you define dialogue?

- ❑ Do you feel your lessons promote dialogue between students? [If yes] please describe how, giving a concrete example.
- ❑ Thinking about the example you have described; what strategies did you use when planning or teaching the lesson that supported the dialogue?
- ❑ Are you aware of any critical thinking skills that the students have been learning about recently? [If yes] Have these influenced your own lessons in any way?

Beliefs about (and use of) technology

- ❑ Do you think it is important the teachers of [specialist subject] use technology such as computers and tablets in the classroom?
- ❑ How often do you use computing technology in your lessons?
- ❑ How do you feel about this technology?
- ❑ Does this technology add value to your lessons? How?
- ❑ Can you explain how and for what purposes students use technology [subject]? Does student use differ from your own or are there overlaps? [If no] Can you explain why not?
- ❑ Does student homework involve the use of technology? [If yes] Does this differ from their use of technology in school? [If no] Can you explain why not?
- ❑ Do you think technology is helpful when planning or conducting collaborative activities for your students? Please explain why you think this.
- ❑ Thinking specifically about Google Classroom (and its associated apps), have you found it useful? [If yes] In what ways? [If not] Why not?
- ❑ Has using Google Classroom affected the dialogue in your classroom? [If yes] Can you give an example?
- ❑ Have you found any functions of Google Classroom particularly effective when promoting dialogue in [subject]?

Contextual Influences

- ❑ What stimulates you to use technology during your work as a teacher? These factors could be personal or school-based.
- ❑ Do any barriers obstruct you from using technology in your work? Again, these could be personal or school-based factors.

End

- ❑ Ask if teacher has additional comments or questions related to the topics of the interview.
- ❑ State that this concludes the interview and thank teacher for their participation.

Appendix 7. *What are the affordances of Learning Management Systems that support Dialogue?* Poster presented at the 2016 EdD Conference, Faculty of Education, Cambridge.

What are the affordances of Learning Management Systems that support dialogue?

Tristan Igglesden

Head of Science and Assistant Director of Studies,

[redacted]

1st Year EdD student.

ti256@cam.ac.uk

Key Questions

- Do LMS (specifically Google Classroom) increase the possibilities for the teacher mediation of learning?
- What is the nature of dialogue within a LMS?
- What new spaces are opened up for dialogue to take place in?

Abstract

I propose that the increasingly widespread use of Learning Management Systems (LMS) to deliver and curate written work (and other digital media) is having a profound effect on classroom practice. This work outlines the rationale and key questions of an nascent investigation into the impact this is having in my own setting, an independent preparatory school that includes a paperless Science department. The project has a focus on the effects that such tools have upon dialogic pedagogy; the way in which "teachers and students explore and generate ideas and questions together" (Alexander 2008).

Dialogue and Social Constructivism

The Russian philosopher Mikhail Bakhtin established that there is a need to create meaning in a dialogic way and this concept of dialogism is widely accepted as a means to promote learning. His compatriot Lev Vygotsky emphasised the importance of a guide-learner relationship to maintain a "Zone of proximal development" or ZPD (Vygotsky, 1978), a gap between the initial problem solving ability and potential development of a learner (when guided by an expert). Indeed, the cultural and psychological functions of language are not necessarily separate; communication and thinking may be considered two sides of the same coin (Mercer & Littleton, 2007). The nature of dialogue conducted within a LMS is therefore of great importance and there is a preference for interactions where participants act as critical friends. In this way they can build upon one another's ideas, engaging in what Mercer (1995) described as "Cumulative" talk. This would be an improvement on much classroom dialogue which is rarely conversational and is therefore poorly employed as a tool for learning, LMS may provide a forum for richer conversation to take place.

A Google Classroom

Over the past five years, the [redacted] Science department has seen an increase in the number of web-based and digital resources used by teachers and learners. Curating digital work in a way that allowed for feedback to readily take place was a challenge for both staff and children. In 2014 we committed to creating a 'paperless' science department for all children based around Google Apps for Education (GAFE), a suite of free online tools that had many logistical benefits. It was during the early trials of this paperless laboratory that I observed the space for dialogue opening up in a number of ways; not least because of the reduction of secretarial tasks demanded of the learners. By providing digital frameworks for students to record their ideas, the practical and collaborative activities could begin earlier in the sessions and continue for longer. The opportunity to comment and work in real time on shared documents was a new experience to most and inevitably led to play and socialization in this new space.

Conclusions

The use of Google Classroom, a recent addition to Google Apps For Education (GAFE) will inevitably impact practice across the globe and the LMS already has 10 million users ("A new kind of Classroom," 2015). Forums such as this offer students longer, even infinite time to dialogue and a variety of ways to post their thoughts. Learning in this manner is a means to empower participants (Wegerif, 2013) and challenge the traditional, vertical transmission of knowledge.

References

A new kind of Classroom for 10 million students and teachers. (2015). Retrieved from http://googleforeducation.blogspot.com/2015/10/

Alexander, R. J. (2008). *Towards Dialogic Teaching: rethinking classroom talk (4th edition)*. Dialogos.

Mercer, N. (1995). *The guided construction of knowledge: Talk amongst teachers and learners*. Multilingual matters.

Mercer, N. & Littleton, K. (2007). *Dialogue and the development of children's thinking: A sociocultural approach*. Routledge.

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Harvard.

Wegerif, R. (2013). *Dialogic: Education for the Internet age*. Routledge.

Appendix 8. Student questionnaire

1. **In LESSONS (including non-academic subjects), how often do you...**
   Scale: Always (5), More than ⅔ of lessons (4), More than ⅓ of lessons (3), Less than ⅓ of lessons (2), Never (1).

- ❑ Share documents with other children on Google Classroom or Google Drive.
- ❑ Act upon comments a teacher has added to your Google Docs.
- ❑ Write your ideas on a Google Classroom stream.
- ❑ Find online animations or videos to better understand a topic.
- ❑ Create 'slides', web pages or blogs to present your work.
- ❑ Use social media (Facebook, Instagram etc.) to share information (about school work) with other children.
- ❑ Use online search engines (like Google).
- ❑ Use YouTube and video apps.

2. When doing HOMEWORK, how often do you...

Scale: Every prep (5), More than ⅔ of prep tasks (4), More than ⅓ of prep tasks (3), Less than ⅓ of prep tasks (2), Never (1).

- ❑ Share documents with other children on Google Classroom or Google Drive.
- ❑ Act upon comments a teacher has added to your Google Docs.
- ❑ Write your ideas on a Google Classroom stream.
- ❑ Find online animations or videos to better understand a topic.
- ❑ Create 'slides', web pages or blogs to present your work.
- ❑ Use social media (Facebook, Instagram etc.) to share information (about school work) with other children.
- ❑ Use online search engines (like Google).
- ❑ Use YouTube and video apps.

3. In which subjects do you use Google Classroom most often? (Please choose 3): List of subjects.

4. **How strongly do you agree with the following statements about Google Classroom?**

Scale: Strongly agree (5), Agree (4), Undecided (3), Disagree (2), Strongly disagree (1).

- ❑ It helps me to learn more.
- ❑ It makes lessons more enjoyable.
- ❑ It makes it easier to communicate with other students.
- ❑ It makes it easier to communicate with teachers.
- ❑ It only works well in some subjects.
- ❑ I don't find it easy to use.
- ❑ It gives me more control over the way I present my ideas.
- ❑ It gives me freedom to find and add information that I find interesting to my work.

5. If you would like to add any further comments about the use of Google Classroom at school, please do so here:

6. During lessons, how often are you asked to talk to other children about your ideas?
Scale: Every lesson (5), More than ⅔ of lessons (4), More than ⅓ of lessons (3), Less than ⅓ of lessons (2), Never (1).

7. In which subjects are you most often asked to talk to other children about your ideas? (Please choose up to 3): List of subjects.

8. **How strongly do you agree with the following statements about talking to other children?**
Scale: Strongly agree (5), Agree (4), Undecided (3), Disagree (2), Strongly disagree (1).

- ❑ It helps me to learn more.
- ❑ It makes lessons better.
- ❑ It's a waste of lesson time.
- ❑ It works well for all subjects.
- ❑ I find it easy.

9. **If you would like to add any further comments about talking to other children in class please do so here:**

Appendix 9. Sample of coded transcript from a teacher interview

Time Stamp	Agent	Utterance	Co-construction	Collaboration & Community	Different Perspectives	Metacognition	Scaffolding	Multimodal	Direct Manipulation	Dynanism	Provisionality	Accessibility	Immediate Feedback
[00:02:05.15]	TJI	Are there any approaches to teaching History that you find particularly effective?											
[00:02:12.09]	George	Stories. I tell a lot of stories. So, [2+] I, if we are doing Henry 1st, trying to sort out his Barons prior to his death so that they will accept Matilda, rather than just saying he organised his Barons, I'll do a little story.											
	George	So I'll get them thinking that there was a line, a desk, two desks at the front of the room and he said to his Barons right, if you accept Matilda and you want to stay a Baron line up behind that desk and sign that piece of paper and if you don't accept Matilda and you want to become a peasant, line up behind this desk and sign that piece of paper.			1								
[00:02:49.06]	George	And we have, and you know, that sort of thing. I think that helps them to try and get into the time and the place and they can recreate it in their own minds.			1	1							
[00:03:00.04]	George	I do a lot of questioning. [2+] As in why do you think so and so did this? Or what do you think so and so was thinking at the time so empathy and questioning linking together. [2+]			1	1							
[00:03:16.00]	TJI	What's the strength of that approach in particular?											
[00:03:19.09]	George	I think if they can empathise with the people in the past it allows them to have a stronger idea about why people made certain decisions that to us nowadays don't seem particularly grounded in, in common sense or, or what you would do.			1	1							
	George	The church is, is the big one. The church in the middle ages had such a grip on people's lives that if they can understand and think about well, if I don't go to church I believe that I am going to go to hell. And everyone believes that and I've been told that since I was old enough to go to church, I've been told it every Sunday and then I see it in the stained glass windows.			1								

Line	Time Stamp	Agent	Utterance	Co-construction	Collaboration & Community	Different Perspectives	Metacognition	Scaffolding	Multimodal	Direct Manipulation	Dynanism	Provisionality	Accessibility	Immediate Feedback
31		George	Whereas now, if you, the idea that if you don't go to church you get punished is a very alien concept because we have so many religions and people don't go to church and so on. So I think that, the more I can ground it in the people in the past and their ideas and thoughts the children find it easier.			1								
32	[00:04:23.10]	TJI	Are there any weaknesses to this questioning approach? Is there any?											
33	[00:04:29.22]	George	I think there are in that [2+] sometimes some children particularly [2+] ones who have [2+] issues with language and so on perhaps don't, don't access the questions as well as I would like and to help, to aid that I'll ask questions in various different formats which perhaps can get confusing [2+]					1						
34	[00:04:59.28]	George	But I try to ask, I'll ask a question and then I'll rephrase it. Maybe quietly to one side for the ones who I think need it rather than rephrasing it for everyone. So that I try to lessen the confusion there.											
35	[00:05:17.00]	TJI	Fine. Can you describe your own activities during a typical History lesson? What you do in a typical History lesson? Rather than the children.											
36	[00:05:32.15]	George	So I, [2+], I'll do the, I'll do a recap of what we've been doing. Usually. Unless we're starting something new so I'll, right, what were we doing last lesson? And I'll ask a couple of questions just to get their minds back on what we're doing. We may re-read over some notes we took last lesson.											
37		George	And then I'll introduce either the activity or the topic and then once the children are working on that then I'm, I'll move around the room and ask question, I'll answer questions I'll, prompt certain children who I know can go in a certain direction. I'll prompt them with a question to get them thinking about what they might move on to next or consider an extra layer of detail on whatever they're doing.											

Line	Time Stamp	Agent	Utterance	Co-construction	Collaboration & Community	Different Perspectives	Metacognition	Scaffolding	Multimodal	Direct Manipulation	Dynanism	Provisionality	Accessibility	Immediate Feedback
38		George	[2+] Some of it is, you know, [2+] Sir I can't log on. OK, let's deal with that. Or, I found a good website, can I look at this and then it's just, you know, checking that, that kind of admin stuff. And then we'll go through the main body of the lesson and then the end of the lesson will vary depending on what it is.											1
39		George	It might be, like let's all come together and let's look at, I don't know, if we've been looking at a padlet for instance, let's have a look at the padlet.		1							1		
40		George	OK, so and so why did you put that piece of information on and let's have a look and see how many other people got that and do we think that's a good idea? And so on. It may be that we finish with a, me rounding it off and giving them a piece of information or some knowledge that I think they need to be able to build on for next time. Depending on what stage we're at.				1					1		
41	[00:07:26.26]	George	Sometimes it's a case of OK. We're going to stop that now. Put that to one side and we're going to come back to that. And this is the prep.									1		
42		George	And that might be something linking on to what we've done or it might be a stand alone piece of prep which sometimes is the case. If a prep, or where we're up to doesn't lend itself to them doing some of their work on it. If they need more from me, and that's.											
43	[00:07:50.01]	TJI	Yeah. What do you expect the pupils to do in a typical lesson?											
44	[00:08:01.27]	George	[2+] I expect them to [2+] move forward from where we were in the beginning in thier knowledge. [2+]											
45	[00:08:12.22]	TJI	In terms of their actual activities, what do you expect of them?											

Line	Time Stamp	Agent	Utterance	Co-construction	Collaboration & Community	Different Perspectives	Metacognition	Scaffolding	Multimodal	Direct Manipulation	Dynanism	Provisionality	Accessibility	Immediate Feedback
45	[00:08:12.22]	TJI	In terms of their actual activities, what do you expect of them?											
46	[00:08:19.12]	George	Oh, OK so there might well be some written work. So some note taking, [2+] some discussion amongst themselves in small groups so I might say work for two minutes in the back of your books in groups of three just jotting down things that you think Henry needs to do in order to stay a strong king. Whatever. So we do some group work like that.		1									
47		George	[2+] Quite often from that research we might then use chromebooks and they can go on, use Padlet and things like that.											1
48		George	They're almost certainly, having to check Classroom if we've got, if I've set work up on there. It's a kind of mixture, I don't like having lessons where they write the whole lesson or when we don't do any writing although, if I was to, if I was to try and count the number of lessons where they don't do much writing it would be higher that I think I would guess if I were to do that.						1					
49	[00:09:25.22]	George	[2+] I'll like them to ask questions. Of themselves and each other and discussion.		1	1								
50	[00:09:33.10]	TJI	So would you say, promoting dialogue between the students is a good approach for History teachers?											
51	[00:09:41.06]	George	Yeah.											
52	[00:09:41.21]	TJI	Is, [2+] Why?											
53	[00:09:45.19]	George	I think linking back to what I said earlier about trying to put themselves into the shoes of people of the past so that, they, if it's just me doing the dialoguing and telling them so they get my impression of what a person might feel.			1	1							
54		George	If they're doing it in a group of three you've got three people's impression. We do it, we all come together as a class you've got twenty-two people's impression of what might happen and then, generally the strands of thoughts and ideas will become more apparent because of that dialogue.		1	1								

Line	Time Stamp	Agent	Utterance	Co-construction	Collaboration & Community	Different Perspectives	Metacognition	Scaffolding	Multimodal	Direct Manipulation	Dynanism	Provisionality	Accessibility	Immediate Feedback
55		George	The listening to what other people have got to say about an event or what someone was thinking just then helps them to build up their ideas and that then comes through in their knowledge and understanding I think.		1	1	1							
56	[00:10:34.02]	TJI	So, how do you actually [2+]. I'm going to ask you to define dialogue, how would you define that?											
57	[00:10:41.06]	George	I think for me it's the, within my classroom a dialogue is two people a) talking about an event or a person or the causes of an event of the effects of an event [2+] and [2+] stating what they think about it but also then accepting other people's ideas and perhaps even, in the light of that information adjusting their own thoughts and perhaps even changing their opinions.		1	1								
58		George	I know that in my sixth form top sets quite often, people start off with quite a fixed opinion about what they, what they think and by the end of it we've had people who've done a complete u-turn and accepted a change, in light of other information from other children not necessarily from me.			1	1							
59	[00:11:40.11]	TJI	Do any, concrete examples of that spring to mind?											
60	[00:11:44.05]	George	Yes. We, I'll work on Richard III and the prince in the tower. Which is a good example for this. So before we even start any of the work I get them to do a hands up, who thinks Richard's responsible? And I'll write the names on the board.			1								
61		George	And then as we go through the work, and we spend a lot of time looking at evidence at the sources that say, yes he was responsible, and we talk about these sources. And then we look at evidence so it would suggest that perhaps he wasn't and in their groups they talk about well this person says this but this person says an opposite view and the ones who think that Richard is responsible are sort of give evidence to, that suggests that is the correct view and they have to dialogue and argue that their case with the evidence.			1		1						

Line	Time Stamp	Agent	Utterance	Barriers to Dialogic Pedagogy	Barriers to Technology use	Contextual learning and engagement	Dialogic Space-Time	Inter-subjectivity	Pedagogy of Emancipation	School Culture	Support for SEND	Key Words & Phrases	Potential Themes	Notes
23	[00:02:05.15]	TJI	Are there any approaches to teaching History that you find particularly effective?											
24	[00:02:12.09]	George	Stories. I tell a lot of stories. So, [2+] I, if we are doing Henry 1st, trying to sort out his Barons prior to his death so that they will accept Matilda, rather than just saying he organised his Barons, I'll do a little story.									Stories		
25		George	So I'll get them thinking that there was a line, a desk, two desks at the front of the room and he said to his Barons right, if you accept Matilda and you want to stay a Baron line up behind that desk and sign that piece of paper and if you don't accept Matilda and you want to become a peasant, line up behind this desk and sign that piece of paper.											
26	[00:02:49.06]	George	And we have, and you know, that sort of thing. I think that helps them to try and get into the time and the place and they can recreate it in their own minds.											
27	[00:03:00.04]	George	I do a lot of questioning. [2+] As in why do you think so and so did this? Or what do you think so and so was thinking at the time so empathy and questioning linking together. [2+]									Questioning, Empathy		
28	[00:03:16.00]	TJI	What's the strength of that approach in particular?											
29	[00:03:19.09]	George	I think if they can empathise with the people in the past it allows them to have a stronger idea about why people made certain decisions that to us nowadays don't seem particularly grounded in, in common sense or, or what you would do.				1					Empathise		
30		George	The church is, is the big one. The church in the middle ages had such a grip on people's lives that if they can understand and think about well, if I don't go to church I believe that I am going to go to hell. And everyone believes that and I've been told that since I was old enough to go to church, I've been told it every Sunday and then I see it in the stained glass windows.									Believes		Contextuality of decisions / thinking

Line	Time Stamp	Agent	Utterance	Barriers to Dialogic Pedagogy	Barriers to Technology use	Contextual learning and engagement	Dialogic Space-Time	Inter-subjectivity	Pedagogy of Emancipation	School Culture	Support for SEND	Key Words & Phrases	Potential Themes	Notes
31		George	Whereas now, if you, the idea that if you don't go to church you get punished is a very alien concept because we have so many religions and people don't go to church and so on. So I think that, the more I can ground it in the people in the past and their ideas and thoughts the children find it easier.											
32	[00:04:23.10]	TJI	Are there any weaknesses to this questioning approach? Is there any?											
33	[00:04:29.22]	George	I think there are in that [2+] sometimes some children particularly [2+] ones who have [2+] issues with language and so on perhaps don't, don't access the questions as well as I would like and to help, to aid that I'll ask questions in various different formats which perhaps can get confusing [2+]	1								Issues with language, Confusing		
34	[00:04:59.28]	George	But I try to ask, I'll ask a question and then I'll rephrase it. Maybe quietly to one side for the ones who I think need it rather than rephrasing it for everyone. So that I try to lessen the confusion there.											
35	[00:05:17.00]	TJI	Fine. Can you describe your own activities during a typical History lesson? What you do in a typical History lesson? Rather than the children.											
36	[00:05:32.15]	George	So I, [2+], I'll do the, I'll do a recap of what we've been doing. Usually. Unless we're starting something new so I'll, right, what were we doing last lesson? And I'll ask a couple of questions just to get their minds back on what we're doing. We may re-read over some notes we took last lesson.									Recap		
37		George	And then I'll introduce either the activity or the topic and then once the children are working on that then I'm, I'll move around the room and ask question, I'll answer questions I'll, prompt certain children who I know can go in a certain direction. I'll prompt them with a question to get them thinking about what they might move on to next or consider an extra layer of detail on whatever they're doing.											

Line	Time Stamp	Agent	Utterance	Barriers to Dialogic Pedagogy	Barriers to Technology use	Contextual learning and engagement	Dialogic Space-Time	Inter-subjectivity	Pedagogy of Emancipation	School Culture	Support for SEND	Key Words & Phrases	Potential Themes	Notes
38		George	[2+] Some of it is, you know, [2+] Sir I can't log on. OK, let's deal with that. Or, I found a good website, can I look at this and then it's just, you know, checking that, that kind of admin stuff. And then we'll go through the main body of the lesson and then the end of the lesson will vary depending on what it is.		1							Can't log on, admin stuff		
39		George	It might be, like let's all come together and let's look at, I don't know, if we've been looking at a padlet for instance, let's have a look at the padlet.									All come together, Padlet		Provisionality (H, 2020) includes debatability.
40		George	OK, so and so why did you put that piece of information on and let's have a look and see how many other people got that and do we think that's a good idea? And so on. It may be that we finish with a, me rounding it off and giving them a piece of information or some knowledge that I think they need to be able to build on for next time. Depending on what stage we're at.									rounding it off		Dialogue' leading to predetermined, T end point. Resolution (absolute notion - Hegel!) dictated by T?
41	[00:07:26.26]	George	Sometimes it's a case of OK. We're going to stop that now. Put that to one side and we're going to come back to that. And this is the prep.				1					put that to one side	Dialogic space-time	Infinalisability of dialogue - digital artifacts can be revisited at will and dialogue resumes, is this covered by provisionality?
42		George	And that might be something linking on to what we've done or it might be a stand alone piece of prep which sometimes is the case. If a prep, or where we're up to doesn't lend itself to them doing some of their work on it. If they need more from me, and that's.				1							
43	[00:07:50.01]	TJI	Yeah. What do you expect the pupils to do in a typical lesson?											
44	[00:08:01.27]	George	[2+] I expect them to [2+] move forward from where we were in the beginning in thier knowledge. [2+]									Knowledge		
45	[00:08:12.22]	TJI	In terms of their actual activities, what do you expect of them?											

Line	Time Stamp	Agent	Utterance	Barriers to Dialogic Pedagogy	Barriers to Technology use	Contextual learning and engagement	Dialogic Space-Time	Inter-subjectivity	Pedagogy of Emancipation	School Culture	Support for SEND	Key Words & Phrases	Potential Themes	Notes
46	[00:08:19.12]	George	Oh, OK so there might well be some written work. So some note taking, [2+] some discussion amongst themselves in small groups so I might say work for two minutes in the back of your books in groups of three just jotting down things that you think Henry needs to do in order to stay a strong king. Whatever. So we do some group work like that.									Written work, note taking, discussion.		
47		George	[2+] Quite often from that research we might then use chromebooks and they can go on, use Padlet and things like that.									Research, Chromebooks		
48		George	They're almost certainly, having to check Classroom if we've got, if I've set work up on there. It's a kind of mixture, I don't like having lessons where they write the whole lesson or when we don't do any writing although, if I was to, if I was to try and count the number of lessons where they don't do much writing it would be higher that I think I would guess if I were to do that.									Classroom, mixture		
49	[00:09:25.22]	George	[2+] I'll like them to ask questions. Of themselves and each other and discussion.						1					
50	[00:09:33.10]	TJI	So would you say, promoting dialogue between the students is a good approach for History teachers?											
51	[00:09:41.06]	George	Yeah.											
52	[00:09:41.21]	TJI	Is, [2+] Why?											
53	[00:09:45.19]	George	I think linking back to what I said earlier about trying to put themselves into the shoes of people of the past so that, they, if it's just me doing the dialoguing and telling them so they get my impression of what a person might feel.					1				Feel, "Into the shoes of people of the past"		
54		George	If they're doing it in a group of three you've got three people's impression. We do it, we all come together as a class you've got twenty-two people's impression of what might happen and then, generally the strands of thoughts and ideas will become more apparent because of that dialogue.					1				Come together, strands of thoughts		

Line	Time Stamp	Agent	Utterance	Barriers to Dialogic Pedagogy	Barriers to Technology use	Contextual learning and engagement	Dialogic Space-Time	Inter-subjectivity	Pedagogy of Emancipation	School Culture	Support for SEND	Key Words & Phrases	Potential Themes	Notes
55		George	The listening to what other people have got to say about an event or what someone was thinking just then helps them to build up their ideas and that then comes through in their knowledge and understanding I think.					1				listening		
56	[00:10:34.02]	TJI	So, how do you actually [2+]. I'm going to ask you to define dialogue, how would you define that?											
57	[00:10:41.06]	George	I think for me it's the, within my classroom a dialogue is two people a) talking about an event or a person or the causes of an event of the effects of an event [2+] and [2+] stating what they think about it but also then accepting other people's ideas and perhaps even, in the light of that information adjusting their own thoughts and perhaps even changing their opinions.					1				Adjusting their own thoughts and perhaps changing opinions		
58		George	I know that in my sixth form top sets quite often, people start off with quite a fixed opinion about what they, what they think and by the end of it we've had people who've done a complete u-turn and accepted a change, in light of other information from other children not necessarily from me.				1	1	1			fixed opinion		
59	[00:11:40.11]	TJI	Do any, concrete examples of that spring to mind?											
60	[00:11:44.05]	George	Yes. We, I'll work on Richard III and the prince in the tower. Which is a good example for this. So before we even start any of the work I get them to do a hands up, who thinks Richard's responsible? And I'll write the names on the board.											
61		George	And then as we go through the work, and we spend a lot of time looking at evidence at the sources that say, yes he was responsible, and we talk about these sources. And then we look at evidence so it would suggest that perhaps he wasn't and in their groups they talk about well this person says this but this person says an opposite view and the ones who think that Richard is responsible are sort of give evidence to, that suggests that is the correct view and they have to dialogue and argue that their case with the evidence.				1					opposite view		

Appendix 10. Selected SEDA (Scheme for Educational Dialogue Analysis) codes used in the analysis of audiovisual data (adapted from Hennessy et al., 2016)

I Invite elaboration or reasoning

	Key words	**Definition**	**Description**	**Example**
I1	Ask for explanation or justification of another's contribution	Ask participant(s) to clarify or make explicit or explain another's or collective ideas or reasoning.	Inviting participants to take up someone else's or collective ideas in order to paraphrase, clarify or make them explicit. As in asking someone to put themselves into another's shoes. It does not include simply asking others to repeat someone else's statement.	1. S: It's 7. T: I think it's 12; why would I think it's 12? 2. Can anyone remember, building on what Emma said, why she said inspection? I am a little bit confused. Adam, why has she said inspection? 3. Chloe found the value for X, she's said it's 2. I know she's correct, but *how* do I know that Chloe is correct? 4. Tell me about Connor's idea about having the same genes or same brain ... people. When you talk to each other and when you listen to each other's ideas. 5. Who can tell me why they might disagree with Joe?

I2	Invite building on / elaboration / (dis)agreement / evaluation of another's contribution or view	Use previous contribution to **elicit further** responses, inviting addition to or elaboration / clarification / (dis)agreement / positioning / comparison / evaluation / critique of another's contribution or idea.	Includes inviting participants to take up others' contribution(s)/ideas in order to promote the extension, elaboration, or deepening of ideas (Examples 1-4). Includes bringing private contributions or knowledge objects (e.g. outcomes from group work) into the public arena, when further responses/additions are then invited. **Reference to specific prior ideas/contributions/views/theories must be explicit** (through naming an individual or referring to a specific idea). Excludes ambiguous cases such as "What do you think, Mary?" Consider E1 for this. Includes inviting **ideas that are different or similar** to others', or inviting others to identify whether ideas are similar or different (Examples 5-6).	1. Can anyone add to what Johnny said? 2. See if what you came up with is different or similar to the ideas we have on the board already. 3. Take a look at what you have written down and see if you have anything no-one else has thought of. 4. Does anyone have some similar ideas that might fit here? 5. Is your idea similar to Manuel's? 6. Did X's idea match with what you thought/discussed/decided? 7. What do you think about what X said? 8. Ricky would you agree with that in view of what you said? 9. What do you think Felix, about that, because earlier you made a distinction between them? Marcel is actually challenging the notion that it's actually possible to imagine it. What do you think?

			Includes asking participant(s) to **critique, evaluate or comment on or compare/agree/disagree** with another's argument/position/conclusion (Examples 7-9), e.g. through - Asking participant(s) to take a position in relation to the topic at hand or asking to agree/disagree with possible courses of action; - Asking for confirmatory or alternative perspectives;. - Bringing private contributions or knowledge objects (e.g. outcomes from group work) into the public arena. - Asking for a critique of an idea, position, concept, hypothesis, viewpoint or academic content. - Inviting a counter-argument. (Example 9) Consider additionally coding C1 – 'Refer back' where positioning	

			is invited in relation to a reference back to an earlier contribution (Example 10).	

I3	Invite possibility thinking based on another's contribution	**Invite speculation/** imagining**,** **hypothesis,** conjecture, or question posing based on another's contribution.	Includes inviting others to imagine new scenarios and to wonder and speculate about possibilities connected to previous contributions. Typically this might include a conjunction linking to a previous comment: eg 'Therefore, what might happen if…' or 'Based on Billy's idea, who has a further question?' The important feature of this code is that whilst it includes invitations to participants to ask open-ended questions, which are typical of creative and divergent thinking, it explicitly links these to ideas already expressed, rather than inviting new ideas (which would be coded as I5).	So, what might happen if…..? What questions does Maria's suggestion lead you to? Consequently, what do you 'wonder'?

I4	Ask for explanation or justification	Ask other(s) for **justification/** evidence or explanation of reasoning or the process of arriving at a solution.	Includes asking others to make their reasoning explicit. Note – Questions beginning with 'why' usually ask for justification. Invitations must **explicitly** ask for reasoning, not just ideas/views (E1-'Invite opinions/ beliefs/ ideas'); typically (but not sufficiently) identified through key words such as 'why?', 'how?', 'what caused...?'.' Includes asking for analogies, distinctions, meanings or categorisations of topics/ideas/phenomena/etc; all constitute reasoning. Also consider I6-'Ask for elaboration or clarification'. This may imply adding information to the previous idea or changing it qualitatively. Invitations require a rationale; also consider E1-Invite the	Why do you think that? What evidence do you have for that? "How did you arrive at that solution?"

			expression of different opinions/ideas/beliefs.	
I5	Invite possibility thinking or prediction	**Invite speculation/** imagining**,** **hypothesis,** conjecture, or question posing.	Includes ask for possibilities and theories to explain a phenomenon; invite the expression of different possibilities based on present information or activity. Often involves extrapolation. Invitations must **explicitly** ask for possibilities, not just ideas/views (E1-'Invite opinions/ beliefs/ ideas'); typically (but not sufficiently) identified through use of conditional tenses or thought experiments as in phrases such as 'what would/could/might happen if...?' Invitations sometimes use future or conditional tense (e.g. thought experiments; especially use of 'would', 'could' or 'might'). Also consider E1-Invite the expression of different	What would happen if…?; What questions can you think of about this story? What might happen next? Which objects do you think might float? What do you imagine the character in this poem is feeling?

			opinions/ideas/beliefs, including for open-ended creative thinking. Consider I4-'Ask for explanation or justification' for post-hoc explanations/justifications	
I6	Ask for elaboration or clarification	Probe/ask for clarification **or elaboration or extension or example.**	Asking someone to clarify or extend (say more about) a **previous** response, or to illustrate it with an example. This category does not apply when the participant asks for confirmation. Questions beginning with 'Why' usually ask for justification, not elaboration. Note – a probe is not always an explicit question, an invitation may be implicit. Also consider I4-'Ask for explanation or justification', which involves making reasoning explicit (I6 may imply asking someone to add	T: Has that ever happened to you? S: It happened to me. T: When, or how? Can you remember an example?

			information to the previous idea or changing it qualitatively).	

R Make reasoning explicit

	Key words	Definition	Description	Example
R1	Explain or justify another's contribution	Provide or elaborate **justification/ evidence** or explanation of another's reasoning or the process of arriving at a solution.	Explain or justify someone else's or collective ideas, stepping into another's shoes. It does not include simply repeating someone else's statement. This category encompasses various forms of argumentation (argument or counter-argument), as well as explanations of the process of arriving at a solution. Includes drawing analogies, making distinctions, and breaking down or categorising topics/ideas; all constitute reasoning. May include bringing evidence from inside or outside the current context into the dialogue to support an argument, opinion, proposal, prediction or theory.	As Emma said, it's an irreversible change because you can't get it back in its original state.

R2	Explain or justify own contribution	Provide or elaborate **justification/ evidence** or explanation of own reasoning or the process of arriving at a solution.	This category encompasses various forms of argumentation (argument or counter-argument), as well as explanations of the process of arriving at a solution . Eg. If the response includes 'because' then this may be a justification. Includes drawing analogies, making distinctions, and breaking down or categorising topics/ideas; all constitute reasoning. May include bringing evidence from inside or outside the current context into the dialogue to support an argument, opinion, proposal, prediction or theory. Also consider B2-'Clarify/ elaborate own contribution' for clarification (R1 involves making reasoning explicit, B2 may imply adding information to the previous idea or changing it qualitatively).	1. She's hurt **because** her Dad… *2. (answering the question: How is knowledge taking place?)* You get knowledge because someone asks you a question and you don't know but someone else knows it. So then you learn from other people if they know things and you can also learn from other people's mistakes. 3. We would put it into three categories: living conditions, medical conditions and the conditions they had to fight under. 4. The ice caps melting by 10% supports the global warming theory. 5. Imagining being in the trenches is like imagining winning the lottery. You can think about what it would be like, but it wouldn't necessarily be like that.
R3	Speculate or predict on the basis of another's contribution	Speculate, hypothesise, conjecture, imagine or express one or more different	Emphasis on the possibilities and theories to explain a phenomenon on the basis of another's contribution. Includes thought experiments or more explicit predictions/hypotheses. It also includes the expression of different possibilities based on present information or activity.	1. So, if what Emma says is correct, then I wonder if the world of the story is a dream? 2. If the shapes in the picture are meant to be cats, as you have just suggested, Tim, then maybe….

		possibilities on the basis of another's contribution	Often involves using future or conditional tense (especially use of 'if', 'if…. then', 'not.... unless', 'would', 'could' or 'might').	
R4	Speculate or predict	**Speculate, hypothesise**, conjecture, imagine or express one or more different **possibilities or theories**.	Emphasis on the possibilities and theories to explain a phenomenon. Includes thought experiments or more explicit predictions/hypotheses. It also includes the expression of different possibilities based on present information or activity. Often involves using future or conditional tense (especially use of 'if', 'if…. then', 'not.... unless', 'would', 'could' or 'might'). It is different from compare/evaluate alternative views in P2, which requires exploring the difference between different possibilities or theories. Consider R1-'Explain or justify reasoning or solution' for post-hoc explanations/justifications.	1. What would happen if…? 2. It could be A but also B… 3. I think the wood will float but not the metal. 4. If it [the transcendent] was on the earth… beyond the universe, somewhere spiritual… we don't know. 5. Is it like when [Brahman] as a singular person has form rather than something that is everywhere? 6. If I was in the situation I'd take [the firework] home and put it in a big bucket of cold water, so just in case if someone lights a match then it wouldn't go off probably. 7. I don't think you could imagine being there unless you've been there and done it. 8. If children didn't have to go to school they might not learn maths properly.

B Build on ideas

	Key words	Definition	Description	Example
B1	Build on / explain / clarify others' contributions	**Build on**, **explain, clarify, revoice, elaborate, make explicit, highlight** or transform contributions provided by other(s) or collective idea, opinion or reasoning.	Make a **responsive** contribution based on another person's previous comment, argument, idea, opinion or information. This is used when reformulating, building on, explaining, exemplifying, elaborating or transforming someone else's idea/opinion/suggestion. It goes further than the original contribution did; **it may either clarify** (to them and/or to others) **or it may add something**. Includes paraphrasing another's contribution to emphasise, clarify or make it explicit to others (see example 3) but should not be used for repeating someone else's words (unless there is a change of tone). Includes explicitly recognising the contribution made by another (example 2), but not just by praising. Includes putting yourself into another's shoes. It includes completing an idea or comment and chaining ideas between two or more participants. Alternatively, it may introduce a different, new idea that is related to a previous contribution.	S1: I think she's worried that they might get hurt. S2: Yes, or they might run away. S1: …and sometimes knowledge can't be true S2: yeah S1: Like people tell you things S3: Like stuff on Wikipedia S1: And then you. . . see reasons why that's not true. 2. José made an excellent contribution to solving this problem by suggesting we multiply and explaining how that would work 3. What Mary meant was… 4. Why has [Emma] said inspection? Because like you said, the one step sums it's called inspection because you got to find a value of

			Includes building on student's knowledge or following up previous contributions. Includes explanation and/or rephrasing of technical terms used by a previous speaker. Includes identifying one's own idea(s) as similar or different to another's (examples 5,6) Also consider P1-'Synthesise ideas' when combined with integrating / distilling ideas. It can apply to collaborative writing. Consider C1 when there is an *explicit* reference back. Also consider G4-'Provide informative feedback'. For clarification of *own* contributions use B2-'Clarify/ elaborate own contribution'.	something and it's basically when you're just looking at it and then you get an answer. 5. My idea is similar to David's; I put XX 6. I've got an idea that no-one has mentioned yet. 7. To answer some questions, the children are using a graph. The teacher ask them about what a bar in the graph means: T: And this one in particular, what does it mean? The blue part. S1: All men of all ages S2: **Yes, men, blue is for men and red is for [women].**
B2	Clarify/ elaborate own contribution	Clarify, **elaborate, exemplify** or extend **own** opinion / idea / belief	Applies when the same person makes a new comment/response based on **their** previous comment (but new comment does not include a justification) or elaborates their own previous question. Also consider R2-'Explain or justify reasoning or solution' for justification.(R2 involves making	**1. S1**: A fig is a fruit. S2:…… **S1**: It is not the biggest fruit on the table. 2. S1: Well, knowledge is kind of like what you know as a person.

		(without justification) or question.	reasoning explicit. B2 may imply adding information to the previous idea or changing it qualitatively). For extended contributions including elaboration of a new idea, consider E2-'Make relevant contribution'. For clarifications of other's contributions, use B1-'Build on / explain /clarify others' contribution'.	S1:Yeah. What you know as a person. . . and sometimes knowledge can be something maybe that you are good at and may be something someone else isn't good at.

P Positioning and Coordinating

	Key words	Definition	Description	Example
P1	Synthesise ideas	Synthesise or summarise others' or collective ideas	Bringing multiple perspectives or ideas into inter-relation and drawing out or distilling a key idea(s) / conclusion / implication. May include ideas from immediately preceding discussion or earlier in lesson / lesson sequence. Must include ideas from more than one person/source (two in total is sufficient). May include own ideas in the collective synthesis. May include integrating or summarising or recapping.e.g. after class brainstorm or during/at the end of a group discussion. Also consider B1-'Build on/ explain/ clarify other's contributions' .	T: Ok. So you mentioned school, class, friends, family, places where you live. There is a lot of different things, different knowledge. Knowledge from the family, from experience. Is some of this knowledge more important than other kinds?

P2	Compare/ Evaluate alternative views	**Compare/ evaluate** different opinions/perspectives / beliefs.	Compare/evaluate at least two arguments / positions (may include own or other's), with explanation or justification. For identifying similarity or difference between ideas without judging their value, use B1. Consider R2-'Speculate, hypothesise or predict' for speculations, hypotheses and predictions.	Aaron: David interpreted well. Emily showed good understanding of the historians, but David cross-referenced their positions better than she did.
P3	Propose resolution		This act includes the result of seeking consensus/ agreement, either by suggesting a solution that could be shared by all, or by suggesting that participant should partially agree, or disagree entirely, **after discussing a task, issue or problem**. Other participants need not agree or share the viewpoint.	1. So, shall we go with option B? 2. I think we're in agreement that a suspension bridge would be the best solution.
P4	Acknowledge shift in position	Participants acknowledge that they have **shifted their position** in response to	It includes clarifying a misconception or changing opinions/ideas/beliefs. There has to be evidence of the shift/adjustment in position or change of mind in the dialogue. E.g. change in the argument or idea that the participant was exposing earlier. It requires an explicit statement. Consider P6 'State (dis)agreement/ position' .	I like that Robert and it wasn't what I'd thought of. I thought I was going to write something else on here [recording Robert's view on the board]. I see what you mean, I agree with you now that C is probably right, not B.

		the preceding dialogue.		
P5	Challenge viewpoint	Challenge viewpoint / assumption	Challenging / confronting others' view / assumption / argument. The challenge must be evident through verbal (or nonverbal) means, including questioning. This should not be used when a simple 'no' response is given. If it is an explicit statement of disagreement use P6- 'State agreement or disagreement'. Use more specific codes where they apply (e.g. I1 or I6E3) Includes partial agreement.	Can we really say that 'knowing how to eat a salmon sandwich' is a form of knowledge? But then that wouldn't happen if… Do you really think these angles are the same?
P6	State (dis)agreement/ position	State that one or more participants (dis)agree with others or acknowledge differences	One or more participants state that they agree or disagree with at least one other (Example 1). This act includes the result of seeking agreement, either by arriving at a solution or acknowledging participants' differences **after discussing a task, issue or problem**. Positioning in relation to other must be explicit. For a statement of different viewpoint, consider P5. If a reason is given (Example 2), also code with R21a 'Explain or justify reasoning or solution.'	1. I disagree with John; We all agree on that; I don't agree with you on that, I agree with Mary; most of us agree/disagree that X was more convincing than Y; 2. I agree with Lucy… it says here Vishnu adopts various forms rather than just one. 3. I don't think that's right, I think.... 4. That's partially true, but not when….

			For agreement, at least 2 positions must have been expressed previously so that one is chosen over the other. For disagreement or partial agreement, a simple statement is sufficient (since we assume two perspectives have been compared). Includes agreeing a course of action (under above conditions). If the statement is of disagreement with a justification (counter argument) code P6 + R2.	

Appendix 11. Summary of the extracts and supporting artifacts included in the inter-coder reliability sample

Sample	Phase	Subject	Standard / Augmented	Activity Description	Notes
1	1	Geography	Standard	In pairs, children were asked to discuss a short video that the teacher has just shown about the building of the 2012 Olympic Village. They were asked to identify and describe examples of sustainability with one another (and make notes in the back of their books).	Transcript from Video 1a - Small camera used as dictaphone. Wide-angle video of whole class did not record due to battery fault. Pair of girls.
2	1	History	Augmented	In pairs, children were asked to decide what was the most important consequence of the black death, add this to a Google Slide and illustrate their idea.	Transcript from Video 2a - This pair of girls were only group to choose to use and share a single chromebook (although 'A' used machine for majority of the session). Image 2b - Digital Artifact the pair created.
3	2	English	Standard	In pairs or triads, children were asked to read a passage they have not seen before. They were not given any context and were asked to think what it might mean and describe how it has been written. This is at the start of a short unit of work on riddles as a form of creative writing.	Transcript from Audio 3a - Triad of girls. Images 3b and 3c - Shared worksheets the girls annotated during task. Video 3d - Wide angle video. Focus group are seated in center of room.
4	2	Science	Augmented	Pairs were asked to move words on a shared Slides presentation and put them in size order (without additional research). Each word represented a biological structure they studied as part of their human body topic. This activity took place ahead of a heart dissection later in the lesson. Children were invited to talk about the lists other children were looking at and to add comments to them (using the comment function) without directly editing the work of others.	Transcript from Audio 4a - Pair of boys (A and B). Briefly, a child from another group, "I" joins their dialogue. Slide 4b - Digital Artifact the pair created. Video 4c - Wide angle video. Focus group are seated on left hand side of room.

				The sample group was initially looking at the words; nucleus, neuron, optic nerve, brain, nervous system, mouse.	
5	3	Religious Studies	Standard	Children were working in groups of three discussing different statements relating to punishment. They were given copies of the statements on a worksheet and recorded their own level of agreement / disagreement on a scale of 1-5. They were asked to justify their choices to one another.	Transcript from Audio 5a - Triad of two boys (A and B) and one girl (C). PDF 5b (child A), 5c (child B) and 5d (child C) - Worksheets the children annotated during task. Video 5e - Wide angle video. Focus group are seated directly in front of camera.
6	3	Geography	Augmented	Children were working in triads using one Chromebook per group. Task was a starter activity, children were asked to choose the odd one out from a range of geographical terms. These were taken from their weather and climate topic. Children were also prompted to justify their answers.	Transcript from Audio 6a - Triad of two boys (A and B) and one girl (C). Slide 6b - Digital artifact showing group's answers to 'odd one out' questions with justifications. Video 6c - Wide angle video. Focus group are seated to left of room in front of 'blue' display board. Initiation-response-feedback (IRF) interactions between teacher and focus group have been removed from transcript.

Appendix 12. Inter-coder reliability exercise: Cohen's kappa test values

	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6
Frequency A	0	2	1	5	10	0	8	40	2	5	42	37	12	0	8	4	13	5
Frequency B	1	0	3	4	13	1	13	31	2	5	40	28	18	0	3	5	8	3
K	**	**	**0.498**	**0.664**	**0.688**	**	**0.66**	**0.791**	**0.498**	**0.596**	**0.61**	**0.523**	**0.725**	**	**0.358**	**0.888**	**0.563**	**0.496**
Standard Error	**	**	0.306	0.183	0.111	**	0.12	0.054	0.307	0.185	0.066	0.078	0.093	**	0.186	0.111	0.131	0.217

Appendix 13. Example of coded audiovisual data

Phase 3, Participant 1 (Jessica), Standard Lesson, Group 1.

			I – Invite elaboration or reasoning						R – Make reasoning explicit				B – Build on ideas		P – Positioning and Coordination						N - Non Dialogic
Line	**Agent**	**Utterance**	**I1**	**I2**	**I3**	**I4**	**I5**	**I6**	**R1**	**R2**	**R3**	**R4**	**B1**	**B2**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**N**
1	B	OK, everybody go through the sheet.																			1
2	A	Yes, everybody go through the sheet.																			1
3	B	And after we've all finished we can just tidy it up a little bit.																			1
4	C	It said peak volume. ((Referring to dictaphone on desk)).																			1
5	B	OK, ignore that.																			1
6	C	Um, do I agree? No, you've got to write your initials.																			1
7	A	Oh yeah.																			1
8	B	I think...																			1
9	A	Why don't we go through it and talk about it later?															1				0

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
10	C	One of us should read out the question then we should individually put our things on ourselves.											1								0
11	B	Yes. “You should take revenge if someone does something wrong, kind of like an eye for an eye, a tooth for a tooth, a life for a life.” I really think tooth for tooth should go first because that's less dramatic than an eye.																			1
12	T	So how are we doing this. Are you guys going to discuss each one in turn and see where you all sit?																			1
13	A	I think we should go through it and then...															1				0
14	B	Write our own ones.											1								0
15	A	Write our own ones and then go through it again.												1							0

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
16	B	“The death penalty is good because it protects the weak from the bad people in society.”																			1
17	B	[C] have you nearly finished? [C]?																			1
18	C	No.																			1
19	B	((Off task talk))																			1
20	B	“You should have no pity for guilty people. It's only fair to punish them as they deserve it.” Punish is not kill.												1							0
21	B	“Punishment is best if it changes the behaviour of the person so they become better.”																			1
22	B	Next one?																			1

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
23	A	((Off task talk))																			1
24	B	((Off task talk)).																			1
25	B	“You should forgive people for their crimes no matter how bad, you should show them love.”																			1
26	A	Sure, go for it. You do you buddy.																			1
27	B	“The death penalty is bad because you must not kill.” I totally agree. Because if you kill the person who kills somebody, that means you are as bad as them.								1											0
28	A	I agree with that.																			1
29	B	See, this is my brain. ((referring to own worksheet)). Now let's turn each other’s ones.																			1

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
30	A	Now let's go to question one.											1								0
31	B	So, “you should take revenge.” Don't touch it, don't touch it.																			1
32	C	[Laughs].																			1
33	B	“You should take revenge, an eye for an eye, a tooth for a tooth, life for a life.” I said, 4. Actually I would put that to a 5. Because, yes.																1			0
34	A	Why did you put it as a 5?				1															0
35	B	I put it as a 5 because I think...																			1

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
36	C	Shall we just do our opinions first? Then we can go around seeing justifications.																			1
37	A	Yeah, OK. So you are a 5 yes?													1						0
38	B	Yes.																			1
39	A	I was a 2.																			1
40	C	I was a 2.																			1
41	B	OK, so should I justify my....																			1
42	A	Yeah, we're doing justify.																			1
43	B	I think it's wrong because if you do this to somebody, let's say I punch you in the face, if you punch me back you are going to get into trouble too.								1											0
44	A	Yeah.																			1
45	B	That's the same. You're as bad as the person who punched you because both have reasons for punching, you don't just randomly go around punching.												1							0
46	A	Some may do.																	1		0

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
47	B	It may not be clear the reason but there will always be a reason.								1											0
48	A	Yes.																			1
49	B	And you are just as bad as the other person if you do the same act.																			1
50	C	OK, can I justify mine?																			1
51	B	Yes. Are you challenging me or justifying yours?		1																	0
52	C	I'm kind of challenging you.																			1
53	B	Oh, I'm being challenged.																			1
54	C	Basically I put 2 because if you're... It's kind of depending on the person who punched someone.								1											0
55	B	Speak louder.																			1
56	C	So you could punch them back and go like, oh that hurt, that must have been what that person felt like when I punched them.												1							0

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
58	C	Obviously you don't want to be punished. I don't know how to say this but, if someone punches you and it hurts you, you shouldn't punch someone else because that hurts them and that's exactly how you felt. Treat people how you want to be treated.								1				1							0
59	B	Do you mean it's a bit like a kitten, they don't know that they are hurting you when they bite you.				1															0
60	C	No. We're talking about people here. That's not deliberate, that's just like them scratching you by accident.								1											0
61	A	I think it's deliberate, my cat deliberately bites me. All the time.								1									1		0
62	C	Also on the form of retribution, they need what.... they should get what they deserve for doing that and they should be taught the lesson of not punching people because it hurts….												1							0

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
62	C	...Therefore, if someone punches you and it hurts you don't punch someone else. Because you know that it hurts. So why would you do that?																			
63	A	I agree with [B], his argument is very good.																		1	0
64	B	See. Big brain arguments. I'm very good at argumen																			1
65	A	Let's go on to number two.																			1
66	C	OK.																			1
67	B	“The death penalty is good because it protects the weak from the bad people in society.”																			1
68	A	What was your one?																			1
69	B	I wrote 5. I strongly disagree with this.																			1
70	A	You are really a 5 person. I wrote 2.																		0	1
71	B	[C]?																			1

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
72	C	I wrote 2. Actually, I might change it.																1			0
73	B	Oh, oh. I strongly disagree with this because it's a bit like the previous question but kind of worse. Becuase, the death penalty sure, you are getting rid of the bad people in life but it's better to change them and to give them another chance to try and be better.								1											0
74	A	That was close.																			1
75	B	I'm not saying you shouldn't punish them because there should be a punishment. You've hurt somebody but not death. Not injury. Maybe just a timeout.											1			1					0
76	A	I can see what you mean. What about you?																		1	0
77	C	So we are talking about the death penalty so a timeout won't solve the death penalty. Let's take a serial killer....											1						1		0
78	A	Who's genocided mass groups.											1								0

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
79	C	Yeah, several people. They are going to carry on killing people because they've already killed so many people so you've got the impression that this person won't stop. The only way you are going to stop them is by killing them. And even though that might not be very good, because you know they are not going to stop, it's the only way to save...								1											0
80	A	Yep. If you are working on the benefits of you, it's definitely a 5 because.... but if you are working on the benefits of society you've got to neutralise the threat to society.								1			1							0	0
81	T	Can we just check, are we all nearly completing, nearly at completion? I'm going to give you I think one more minute and then we are going to share different opinions across the classroom. Off you go, two more minutes.																			1

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
83	C	Number three, “you should have no pity for guilty people. It is only fair to punish them as they deserve it.”																			1
84	B	Wait, I was going to say for the last one. Actually I can't even remember what I was going to say.																			1
85	C	We don't have much time.																			1
86	B	What did you write?																			1
87	C	For question three, I put 3.																			1
88	A	I put 2.																			1
89	C	[B] what did you put?																			1
90	B	For this one, I said 3.																			1
91	A	Can I explain my two.																			1
92	B	Wait, I'm going first.																			1
93	A	No because you've already done one.																		0	1
94	C	[A] go.																			1

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
95	B	I'll just be in the middle ground because that's kind of where I am right now.								1											0
96	A	Because 2, if you punish them as they deserve by saying detention in this school, you should have, see that is why they've put a 1, you should have pity for them because they have been misled. Not misled but, they all have a reason and it may not be a reason you should know. And it may be a reason that made them do it without really thinking about it. So you should definitely always have pity on them but you shouldn't have too much pity because they still did the thing.								1				1							0
97	C	OK, can I justify mine.																			1
98	B	So you went for 3 too right?																			1

Line	Agent	Utterance	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	N
99	C	I put 3 because I'm not sure. It's kind of depending on the situation that person is in. So if that person comes from a really bad environment....								1											0

Appendix 14. Summary of coded audiovisual data

Observed Frequencies

Phase	Teacher	Lesson	Group	Group Size	Time	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	I	R	B	P	N
1	Paul	Standard	1	2	0:06:40	0	0	0	0	1	0	0	1	0	0	1	4	1	0	0	0	0	0	1	1	5	1	37
1	Paul	Standard	2	2	0:06:40	0	0	0	0	0	0	0	5	0	0	7	12	1	0	0	0	0	0	0	5	19	1	32
1	Paul	Standard	3	2	0:06:40	0	0	1	1	1	0	3	6	2	1	14	7	3	0	0	0	0	0	3	12	21	3	17
					Averages	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**4**	**1**	**0**	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**6**	**15**	**2**	**29**
1	Paul	Augmented	1	2	0:20:51	0	0	2	1	2	0	1	1	0	0	4	0	2	0	0	0	0	0	5	2	4	2	135
1	Paul	Augmented	2	2	0:29:38	1	1	1	0	3	4	0	5	0	2	10	13	9	0	2	0	1	1	10	7	23	13	215
1	Paul	Augmented	3	2	0:29:29	0	0	0	0	2	5	0	4	0	0	3	5	2	0	1	0	0	0	7	4	8	3	57
					Averages	**0**	**0**	**1**	**0**	**2**	**3**	**0**	**3**	**0**	**1**	**6**	**6**	**4**	**0**	**1**	**0**	**0**	**0**	**7**	**4**	**12**	**6**	**136**
1	George	Standard	1	3	0:07:21	0	0	2	2	1	3	1	4	0	1	13	6	6	0	0	1	0	1	8	6	19	8	41
1	George	Standard	2	2	0:06:31	0	1	1	0	1	1	1	5	0	0	7	10	7	0	0	0	1	0	4	6	17	8	25
1	George	Standard	3	2	0:06:07	0	0	1	0	0	0	0	1	0	0	6	5	3	0	0	0	0	0	1	1	11	3	35
					Averages	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**	**9**	**7**	**5**	**0**	**0**	**0**	**0**	**0**	**4**	**4**	**16**	**6**	**34**
1	George	Augmented	1	2	0:10:37	0	0	1	0	0	0	0	2	0	0	6	5	1	0	1	1	1	2	1	2	11	6	69
1	George	Augmented	2																									
1	George	Augmented	3	2	0:19:17	0	0	0	0	4	0	1	3	0	0	5	3	3	0	0	0	1	1	4	4	8	5	59
					Averages	**0**	**0**	**1**	**0**	**2**	**0**	**1**	**3**	**0**	**0**	**6**	**4**	**2**	**0**	**1**	**1**	**1**	**2**	**3**	**3**	**10**	**6**	**64**

Phase	Teacher	Lesson	Group	Group Size	Time	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	I	R	B	P	N
1	Paul	Standard	1	2	0:06:40	0	0	0	0	1	0	0	1	0	0	1	4	1	0	0	0	0	0	1	1	5	1	37
1	Paul	Standard	2	2	0:06:40	0	0	0	0	0	0	0	5	0	0	7	12	1	0	0	0	0	0	0	5	19	1	32
1	Paul	Standard	3	2	0:06:40	0	0	1	1	1	0	3	6	2	1	14	7	3	0	0	0	0	0	3	12	21	3	17
Averages						**0**	**0**	**0**	**0**	**1**	**0**	**1**	**4**	**1**	**0**	**7**	**8**	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**6**	**15**	**2**	**29**
1	Paul	Augmented	1	2	0:20:51	0	0	2	1	2	0	1	1	0	0	4	0	2	0	0	0	0	0	5	2	4	2	135
1	Paul	Augmented	2	2	0:29:38	1	1	1	0	3	4	0	5	0	2	10	13	9	0	2	0	1	1	10	7	23	13	215
1	Paul	Augmented	3	2	0:29:29	0	0	0	0	2	5	0	4	0	0	3	5	2	0	1	0	0	0	7	4	8	3	57
Averages						**0**	**0**	**1**	**0**	**2**	**3**	**0**	**3**	**0**	**1**	**6**	**6**	**4**	**0**	**1**	**0**	**0**	**0**	**7**	**4**	**12**	**6**	**136**
1	George	Standard	1	3	0:07:21	0	0	2	2	1	3	1	4	0	1	13	6	6	0	0	1	0	1	8	6	19	8	41
1	George	Standard	2	2	0:06:31	0	1	1	0	1	1	1	5	0	0	7	10	7	0	0	0	1	0	4	6	17	8	25
1	George	Standard	3	2	0:06:07	0	0	1	0	0	0	0	1	0	0	6	5	3	0	0	0	0	0	1	1	11	3	35
Averages						**0**	**0**	**1**	**1**	**1**	**1**	**1**	**3**	**0**	**0**	**9**	**7**	**5**	**0**	**0**	**0**	**0**	**0**	**4**	**4**	**16**	**6**	**34**
1	George	Augmented	1	2	0:10:37	0	0	1	0	0	0	0	2	0	0	6	5	1	0	1	1	1	2	1	2	11	6	69
1	George	Augmented	2																									
1	George	Augmented	3	2	0:19:17	0	0	0	0	4	0	1	3	0	0	5	3	3	0	0	0	1	1	4	4	8	5	59
Averages						**0**	**0**	**1**	**0**	**2**	**0**	**1**	**3**	**0**	**0**	**6**	**4**	**2**	**0**	**1**	**1**	**1**	**2**	**3**	**3**	**10**	**6**	**64**

Phase	Teacher	Lesson	Group	Group Size	Time	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	I	R	B	P	N
2	Laura	Augmented	1	2	0:14:21	0	0	2	0	0	0	0	1	0	3	2	1	1	0	0	0	1	0	2	4	3	2	37
2	Laura	Augmented	2	2	0:14:09	0	0	1	0	0	1	0	0	0	3	4	2	4	0	0	0	0	2	2	3	6	6	46
2	Laura	Augmented	3	2	0:10:38	0	0	0	0	0	0	0	1	0	0	5	7	2	0	0	0	0	0	0	1	12	2	31
					Averages	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**4**	**3**	**2**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**7**	**3**	**38**
2	Tristan	Standard	1	2	0:06:35	0	0	0	0	2	3	0	6	0	5	4	6	0	0	1	0	3	3	5	11	10	7	50
2	Tristan	Standard	2	2	0:05:15	0	0	0	0	0	1	0	3	0	5	6	3	2	0	1	2	1	1	1	8	9	7	32
2	Tristan	Standard	3	2	0:05:47	0	0	1	0	0	1	0	1	0	11	1	2	0	0	2	2	2	1	2	12	3	7	47
					Averages	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**3**	**0**	**7**	**4**	**4**	**1**	**0**	**1**	**1**	**2**	**2**	**3**	**10**	**7**	**7**	**43**
2	Tristan	Augmented	1	2	0:09:42	0	1	0	1	2	0	0	5	0	1	6	12	1	0	3	1	2	0	4	6	18	7	63
2	Tristan	Augmented	2	2	0:08:23	0	0	0	0	0	2	2	3	0	4	4	2	2	0	3	1	2	5	2	9	6	13	63
2	Tristan	Augmented	3	2																								
					Averages	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**4**	**0**	**3**	**5**	**7**	**2**	**0**	**3**	**1**	**2**	**3**	**3**	**8**	**12**	**10**	**63**
3	Jessica	Standard	1	3	0:08:57	0	1	0	2	0	0	0	13	0	0	7	7	1	1	2	2	3	2	3	13	14	11	64
3	Jessica	Standard	2	3	0:09:02	0	0	1	1	0	3	0	6	0	0	6	10	1	0	2	2	0	8	5	6	16	13	79
3	Jessica	Standard	3	3	0:08:23	0	0	0	3	1	2	0	8	0	0	1	5	0	0	1	0	0	5	6	8	6	6	93
					Averages	**0**	**0**	**0**	**2**	**0**	**2**	**0**	**9**	**0**	**0**	**5**	**7**	**1**	**0**	**2**	**1**	**1**	**5**	**5**	**9**	**12**	**10**	**79**
3	Jessica	Augmented	1	3	0:10:47	0	0	1	2	1	1	0	11	0	0	2	4	2	0	1	2	1	1	5	11	6	7	74
3	Jessica	Augmented	2	3	0:11:01	0	0	0	1	1	2	0	10	0	1	7	10	4	0	0	0	2	6	4	11	17	12	111
3	Jessica	Augmented	3	3	0:10:59	0	0	0	3	0	0	0	3	0	0	1	4	0	0	0	3	0	5	3	3	5	8	135
					Averages	**0**	**0**	**0**	**2**	**1**	**1**	**0**	**8**	**0**	**0**	**3**	**6**	**2**	**0**	**0**	**2**	**1**	**4**	**4**	**8**	**9**	**9**	**107**

Phase	Teacher	Lesson	Group	Group Size	Time	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	I	R	B	P	N
3	Lucy	Standard	1	3	0:19:56	0	0	0	0	0	1	1	8	0	5	15	8	2	0	4	1	1	1	1	14	23	9	146
3	Lucy	Standard	2	3	0:23:33	0	0	0	5	0	2	0	6	0	3	8	6	1	0	1	2	2	1	7	9	14	7	211
3	Lucy	Standard	3	3	0:19:35	0	0	0	2	0	0	0	7	0	3	6	10	1	0	4	1	1	6	2	10	16	13	119
					Averages	**0**	**0**	**0**	**2**	**0**	**1**	**0**	**7**	**0**	**4**	**10**	**8**	**1**	**0**	**3**	**1**	**1**	**3**	**3**	**11**	**18**	**10**	**159**
3	Lucy	Augmented	1	3	0:19:06	0	0	1	7	0	2	2	13	1	9	23	18	4	0	9	0	7	10	10	25	41	30	207
3	Lucy	Augmented	2	3	0:11:15	0	0	0	0	1	0	2	9	1	2	9	5	3	0	3	1	6	4	1	14	14	17	70
3	Lucy	Augmented	3	3	0:19:35	0	0	1	1	0	0	1	4	0	2	12	7	1	0	6	0	1	2	2	7	19	10	101
					Averages	**0**	**0**	**1**	**3**	**0**	**1**	**2**	**9**	**1**	**4**	**15**	**10**	**3**	**0**	**6**	**0**	**5**	**5**	**4**	**15**	**25**	**19**	**126**
3	Nicola	Standard	1	3	0:10:57	0	0	0	0	0	0	0	5	1	5	6	3	0	0	1	0	0	2	0	11	9	3	58
3	Nicola	Standard	2	3	0:08:35	0	1	0	0	0	0	0	1	0	1	1	0	0	0	1	0	0	1	1	2	1	2	29
3	Nicola	Standard	3	3	0:10:31	0	0	0	4	1	0	0	2	0	5	5	8	0	0	6	1	0	5	5	7	13	12	85
					Averages	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**3**	**0**	**4**	**4**	**4**	**0**	**0**	**3**	**0**	**0**	**3**	**2**	**7**	**8**	**6**	**57**
3	Nicola	Augmented	1	3	0:10:01	0	0	0	2	0	1	1	9	0	2	2	9	0	0	3	1	1	0	3	12	11	5	78
3	Nicola	Augmented	2	3	0:09:57	0	0	0	0	0	0	3	6	0	7	7	12	2	0	4	0	1	4	0	16	19	11	48
3	Nicola	Augmented	3	3	0:10:05	0	0	0	0	0	1	0	7	1	9	11	12	0	0	5	0	0	5	1	17	23	10	79
					Averages	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**7**	**0**	**6**	**7**	**11**	**1**	**0**	**4**	**0**	**1**	**3**	**1**	**15**	**18**	**9**	**68**

Adjusted Frequencies

Phase	Teacher	Lesson	Group	Group Size	Time	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	I	R	B	P	N
1	Paul	Standard	1	2	0:12:00	0	0	0	0	2	0	0	2	0	0	2	7	2	0	0	0	0	0	2	2	9	2	66
1	Paul	Standard	2	2	0:12:00	0	0	0	0	0	0	0	9	0	0	12	21	2	0	0	0	0	0	0	9	34	2	57
1	Paul	Standard	3	2	0:12:00	0	0	2	2	2	0	5	11	4	2	25	12	5	0	0	0	0	0	5	21	37	5	30
					Averages	**0**	**0**	**1**	**1**	**1**	**0**	**2**	**7**	**1**	**1**	**13**	**14**	**3**	**0**	**0**	**0**	**0**	**0**	**2**	**11**	**27**	**3**	**51**
1	Paul	Augmented	1	2	0:12:00	0	0	1	1	1	0	1	1	0	0	2	0	1	0	0	0	0	0	3	1	2	1	77
1	Paul	Augmented	2	2	0:12:00	0	0	0	0	1	2	0	2	0	1	4	5	4	0	1	0	0	0	4	3	9	5	86
1	Paul	Augmented	3	2	0:12:00	0	0	0	0	1	2	0	2	0	0	1	2	1	0	0	0	0	0	3	2	3	1	23
					Averages	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**2**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**3**	**2**	**5**	**3**	**62**
1	George	Standard	1	3	0:12:00	0	0	3	3	2	5	2	6	0	2	21	10	10	0	0	2	0	2	13	10	31	13	66
1	George	Standard	2	2	0:12:00	0	2	2	0	2	2	2	9	0	0	13	18	13	0	0	0	2	0	7	11	31	15	46
1	George	Standard	3	2	0:12:00	0	0	2	0	0	0	0	2	0	0	12	10	6	0	0	0	0	0	2	2	21	6	68
					Averages	**0**	**1**	**2**	**1**	**1**	**2**	**1**	**6**	**0**	**1**	**15**	**13**	**9**	**0**	**0**	**1**	**1**	**1**	**7**	**8**	**28**	**11**	**60**
1	George	Augmented	1	2	0:12:00	0	0	1	0	0	0	0	2	0	0	7	6	1	0	1	1	1	2	1	2	12	7	77
1	George	Augmented	2																									
1	George	Augmented	3	2	0:12:00	0	0	0	0	2	0	1	2	0	0	3	2	2	0	0	0	1	1	2	2	5	3	36
					Averages	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**2**	**0**	**0**	**5**	**4**	**1**	**0**	**1**	**1**	**1**	**1**	**2**	**2**	**9**	**5**	**57**

Phase	Teacher	Lesson	Group	Group Size	Time	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	I	R	B	P	N
1	Tristan	Standard	1	3	0:12:00	0	0	1	0	2	1	0	1	0	1	2	3	2	0	0	0	0	1	4	2	5	3	109
1	Tristan	Standard	2	4	0:12:00	1	0	1	0	3	3	0	1	0	0	4	8	1	0	3	0	0	0	8	1	12	4	91
1	Tristan	Standard	3	4	0:12:00	0	0	1	1	1	2	0	1	0	1	2	7	3	0	0	0	0	0	5	2	9	3	130
Averages						**0**	**0**	**1**	**0**	**2**	**2**	**0**	**1**	**0**	**1**	**2**	**6**	**2**	**0**	**1**	**0**	**0**	**0**	**5**	**2**	**8**	**3**	**110**
1	Tristan	Augmented	1	3	0:12:00	0	0	1	0	2	5	0	0	0	3	4	4	1	0	0	0	0	0	8	3	8	1	80
1	Tristan	Augmented	2	4	0:12:00	0	0	0	0	1	3	0	1	0	2	5	1	0	0	1	0	0	0	4	3	7	1	89
1	Tristan	Augmented	3	4	0:12:00	1	0	1	0	3	1	0	0	0	2	3	4	0	0	0	0	0	1	5	2	7	1	161
Averages						**0**	**0**	**0**	**0**	**2**	**3**	**0**	**0**	**0**	**2**	**4**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**3**	**7**	**1**	**110**
2	Rebecca	Standard	1	3	0:12:00	0	0	2	2	4	0	2	15	2	2	17	9	11	0	2	0	2	0	9	22	26	15	103
2	Rebecca	Standard	2	2	0:12:00	0	0	2	4	0	2	0	4	0	15	8	15	0	0	0	0	0	4	8	19	23	4	74
2	Rebecca	Standard	3	2	0:12:00	0	0	0	0	2	4	0	0	0	15	4	4	0	0	0	0	0	6	6	15	9	6	78
Averages						**0**	**0**	**1**	**2**	**2**	**2**	**1**	**6**	**1**	**11**	**10**	**9**	**4**	**0**	**1**	**0**	**1**	**4**	**8**	**19**	**19**	**9**	**85**
2	Rebecca	Augmented	1	2	0:12:00	0	0	3	0	0	3	0	3	0	5	7	10	0	0	0	0	0	2	7	8	17	2	58
2	Rebecca	Augmented	2	2	0:12:00	0	0	2	0	0	2	0	2	0	9	2	6	0	0	0	3	0	5	3	11	8	8	74
2	Rebecca	Augmented	3	3	0:12:00	0	0	3	2	0	3	0	2	0	10	2	3	0	0	0	0	0	2	9	12	5	2	119
Averages						**0**	**0**	**3**	**1**	**0**	**3**	**0**	**2**	**0**	**8**	**3**	**7**	**0**	**0**	**0**	**1**	**0**	**3**	**6**	**10**	**10**	**4**	**84**
2	Laura	Standard	1	2	0:12:00	0	0	0	0	0	1	0	1	0	2	1	3	3	0	0	0	0	0	1	3	4	3	75
2	Laura	Standard	2	2	0:12:00	0	0	0	0	0	1	0	0	0	1	2	3	3	0	0	0	0	0	1	1	6	3	55
2	Laura	Standard	3	2	0:12:00	0	0	0	0	1	2	0	0	0	2	3	2	4	0	1	0	0	0	3	2	5	5	68
Averages						**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**2**	**2**	**3**	**4**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**5**	**4**	**66**

Phase	Teacher	Lesson	Group	Group Size	Time	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	I	R	B	P	N
2	Laura	Augmented	1	2	0:12:00	0	0	2	0	0	0	0	1	0	2	2	1	1	0	0	0	1	0	2	3	2	2	31
2	Laura	Augmented	2	2	0:12:00	0	0	1	0	0	1	0	0	0	3	3	2	3	0	0	0	0	2	2	3	5	5	38
2	Laura	Augmented	3	2	0:12:00	0	0	0	0	0	0	0	1	0	0	6	8	2	0	0	0	0	0	0	1	13	2	34
Averages						**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**4**	**3**	**2**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**7**	**3**	**34**
2	Tristan	Standard	1	2	0:12:00	0	0	0	0	4	5	0	11	0	9	7	11	0	0	2	0	5	5	9	20	18	13	90
2	Tristan	Standard	2	2	0:12:00	0	0	0	0	0	2	0	7	0	11	14	7	5	0	2	5	2	2	2	18	20	16	72
2	Tristan	Standard	3	2	0:12:00	0	0	2	0	0	2	0	2	0	23	2	4	0	0	4	4	4	2	4	25	6	14	96
Averages						**0**	**0**	**1**	**0**	**1**	**3**	**0**	**7**	**0**	**14**	**8**	**7**	**2**	**0**	**3**	**3**	**4**	**3**	**5**	**21**	**15**	**14**	**86**
2	Tristan	Augmented	1	2	0:12:00	0	1	0	1	2	0	0	6	0	1	7	15	1	0	4	1	2	0	5	7	22	9	77
2	Tristan	Augmented	2	2	0:12:00	0	0	0	0	0	3	3	4	0	6	6	3	3	0	4	1	3	7	3	13	8	18	89
2	Tristan	Augmented	3	2																								
Averages						**0**	**1**	**0**	**1**	**1**	**1**	**1**	**5**	**0**	**3**	**6**	**9**	**2**	**0**	**4**	**1**	**3**	**4**	**4**	**10**	**15**	**13**	**83**
3	Jessica	Standard	1	3	0:12:00	0	1	0	3	0	0	0	17	0	0	9	9	1	1	3	3	4	3	4	17	19	15	85
3	Jessica	Standard	2	3	0:12:00	0	0	1	1	0	4	0	8	0	0	8	13	1	0	3	3	0	10	7	8	21	17	103
3	Jessica	Standard	3	3	0:12:00	0	0	0	4	1	3	0	11	0	0	1	7	0	0	1	0	0	7	8	11	8	8	131
Averages						**0**	**0**	**0**	**3**	**0**	**2**	**0**	**12**	**0**	**0**	**6**	**10**	**1**	**0**	**2**	**2**	**1**	**7**	**6**	**12**	**16**	**13**	**106**
3	Jessica	Augmented	1	3	0:12:00	0	0	1	2	1	1	0	12	0	0	2	4	2	0	1	2	1	1	5	12	7	8	81
3	Jessica	Augmented	2	3	0:12:00	0	0	0	1	1	2	0	11	0	1	8	11	4	0	0	0	2	6	4	12	18	13	119
3	Jessica	Augmented	3	3	0:12:00	0	0	0	3	0	0	0	3	0	0	1	4	0	0	0	3	0	5	3	3	5	9	145
Averages						**0**	**0**	**0**	**2**	**1**	**1**	**0**	**9**	**0**	**0**	**4**	**6**	**2**	**0**	**0**	**2**	**1**	**4**	**4**	**9**	**10**	**10**	**115**

Phase	Teacher	Lesson	Group	Group Size	Time	I1	I2	I3	I4	I5	I6	R1	R2	R3	R4	B1	B2	P1	P2	P3	P4	P5	P6	I	R	B	P	N
3	Lucy	Standard	1	3	0:12:00	0	0	0	0	0	1	1	5	0	3	9	5	1	0	2	1	1	1	1	8	14	5	87
3	Lucy	Standard	2	3	0:12:00	0	0	0	3	0	1	0	3	0	2	4	3	1	0	1	1	1	1	4	5	7	4	106
3	Lucy	Standard	3	3	0:12:00	0	0	0	1	0	0	0	4	0	2	4	6	1	0	2	1	1	4	1	6	10	8	72
Averages						**0**	**0**	**0**	**1**	**0**	**1**	**0**	**4**	**0**	**2**	**6**	**5**	**1**	**0**	**2**	**1**	**1**	**2**	**2**	**6**	**10**	**6**	**88**
3	Lucy	Augmented	1	3	0:12:00	0	0	1	4	0	1	1	8	1	6	14	11	2	0	6	0	4	6	6	15	25	19	128
3	Lucy	Augmented	2	3	0:12:00	0	0	0	0	1	0	2	9	1	2	9	5	3	0	3	1	6	4	1	15	15	18	74
3	Lucy	Augmented	3	3	0:12:00	0	0	1	1	0	0	1	2	0	1	7	4	1	0	4	0	1	1	1	4	11	6	61
Averages						**0**	**0**	**0**	**2**	**0**	**0**	**1**	**7**	**1**	**3**	**10**	**7**	**2**	**0**	**4**	**0**	**4**	**4**	**3**	**11**	**17**	**14**	**88**
3	Nicola	Standard	1	3	0:12:00	0	0	0	0	0	0	0	5	1	5	6	3	0	0	1	0	0	2	0	12	10	3	63
3	Nicola	Standard	2	3	0:12:00	0	1	0	0	0	0	0	1	0	1	1	0	0	0	1	0	0	1	1	3	1	3	40
3	Nicola	Standard	3	3	0:12:00	0	0	0	4	1	0	0	2	0	6	6	9	0	0	7	1	0	6	6	8	15	13	96
Averages						**0**	**0**	**0**	**1**	**0**	**0**	**0**	**3**	**0**	**4**	**4**	**4**	**0**	**0**	**3**	**0**	**0**	**3**	**2**	**8**	**9**	**6**	**66**
3	Nicola	Augmented	1	3	0:12:00	0	0	0	2	0	1	1	11	0	2	2	11	0	0	4	1	1	0	4	14	13	6	92
3	Nicola	Augmented	2	3	0:12:00	0	0	0	0	0	0	4	7	0	8	8	14	2	0	5	0	1	5	0	19	23	13	57
3	Nicola	Augmented	3	3	0:12:00	0	0	0	0	0	1	0	8	1	11	13	14	0	0	6	0	0	6	1	20	27	12	93
Averages						**0**	**0**	**0**	**1**	**0**	**1**	**2**	**9**	**0**	**7**	**8**	**13**	**1**	**0**	**5**	**0**	**1**	**4**	**2**	**18**	**21**	**10**	**81**

Appendix 15. Summary of results from teacher survey

Survey Open from 30.01.17 - 09.02.17
25 responses (from 70 potential)
Year 1 - Year 8 represented
All subjects represented

Teaching Approach

- All respondents agreed that promoting dialogue between children is important in their subject (18 strongly agreed).
- 80% agreed that educational technology (Google Classroom, iPads, IWBs, visualisers etc.) is helpful when creating collaborative activities for children.
- 79% agree that 'educational technologies improve the quality of my teaching'.
- 84% agree that 'educational technologies improve the quality of my students' learning'.
- 84% believe educational technologies correspond with my teaching philosophy.
- 60% agree educational technologies enhance my communication with students.
- 55% agree educational technologies enhance communication between students.
- 48% feel educational technologies do not fit subjects they most often teach.
- 68% agree technology has 'altered the educational content of my lessons'.
- 72% agree educational technologies have transformed the activities in lessons.
- 87.5% agree that 'I have the technical knowledge to effectively integrate ICT into my teaching'.
- 96% agree that they 'have sufficient knowledge of pedagogy (teaching and learning) to effectively integrate ICT into my teaching'.

Teacher activities

- 52% of Teachers use Google Classroom for less than ⅓ of lessons (12% always).
- 72% never make use of classroom stream or message boards.
- 68% never use real-time forums.
- 68% never use simulations.
- 80% never use web pages, wikis or blogs to co-create content.
- 96% of teachers do not use social networks to share information.
- 68% use Google Classroom for real-time collaboration in lessons.
- All Teachers have used youtube and video apps (16% more than ⅔ of lessons).
- 8% never use search engines.

Student Activities

- 48% never expect children to upload learning materials for others.
- 68% never expect students to use Google Classroom stream.
- 72% never expect students to use real time forums.
- 84% never expect students to use wikis etc. to co-edit.
- 100% do not expect students to use social media.
- 12% never expect children to use search engines, whilst 12% always do.
- 24% of teachers ever use YouTube or video apps.

Appendix 16. Example of *standard* lesson plan

Geography Lesson Plan			Date: 2nd May 2017	
Class name: **Year 7C**	Name of teacher: **Paul**	Ability: Mixed Start/finish time: lessons 1 and 2	Subject / area of learning: **Population and settlement, case study of an urban regeneration project**	Number on roll 20 Boys: 15 Girls: 5

Teaching and Learning Context: **Following the ISEB syllabus towards CE. This module is on Population and Settlement which requires a case study of an urban redevelopment project, we are doing the Olympic Park and aiming to develop the concept of sustainable development**

Learning Objectives:

- To understand why the Olympic Park in London was built where it was looking at ideas around redevelopment, brownfield sites, regeneration, and the effects on people.
- To further explore the concept of sustainable development and revisit the reasons for the need for sustainability. See real examples in action.
- To think about their carbon footprint thus building further on our previous study of how we plan for a rapidly growing global population.

The class should complete the following work in this lesson:

All children will…make connections between the need for an Olympic park and the final decision of where to put it. Have a basic understanding of what efforts were made to keep the Olympics sustainable and the reasons for a sustainable outlook.

Most children will… make some links between the examples we see of sustainable development and the many ramifications of these examples. They will be able to orally articulate their understanding.

Some children will… answer or ask questions that lead the discussion towards a deeper understanding of the human aspects of this topic, those who had to leave home, the benefits of living spaces to be proud of.

Introduction

Title-'Managing an Urban Redevelopment Project- the London Olympic Park'.

Main activity

- Recap video seen last time and check the photos they did for prep of the QEP site before and after development. Discuss photos and write a few sentences of what they show and what can be *inferred* from the photos.
- **As a class, watch Video 3 (https://www.youtube.com/watch?v=wmOmS-vHdzo - Sustainability David Stubbs) paused occasionally allowing opportunities to discuss with partners the aspects of the film that illustrate sustainability in action.**
- How else might the organisers make the Olympic Park sustainable- transport, lighting, jobs?
- In pairs discuss why was this a good place to build- London connections, brownfield site (why is that good?), needed regeneration, any disadvantages of building at Stratford? add to notes
- The legacy (what is this)
- Why was London different? It thought about sustainability.
- Show map of Plans for QE Park, why are these things sustainable- discuss in pairs.

Plenary

-lots been said so distil to key factors, ask questions and make notes.

Prep- look at how the Athens and Rio Olympic sites have fared since the Games and make notes on how things are different to London.	**Notes on differentiation/different groups & individuals:**

Appendix 17. Example of *augmented* lesson plan

Geography Lesson Plan		Date: 4th May 2017		
Class name: **Year 7A**	Name of teacher: **Paul**	Ability: Mixed Start/finish time: lessons 1 and 2	Subject / area of learning: **Population and settlement, case study of an urban regeneration project**	Number on roll 20 Boys: 15 Girls: 5

Teaching and Learning Context: Following the ISEB syllabus towards CE. This module is on Population and Settlement which requires a case study of an urban redevelopment project, we are doing the Olympic Park and aiming to develop the concept of sustainable development

Learning Objectives:

- To understand why the Olympic Park in London was built where it was looking at ideas around redevelopment, brownfield sites, regeneration, and the effects on people.
- To further explore the concept of sustainable development and revisit the reasons for the need for sustainability. See real examples in action.
- To think about their carbon footprint thus building further on our previous study of how we plan for a rapidly growing global population.

The class should complete the following work in this lesson:

All children will…make connections between the need for an Olympic park and the final decision of where to put it. Have a basic understanding of what efforts were made to keep the Olympics sustainable and the reasons for a sustainable outlook.

Most children will… make some links between the examples we see of sustainable development and the many ramifications of these examples. They will be able to orally articulate their understanding.

Some children will… answer or ask questions that lead the discussion towards a deeper understanding of the human aspects of this topic, those who had to leave home, the benefits of living spaces to be proud of.

Introduction

Title-'Managing an Urban Redevelopment Project- the London Olympic Park'.

Main activity

- Recap video seen last time and check the photos they did for prep of the QEP site before and after development. Discuss photos and write a few sentences of what they show and what can be *inferred* from the photos.
- **Using link provided on Chromebooks, students independently watch Video 3. Afterwards they are to identify and discuss with partners the aspects of the film that illustrate sustainability in action.**
- **In their discussion pairs, children should add a screenshot of part of the video and add it to the shared Google 'slides' with annotation justifying their choice.**
- **Children are then encouraged to add comments to expand or challenge the choices of others.**
- How else might the organisers make the Olympic Park sustainable- transport, lighting, jobs?
- In pairs discuss why was this a good place to build- London connections, brownfield site (why is that good?), needed regeneration, any disadvantages of building at Stratford? add to notes
- The legacy (what is this)
- Why was London different? It thought about sustainability.
- Show map of Plans for QE Park, why are these things sustainable- discuss in pairs.

Plenary

-lots been said so distil to key factors, ask questions and make notes.

Prep- look at how the Athens and Rio Olympic sites have fared since the Games and make notes on how things are different to London.	**Notes on differentiation/different groups & individuals:**