ANGLIA RUSKIN UNIVERSITY

FACULTY OF ARTS, HUMANITIES, EDUCATION
AND SOCIAL SCIENCES

LOW-STAKES, HIGH-INTEREST LEARNING: A HERMENEUTIC PHENOMENOLOGICAL STUDY OF CHILDREN LEARNING MATHEMATICS OUTDOORS

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Abstract

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ABSTRACT

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The National Curriculum for England describes effective mathematics education as instilling a sense of creativity, enjoyment and curiosity about the subject. However, research demonstrates that many children experience mathematics as difficult, boring and scary. Simultaneously, research is growing around the impact of outdoor learning as a pedagogy for delivering the national curriculum. Yet, little research has been conducted to understand how learners experience outdoor learning. This study aimed to gain insights into how outdoor learning is experienced by children and the implications this has for pedagogy and practice, both in the context of mathematics and the wider curriculum.

This study adopted a hermeneutic phenomenological approach to understanding children's lived experiences. First, five phenomenological place-based interviews were conducted to enable participants to provide rich experiential accounts. The interview transcripts were then subject to creative, in-depth analysis, including phenomenological thematization, story construction and the use of artificial intelligence to demonstrate insights into the participants' lived experiences.

This research reveals that participants experience outdoor mathematics learning through a sense of safety, belonging, peace and freedom. Findings indicate that the outdoors is experienced as a safe space for learning where everyone is included, and mistakes are learning opportunities. In addition, the research data reveals that participants experience peace, which removes their worries and stresses, and freedom to be self-directed and creative in their learning. Throughout the study, participants highlight the importance of space, sounds, natural objects and their connections with peers when learning mathematics outdoors.

The research asserts that children engage in low-stakes, high-interest mathematics learning when in the outdoor environment. Therefore, outdoor education can provide an effective pedagogy to counter negative attitudes and anxiety in mathematics. Outcomes from this have implications for both practice and policy and confront the current pedagogy of mathematics teaching.

Keywords: Mathematics education, outdoor learning, hermeneutic phenomenology, practitioner research, low-stakes, high-interest learning.

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Declaration

I confirm that this thesis, presented for the degree of Doctor of Education, has been composed entirely by myself, has been solely the result of my own work and has not been submitted for any other degree or professional qualification.

Lewis Barrett-Rodger

Chapter One: Beginning with Wonder

"Phenomenological research begins with wonder."
(van Manen, 2016a, p.27)

As explained by van Manen, the origin of any phenomenological pursuit is wonder. In this sense, wonder does not refer to amazement or awe but to intrigue and questioning. I arrive at this research with curiosity and questions that arise from my professional practice, and this state of wonder drives this study.

I have been a primary school teacher for over a decade and have led mathematics for much of this time. I am passionate about the teaching and learning of mathematics and appreciate the beauty and creativity that the subject has to offer. However, throughout my career, I have come to understand that many children do not have positive experiences with mathematics learning. Equally, as a mathematics subject specialist for an initial teacher training provider, I recognise that many adults (even teachers) have had and continue to have negative experiences with the subject. As a mathematician, teacher and teacher trainer, I have been concerned for many years about the impact that adverse experiences of mathematics learning can have on children and adults throughout their education and later life.

At the same time as I have been developing my professional practice, my school has been on a journey to becoming a centre of excellence in outdoor learning. My school promotes outdoor learning as a positive pedagogy for teaching across the primary curriculum. Children at my school participate in outdoor lessons as part of their everyday routine. My experience teaching outdoors has taught me that teaching mathematics outdoors is very different to teaching within the comfort of the four walls of the classroom. The difference in space, resources and weather are among a series of factors that require a different approach to planning and lesson delivery. Teaching outdoors, for me, is a very different experience from teaching within a more formal

classroom setting. I have also noticed that children engage with their learning differently outdoors. My years of teaching have led me to the impression that something different happens for children when they learn outdoors – an experience of learning that educational literature has yet to explore and begin to understand.

In his book Phenomenology of Practice (2016a), van Manen asks, “We talk about our children learning, and yet do we really know what happens experientially in that living moment of learning something?” (p.58). Before undertaking this research, I delivered presentations at national conferences on outdoor learning as a pedagogy for teaching mathematics. I discussed what the current literature says about improvements in academic attainment, wellbeing and behaviour and presented my personal experiences of teaching mathematics outdoors and what I noticed about the children I taught. However, I could only guess what was happening for children experientially. Therefore, this research seeks to understand better how children experience outdoor mathematics learning. The combination of my interests in mathematics education and the pedagogy of outdoor learning leads me to ask the questions that drive this research forward.

The Educational Doctorate (EdD) is a professional qualification that aims to impact the practice and pedagogy of the researcher’s professional context (Creaton, 2020). Therefore, this thesis seeks to uncover insights into the experience of children learning mathematics outdoors, which have implications for my practice and the practice and pedagogical approaches of the wider community of mathematics teachers and policymakers. To realise the ambition to provide recommendations to a broad spectrum of readers, this study must be firmly situated within the contemporary literature and national context of mathematics education.

National Context of Primary Mathematics Education

As will be evident from the quotation below from United Kingdom (UK) Prime Minister Rishi Sunak, mathematics is commonly called 'maths' in the UK. However, the abbreviation 'math' is used in countries such as Canada and the United States of America (Osmond, 2023). Although this research is conducted within the UK, for the findings to reach an international audience, the term 'mathematics' is referred to throughout this thesis.

> *"You can't make movies without maths. You can't make visual effects without vectors and matrices. You can't design a set without some geometry. You can't run a production company without being financially literate. And that's not just true of our creative industries. It's true of so many of our industries."*
>
> *(Sunak, 2023, n.p.).*

The Prime Minister of the UK, Rishi Sunak, decided to place mathematics at the forefront of his vision for education in his April 2023 speech, demonstrating the importance of high-quality mathematics education for the individual and the wider economy. Equally, research indicates that many societies worldwide consider mathematics a vital subject to teach in schools (Esmonde, 2009). However, there are concerns about poor financial literacy skills among the adult population (Bhutoria, Jerrim and Vignoles, 2018). One reason for focusing on mathematics as central to any country's curriculum, as Dowker, Sarkar and Looi (2016) suggest, is that companies internationally depend on employees to have proficient numeracy skills. The UK-based charity National Numeracy also claims that poor numeracy can impact employability, financial stability and wellbeing, and behavioural difficulties, such as school exclusions, truancy and crime (2023).

A particular area of concern within contemporary mathematics education literature is Mathematics Anxiety (MA). Ashcraft and Moore (2009) describe MA as "a person's negative affective reaction to situations involving numbers, math, and mathematics calculations" (p.197). MA has been shown to reduce academic achievement and have long-lasting

implications for individuals (Dowker, Sarkar and Looi, 2016). Recently there has been an increase in the number of scales to measure MA with the aim of better understanding the causes of MA and finding solutions to reduce learners' anxiety towards the subject (Lu, et al., 2021). Research by Chinn (2009) claims that up to 6% of mainstream students have MA, which "suggests they are 'often' anxious" (p. 66). It is no surprise, therefore, that mathematics education has been a governmental priority for several years due to the prevalence of MA within the UK and as the Programme for International Student Assessment (PISA) continues to rank the UK below other comparable countries worldwide.

PISA is run by the Organisation for Economic Co-operation and Development (OECD) project, which aims to rank countries according to how well children can apply knowledge and skills to real-life situations in different subjects. Tests are taken every three years, and the UK has continued to perform poorly against other leading economic nations. Following a ranking of 27th in 2015, the head of OECD's education and skills directorate commented that the UK's progress was "flat in a changing world" (Coughlan, 2016, n.p.). Poor performance as a nation has catalysed a governmental focus on mathematics education in England. Nick Gibb (England's Minister of State for Schools) remarked that "a deficiency at mathematics has come to be seen as a defining national feature" (Gibb, 2016, n.p.).

Despite an increase to a world ranking of 18th in 2018, it has been argued that this represented encouraging signs rather than signals of considerable progress (Schleicher, 2019). Furthermore, in 2018, PISA laid out plans to make mathematics the focus of the assessments in their 2021 series (OECD, 2018). This further highlights the importance of standards within mathematics at a global level. However, because of the Coronavirus pandemic, the 2021 series was postponed to 2022, and results are yet to be published. Nevertheless, the desire to push the UK up the rankings has triggered a race for results and successive government interventions to increase children's test scores. Following the introduction of the first National

Curriculum in 1988, several iterations of the Department for Education (DfE) have attempted to boost the proportion of children leaving primary school with essential mathematics competencies, as seen by looking at the historical background of primary mathematics education in England.

Historical Background of Primary Mathematics Education in England

Before 1988, the government had no top-down control over what was taught in primary schools. Schools could employ a curriculum they saw fit to meet the needs of their pupils. The 1988 National Curriculum was pivotal to the link between education and economic prosperity. The concept of accountability demonstrated the need for government control over education and a value-for-money ethos (Wyse and Torrance, 2009). In 1991, Standard Assessment Tasks (SATs) were introduced and, alongside published league tables, focused on individual schools' performance. Some criticised this as changing toward testing and away from developing children as individual mathematicians (Daugherty, 1995).

Following the election of a labour government in 1997, the National Numeracy Strategy (NNS) was introduced, supplementing the national curriculum. The NNS provided teachers with lesson plans and firmly established the strict three-part lesson, which consisted of an oral starter, the main task and a plenary. In addition, it gave detailed support to teachers. The focus of the NNS was on arithmetic and came from concerns that children lacked the basic mathematic abilities required to understand more complex concepts further. Years later, one criticism of the NNS is that it de-professionalised classroom teachers (Benson, 2016). By providing lesson plans and a strict structure, the NNS removed the need for professional judgement and established a one-size-fits-all attitude towards mathematics learning.

In 1998, the government disapplied the requirement for schools to teach the National Curriculum beyond the core subjects through a series of order revocations (e.g., UK

Government, 1998). This meant schools no longer had to teach prescribed content in subjects such as History and Art. Whilst the government instructed schools to provide a broad and balanced curriculum, the only statutory requirements were within the core subjects of mathematics and English. The revocation of non-core subjects meant schools narrowed their curriculum to focus on core skills within numeracy and literacy (BBC, 1998).

In 2000, a new National Curriculum was introduced, which clarified content that needed to be improved in earlier additions. However, the new curriculum failed to address content overload concerns (Oates, 2011). The content-heavy curriculums have been criticised for forcing teachers to speed through materials and promoting a tick-box culture (Alexander, 2010). In 2003, the NNS was merged with the NLS (National Literacy Strategy) to create the PNS (Primary National Strategy), which was then updated in 2006. The PNS was developed to bring greater cohesion to primary education and reinforce the literacy and numeracy hour concept and the typical three-part lesson structure. Whilst the numeracy elements of the PNS focussed on arithmetic, a later review of primary mathematics commissioned by the Department for Children, Schools and Families (DCSF) recommended an increased focus on application and priority to classroom discussions of mathematics (Williams, 2008). The emphasis on mathematical talk within classrooms changed the dynamic of mathematics lessons in many schools, with a greater emphasis on reasoning and problem solving.

Finally, in 2014, the current National Curriculum was introduced following a review by the then-Conservative-led coalition. The government described the new National Curriculum as more demanding and providing children with “a solid grounding in the basics of mathematics” (Gibb, 2015, n.p.). The current mathematics programme of study aims to develop children’s fluency, reasoning and problem solving. The learning expectations were also increased with content previously in older year groups being taught to younger children.

The current purpose of study for mathematics states that:

> *Mathematics is a creative and highly inter-connected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment. A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.* (Department for Education, 2013, p.99).

The purpose of study highlights the importance of creativity, beauty, enjoyment and curiosity in effective mathematics teaching. Almost a decade since the introduction of the new curriculum, it may be worth considering whether current mathematics pedagogy achieves the creativity, beauty, enjoyment and curiosity intended within the purpose of study. It has been reported that a recent survey conducted by Cuemath found that learners in the UK experience more MA than any other of the twenty participating nations (Davis, 2022). High levels of MA suggest that current mathematics pedagogy is not meeting the purpose of study.

The 2014 national curriculum also saw a significant shift in policy to local autonomy by providing an "outline of core knowledge around which teachers can develop exciting and stimulating lessons" (Department for Education, 2013, p.6). The 2014 national curriculum outcomes were no longer overly prescriptive; no lesson planning or structures were provided, and no pedagogical approaches were dictated. The new curriculum shifted from the prescribed practices of the PNS and provided greater autonomy for schools.

Prime Minister Rishi Sunak recently called for reforms in mathematics education to change "how we value maths in this country" (Sunak, 2023, n.p.). This places mathematics at the forefront of current educational reform and solidifies mathematics ability as key to the future success of individuals and the wider society. However, the Department for Education (DfE) allows schools to implement their chosen pedagogies for teaching mathematics in primary schools, with high-stakes testing and accountability in place, aiming to achieve the Prime Minister's vision for education. It is, therefore, a decision for schools to decide how they deliver

the national curriculum content. This has resulted in schools utilising alternative approaches to encourage meaningful learning opportunities for their pupils, drawing on several different learning theories.

Learning Theory

Ideas about how people learn date back over 2500 years to the times of Plato and Aristotle, and academics have offered countless theories in the following centuries (Bates, 2019). Therefore, it is impossible to provide a thorough evaluation of the theories that underpin contemporary educational practices in this thesis. However, in this section, I will illustrate some of the learning theories that will become most relevant to the unfolding narrative of this research.

Instructivism

Instructivism forms the foundations for many traditional education systems worldwide and can be described as the "passive reception of sanctioned information through memorization and recall" (Porcaro, 2011, p.40). Therefore, instructivists believe that new knowledge is passed from a teacher to a student: a model of transmission learning. From an instructionist perspective, the power is with the teacher, who transfers information to the learner (Crosslin, 2016). This means that learning is teacher-centred rather than learner-centred.

Many contemporary learning theories, such as Engelmann and Carnine's (1982) Theory of Instruction, build upon the instructivist approach to provide models for effectively transferring knowledge from teacher to student. The phrase 'If the student hasn't learned, the teacher hasn't taught', often attributed to Engelmann (Bates, 2019), emphasises the instructionist view that learning is the teacher's responsibility and suggests that students are passive vessels to be filled.

Instructivism can be criticised for not engaging learners in creating their own knowledge and understanding (Sawyer, 2022). Sawyer (2022) points out that whilst an instructionist model for learning may enable students to learn and recite facts, it does little to instil creativity, problem solving and the ability to learn independently, all of which are important in modern society. Therefore, looking at alternative learning theories that have influenced current classroom practices is essential.

Constructivism

In his seminal (1954) text, *Construction of Reality in the Child,* Jean Piaget moved the focus on the role of the teacher towards the individual learner. This child-centric model of education considered that learning was not simply knowledge received from a source of information but an internally constructed process of meaning-making. Constructivism, therefore, moves the role of the teacher to that of facilitator where learning opportunities are provided, and the teacher acts as a guide to the pupil. This means that knowledge is constructed through self-discovery (Crosslin, 2016).

Constructivism now forms the basis for most contemporary cognitive theories and is increasingly common in pedagogical classroom practices (Bates, 2019). Bruner's (1966) discovery learning theory is an example of a constructionist approach. Discovery learning is based on the principle that a teacher should assess what their learners already know before allowing the learner to discover new knowledge. In discovery learning, the teacher is still the expert, but unlike the traditional transmission model, the teacher allows the learner to make discoveries through carefully planned learning opportunities. Discovery learning links closely to another constructionist theory, that of experiential learning.

Experiential Learning

According to Kolb's (2015) theory, experiential learning involves first-hand practical experiences and builds on Dewey's philosophy of pragmatism, which states, "The task of teachers should not be to communicate knowledge and skills to learners but to use their learners' experiences as a teaching tool." (Bates, 2019, p.20). From Dewey's perspective, learning results from the learner's actions and engagement, not a passive act of receiving. Therefore, when engaging with outdoor learning, typically, learners participate in practical, hands-on experiences, resulting in learning.

Experiential learning requires the teacher to facilitate an experience (Beard and Wilson, 2013). Therefore, learning results from the student's engagement in that experience rather than knowledge transferred directly from the teacher (Chan, 2023). In this sense, the teacher's role is to allow access to a quality experience that engages the learner and supports the learner to build on their existing experiences.

Experiential learning can also be considered a form of connectionism, an educational theory introduced by Thorndike (1999). Connectionism is similar to constructivism as it recognises that new knowledge is constructed rather than transmitted (Crosslin, 2016). However, the theory of connectionism places the relationships between students as the primary sources of learning (Bates, 2019). Connectionists view learning as the result of an individual connecting with an activity, the learning environment and other students. Learners who work together to solve a problem co-construct learning based on their understanding and previous experiences. One example of a pedagogy that follows an experiential and connectionist approach is the practice of outdoor learning (Yildiz, 2022).

Outdoor Learning

Whilst the UK has a tradition of using natural places for educational purposes dating back to the Victorian period (Cree and McCree, 2012), the modern movement towards a pedagogy of outdoor learning within a more formal curriculum context may be dated to the introduction of Forest School to the UK in 1993 (Maynard, 2007). Forest School is a programme that offers children regular sessions in a natural environment to develop their confidence and self-esteem (Forest School Association, 2023). Forest School emerged from the Danish practice of udeskole, inspired by the Norwegian concept of uteskole. Closely related to the Nordic phenomenon of outdoor activity in nature, known as frilufsliv, and the broader Scandinavian tradition of outdoor pedagogy (Waite, Bølling and Bentsen, 2016; Fasting and Høyem, 2022), 2012 saw the formation of the Forest School Association, and since then, there has been a significant increase in the number of primary schools adopting Forest School provisions (Leather, 2018). However, Forest School is a programme not linked to the national curriculum. Nevertheless, in recent years, there has been an uptake in the number of UK schools using outdoor locations for regular curriculum-based schooling, partially as a result of a government manifesto that claims that outdoor learning should be “an essential part of learning.” (Department for Education and Skills, 2006, p.2).

Defining Outdoor Learning

Because of the differences in practices between educational settings, there is no established definition of outdoor learning (Becker, et al., 2017). Outdoor learning can be used to refer to a range of different approaches, including:

- Outdoor Adventure Education (Roberts, 2021)
- Wilderness Schooling (Quibell, Charlton and Law 2017)
- Learning in Natural Environments (LINE) (King’s College London, 2011)

- Environmental-based or Natural Schooling (Malone and Waite, 2016)

The term outdoor learning can also refer to a mixture of the above. Alternative terms, such as Learning Outside the Classroom (LOtC), Learning Beyond the Classroom (LBtC) or Education Outside the Classroom (EOtC), are often used as umbrella names which span the breadth of outdoor learning from outdoor adventure to curriculum enrichment (Hawxwell, et al., 2019; Jørring, et al., 2020). Each perspective on outdoor learning has introduced a range of outdoor education programmes. In addition, national and regional bodies such as the Forest School Association, Institute for Outdoor Learning, Council for Learning Outside the Classroom, Natural England and Learning through Landscapes have been formed, each taking a distinct perspective.

With the numerous interpretations of outdoor learning evident from the literature, it is essential to define what this thesis means by outdoor learning. From this point in the thesis, the term outdoor learning indicates ***regular curriculum-based lessons in the outdoor environment*** because this is how it is used within the school setting where this research is conducted. Outdoor learning is, therefore, embedded throughout the school curriculum and frequently used within a typical school timetable. Additionally, the word outdoors in this study does not always refer to natural spaces. Drawing on children's experiences in all outdoor environments, this research is conducted in two notable outdoor locations: a school playground and a woodland.

Current Outdoor Learning Research

The rise in outdoor learning as a popular pedagogy in primary education has seen increased academic research. Becker, et al. refer to the research into outdoor learning as "a young field of research." (2017, p.14). Many studies have been conducted to evaluate the impact of outdoor learning, finding benefits for:

- improving behaviour (Waite, 2010),
- emotional wellbeing (Herrington, 2001; Beames, Higgins and Nicol, 2012),
- academic outcomes (Becker, et al., 2017; Khan, McGeown and Bell, 2020), and
- social development (Gill, 2011; Dillon and Dickie, 2012; Fiennes, et al., 2015).

There is also a growing body of evidence suggesting that an outdoor learning pedagogy can develop learners' soft skills. For example, a qualitative analysis of pupil views of outdoor learning (Marchant, et al., 2019) found that the experiential nature of outdoor learning provided pupils with skills such as collaboration, leadership, teamwork, communication and resilience. In addition, outdoor learning as a research area with growing interest is demonstrated through new research collaborations such as the Nature, Outdoor Learning and Play specialist interest group, which was formed by members of the British Educational Research Association (BERA) in 2019 (BERA, 2022).

Whilst an increasing number of studies look at the impact of outdoor learning, there is a lack of understanding of how children experience it. Furthermore, the focus of outdoor learning research is restricted to what effect the pedagogy has on learning, emotions and wellbeing rather than seeking to understand how an individual experiences outdoor learning. Therefore, this study aims to add to outdoor learning research by exploring the lived experiences of children learning mathematics outdoors. However, it is also important to consider my professional role and the context of this research.

Professional Context of this Research

One benefit of a professional doctorate is the combination of practice and research (Smith, 2009). Consequently, one arrives at a research question from within their professional context to provide an answer that moves forward thinking and practices in the workplace. As my

research arises from my professional context, it is important to briefly describe the relevance of my background to ground this study in the broader context.

This research was conducted at Kendall Church of England Primary School in Colchester, Essex. I decided to name the school in this thesis because my connection to the school is information freely available online. In addition, to be transparent in my positionality throughout this research, it was necessary to explain that my research was conducted at the school where I am employed. The school have given permission to be named, and this has been approved by Anglia Ruskin University (ARU) Health, Education, Medicine and Social Care (HEMS) Faculty Research Ethics Panel (FREP). It was also made clear in Participant Information Sheets that the school would be named. Further considerations about maintaining participant confidentiality whilst naming the school are made in a subsequent chapter.

After obtaining qualified teacher status in 2012, I began teaching at Kendall Church of England Primary School. Over the past ten years, I have taught predominately in Year 5 and Year 6 and have led mathematics across the school for eight years, becoming the deputy headteacher in 2016. In 2016, alongside the school's senior leadership team, I led Kendall through an ambitious school improvement programme to become a centre of excellence for outdoor learning. As I worked to achieve the school's vision, I was involved in training staff on the pedagogy of outdoor education, developing the school site, supporting subject leaders to promote outdoor learning opportunities across the curriculum, and working through external validation programmes. In addition, I have presented at national conferences on the benefits of outdoor learning across the primary curriculum, written an online case study for the Council for Learning Outside the Classroom (Barrett-Rodger, 2022), and now facilitate the Level 3 Learning Beyond the Classroom Award. This research is being conducted at Kendall Primary School with children who all have years of experience in learning mathematics outdoors.

Alongside my role at Kendall, since 2015, I have been a mathematics subject delivery lead for an initial teacher training provider in Essex. Being a subject delivery lead involves me working with trainee teachers, developing their mathematics subject knowledge, pedagogy and educational theory to prepare them to teach primary mathematics. As a result, I have been exposed to many different mathematical pedagogies. In addition, I have worked alongside other mathematics specialists, including those from the secondary education sector. I have been influenced by the examples of best practices I have seen in schools around Essex, which has further shaped my curiosity about what high-quality mathematics education looks like.

I enrolled on the EdD in September 2017, formally beginning this research on entering Stage 2 in 2019. Initially, I was a student in ARU's HEMS faculty. Subsequently, in August 2023, the School of Education moved to the newly formed faculty of Art, Humanities, Education and Social Sciences (AHESS). Therefore, whilst now a student of AHESS, HEMS is referred to in much of this thesis as it was through that faculty that ethical approval was granted. My ideas and understanding of learning, mathematics, and being outdoors have changed throughout the six years of my doctoral studies. In many respects, this thesis is the unfolding of that journey.

I bring all of my personal and professional context with me to this research. Whilst it can be claimed that the role of an insider-research gives the potential for a deeper understanding of a subject (Cooper and Rogers, 2015), there can be an inherent danger of having formed a professional opinion when conducting research (White, et al., 2014). My professional context demonstrates my love of mathematics and my support of outdoor learning as an effective pedagogy. Therefore, my positionality within this research is a topic that will be significantly discussed in subsequent chapters as both integral to remaining methodologically congruent and conducting ethical research.

Ethics of Preserving Children's Lived Experiences

As well as influencing how I conduct my research, my position in the school as the Deputy Headteacher and class teacher also calls on ethical considerations to be made about focusing this research on the children I teach. In a later chapter, I discuss the ethics of practically conducting the study, such as informed consent, withdrawal, anonymity and the methods used for data collection. In this introduction, however, it is important to discuss how the particular experiences of the children in this study may be ethically preserved and centred through the interpretation of an adult teacher-researcher.

There has been an increase in research that claims to research 'with' children rather than 'on' them when investigating areas that concern children and their lives (Sammons, et al., 2016). Using children as active participants in research recognises that children are best placed to provide information about themselves (Fraser, Flewitt and Hammersley, 2014). However, there is concern that a naïve approach to voice-based research overlooks the complex power relations that inform research processes (Spencer, Fairbrother and Thompson, 2020). Therefore, this thesis must describe how the children in this study are positioned as competent participants at the centre of the research.

As the children's teacher, deputy headteacher and mathematics lead, I acknowledge that I hold great power. The dynamics of my authoritative roles over the children bring additional complexities to the participant-researcher relationship, which could have significant consequences. Participants may wish to please me, and I may be tempted to impose my perspective onto the children, resulting in describing my own experiences above theirs (Rengel, 2014). My influence on interpreting the children's lived experiences will be significant, and my adult-based assumptions will play a role in collecting and analysing the data. However, I approach this research fully understanding these barriers and with the utmost commitment to preserving the children's experiences as-lived. The term as-lived is used in this thesis to

refer to how the experience is lived prereflectively by the individual. This is a concept which will be further explored in Chapter Two.

The ‘voice’ of a child is not to be seen as something waiting to be discovered. Instead, child voice is a complex construction between the child and the researcher during data collection (Facca, Gladstone and Teachman, 2020). As a result, Eakin (2016) explains that research that presents a participant’s words as authentic overlooks the researchers’ influence in formulating those words. Spyrou (2011) advocates more critically reflexive research practices that acknowledge the role of the researcher and power dynamics in presenting the child participants' voices. Therefore, it is incumbent on the research to ensure that the participants' experiences are accurately reflected in the study’s findings as much as is practically possible.

Additionally, the need to portray children’s experiences accurately needs to be balanced with the need to maintain methodological congruence. As will be explored in Chapter Two, this study adopts a hermeneutic phenomenological approach to the research. Child voice research focuses on participants' opinions, perspectives or interpretations. However, hermeneutic phenomenology is not concerned with how participants make sense of their own experience but with how the experience was as-lived (van Manen, 2017). This is not to say that the child’s voice is not important in this study, but accurately representing the child’s voice is not the ultimate goal. The aim is to present an example of the lived experience to uncover previously unknown possibilities. This study focuses on the children's experiences, which are glimpsed through my interpretations of the stories the children relay. Therefore, the voice of the participants is not the endpoint but the means through which the experiential data is acquired.

Spencer, Fairbrother and Thompson (2020) encourage researchers to ask, “How do the study’s aims and theoretical underpinnings contribute to children’s status and positioning – both during the research process and in society more broadly” (p.6) I will conclude this section with a response to this question. Currently, no research illustrates what it is like for children to

learn mathematics outdoors. As a professional with experience within the context, I have made assumptions about what it might be like and these feed into my continuing professional development. However, using my taken-for-granted assumptions ignores the children as agents of their own experience; my adult-centric views currently inform how I teach. Conducting this research seeks to move beyond my acceptance of what I think to look into the possibilities of what actually is.

Although I accept that power dynamics and my positionality will influence my findings, muddying the purity of the participants' experiences, I aim to better understand possible experiences through my interpretations of the children's descriptions. Throughout this thesis, I will detail my reflexive practices and identify attempts that have been made to centre the children within this study to maintain transparency in how I have conducted the research and preserved the voices of the participants.

Research Purpose, Aim and Question

This chapter has outlined the context and background of the thesis. It is clear from the literature and practices discussed that mathematics is regarded as an essential subject internationally and that successive UK governments have implemented measures to improve mathematics teaching and learning over several decades. However, with the prevalence of MA as a concern in the academic literature, it is evident that not all children have positive mathematics education experiences. My professional practice tells me that something different happens for children when they learn outdoors. As discussed earlier in this chapter, much literature identifies the benefits of outdoor learning, yet little describes how learners experience outdoor learning first-hand. Therefore, the purpose of this research is to understand better the experiences of children learning mathematics outdoors. By gathering insights into the lived experience of children learning mathematics, teachers will have a greater awareness of the implications of this increasingly popular pedagogy.

This research focuses on children's experiences of outdoor learning within the context of mathematics lessons rather than children's experiences of mathematics learning within the context of the outdoors. Whilst the context of learning mathematics is essential within this research, the central phenomenon being studied is how children experience the outdoors as a learning environment. The purpose is not to compare children's experiences in the classroom and outdoors. Nor is the goal of this study to claim that the findings could not also be found within a traditional classroom environment. Instead, the purpose is to understand how participating in outdoor mathematics lessons is experienced by the participants in this research. Additionally, whilst this study specifically looks at the experience of mathematics learning outdoors, there may be insights helpful for other curriculum areas. These are discussed in Chapter Seven.

This study aims to illuminate children's experiences of learning mathematics outdoors so that mathematics teachers can "expand and enrich our sense of what it means to teach" (Dahl, 1995, p.130). Furthermore, by illuminating the lived experiences of children through their first-hand accounts, this research seeks to uncover insights that have implications for practice and pedagogy. Therefore, the research question for this study is: **What are the lived experiences of children learning mathematics outdoors?**

Thesis Guide

There are seven chapters within this thesis. Each chapter begins with a quotation from one of Max van Manen's 2016 books, 'Phenomenology of Practice: meaning-giving methods in phenomenological research and writing' or 'Researching lived experience human science for an action sensitive pedagogy'. Both titles have been pivotal in informing my approach to the research, and I have carefully selected quotations to orientate the reader and foreshadow the intended purpose of each chapter. The references also provide a framework that supports methodological congruence throughout the thesis.

Ethical considerations are threaded through each chapter rather than being separated from the rest of the text. This underlines the ethical backbone of the study and my desire to conduct research concerned with the voices and wellbeing of all involved while maintaining methodological congruency.

As it best suits the chosen methodology, the thesis is written narratively and often using the first person. Whilst the thesis meets the requirements of the EdD, elements of it can also be seen as a phenomenological text. The writing aims to speak to the reader in a way that resonates with their experiences and interpretations. Chapters are punctuated with my reflections and reflexivity to demonstrate transparency within the study.

The content and order of each chapter are designed to guide the reader through the research's narrative, beginning with the rationale for the study and closing with the implications of what the research has uncovered. Below, I provide an overview of each chapter to guide the reader.

Chapter One (Beginning with Wonder) has provided the background of the thesis by describing how my professional context has led to the research. The chapter then outlined the national and local context of the study before providing the aims and overriding research question.

Chapter Two (Approaching the Research) describes the methodology and philosophical underpinning that inform the principles of this study. This chapter is placed early because the philosophical character of the research is pivotal in the thesis. My positionality within the research is explored through a hermeneutic phenomenological lens, and a reflexive approach to the study is detailed. In this chapter, there is a discussion of the strengths and limitations of the methodology and a description of the criteria used to ensure a reliable and rigorous approach to research.

Chapter Three (Coming to Understanding through the Literature) outlines the current literature through a hermeneutic approach with two scoping reviews concerning children's experiences learning mathematics and being outdoors presented. As well as literature collected through a systematic approach to scoping reviews, additional literature is included that resonates with the experiences being studied. This chapter identifies the gap in the literature that this thesis serves to fill and further uncovers my preconceptions through engaging with contemporary research.

Chapter Four (Gaining Sight of Lived Experience) details how the philosophical foundations of this thesis are realised through a systematically applied research design. Although presented linearly, I explain how the study's design underwent several changes and modifications in response to reflexive practices and a desire to be led by the participants and their data. Several creative and newly-devised methods are explored, contributing to new methodological understanding.

Chapter Five (Grasping Meaning) presents the findings of the research. This chapter comprises three distinct yet interconnected poieses demonstrating the insights gleaned from in-depth phenomenological analysis of the children's lived accounts. The poieses within this chapter are presented as phenomenological texts, rich with experiential data and uncovered insights.

Chapter Six (Fusing Horizons) provides a discussion that draws the uncovered meanings together. The insights are discussed with extant literature to pull together the research findings. These represent this thesis's answer to the overriding research question. Based on the interrogated insights, this chapter makes ten critical recommendations for both policy and practice.

Chapter Seven (A Closing) outlines the critical contributions of this thesis, both concerning methodological advances and addressing the aims of the study. Here, consideration is given to future research that may continue engaging in this thesis topic. Finally, the chapter concludes with a reflection on the thesis's strengths and weaknesses, including a critical analysis of its success as a doctoral study.

Chapter Two: Approaching the Research

"Phenomenology is originally and essentially a philosophical discipline."
(van Manen, 2016a, p.22)

In this chapter, I describe my chosen methodology: hermeneutic phenomenology. The decision was made to include this chapter before the literature review as the methodology underpins the approach to engaging with the literature. Above, van Manen identifies the foundation of phenomenology as an attitude and way of thinking. Phenomenological philosophy runs centrally through this thesis; therefore, placing this chapter early is essential.

Approaches to methodology blend both epistemological and ontological standpoints. The researcher's unique combination of how they understand or define what knowledge is (epistemology) and how they understand reality to exist (ontology) will influence their approach to addressing the research question (Cohen, Manion and Morrison, 2018). Therefore, this chapter begins with an examination of my own epistemological and ontological position and how these have led me to adopt hermeneutic phenomenology. Then, as a result of the richness of the philosophical traditions of phenomenology, I move on to illustrate the foundations of phenomenology as a research approach, with a particular focus on the hermeneutics of Heidegger as presented in his 1927 [2010] treatise, *Being and Time*.

The chapter then presents an overview of Max van Manen's (2016a) hermeneutic phenomenological approach to research, Phenomenology of Practice, which I have selected as the basis for my research design. Finally, the chapter is brought together with a description of the underlying principles of the study, combining the philosophical elements of the phenomenological tradition, paving the way to engaging with the literature and providing a detailed outline of the research design in subsequent chapters.

Epistemological and Ontological Positioning

Approaching this study, I bring my own experiences and views, which shape my attitude towards the research design. From my background as a mathematics specialist, my epistemology is deeply rooted in a quantitative perspective. My day-to-day role as a deputy headteacher involves searching for the quantifiable impact of teaching and interventions on academic outcomes for learners. I am held to account over results, and pupils' progress is measured through numbers. Indeed, Rea (2008) points out that much of the research into outdoor learning aims to find quantifiable measures of impact because of a culture of targets and league tables in the British education system. My previous experience leading up to my research has been entrenched within the quantifiable world. Therefore, I naturally started my educational doctorate journey looking for ways to find a quantifiable answer to my questions.

The positivist approach I adopted for much of my professional practice initially led me to consider a quantitative methodology that aimed to identify findings which are specific, measurable, and observable (Creswell, 2013). Quantitative studies drive to quantify findings, resulting in generalisable and repeatable conclusions. Following a positivist stance, quantitative research often examines trends, compares variables, and seeks to answer questions of causations without explaining how and why. Objectivity is, therefore, critical in quantitative research, ensuring that findings remain uninfluenced by the biases of the researcher's positionality (Hoy, 2010). Hoy (2010) argues that quantitative analysis is essential in educational research as teachers seek ways to improve children's learning, reflecting how quantifying learning is steeped within national policy, where learner progression is measured quantitatively (e.g., Department for Education, 2019). However, some argue that a more beneficial stance towards educational research would be through the paradigm of postpositivism (Panhwar, Ansari and Shah, 2017).

Postpositivism, a term initially coined by Denis Phillips, was used to describe a group of thinkers who critiqued the positivist stance (Miller, 2005). One of the early critics of positivism was Karl Popper. Popper (1959) argued that scientific laws could not be proven, rejecting the positivist claim that the scientific method can discover single, subjective truths about reality. He postulated that just because the sun had risen every morning in the past, it did not mean that it was inevitable that it would rise again every morning in the future. Popper's approach is critical rationalism as it attends to the beliefs on which 'truths' are constructed. His work establishing a postpositivist approach is important for educational researchers as it highlights the temptation for researchers to seek out data that defends their views (Green, et al., 2006). Thomas Kuhn (1962) also criticised the positivist approach with his notion of paradigm shifts. Kuhn argued that paradigms (the system established to govern a scientific discipline through widely accepted sets of theories and practices) shifted over time as inconsistencies between data and the accepted theories diverged. Consequently, meaning is only relative to the paradigm through which it is viewed. Kuhn's views reinforce the postpositivist view that truth is relative and not objective.

Jones (2014) points out that while postpositivism does not refute the importance of the scientific method as appropriate for gaining greater understanding, it rejects the purely objective thinking of an empirical study. Postpositivism remains an objectivist epistemology; while postpositivists accept that the underlying nature of reality is uncertain, they maintain that an objective reality exists within an object independent of the subject. Therefore, it is also essential to consider a third way of approaching educational research: interpretivism.

Interpretivists accept that there are no universal objective truths (similarly to postpositivists) but also believe that there are multiple, subjective interpretations of reality (Luttrell, 2010). Philosophers have made fashionable the term *qualia* to describe individual instances of human experience. Exploration of human experiences is highly subjective and demonstrates

interpretivism’s desire to understand human experiences' meaning without the constraints of objectivity and impartiality. Qualitative researchers utilise their understanding of the world to draw insight into experiences without concern for generalisable or repeatable findings (O’Donoghue and Punch, 2003). The curious predisposition of human nature allows people to find meaning within conscious experience, highlighting the ambition of the qualitative approach. The consequence of this is a more flexible research approach (Hammersley, 2013).

Whilst I appreciate the value that quantitative research can bring to educational research, I have identified that my research aim cannot be met from a positivist stance. Human studies concerned with experiences require a methodological approach that considers the subjective human nature, temporality, and the active particularity of being a person. Further, whilst a postpositivist paradigm moves towards understanding unverifiable truths, its stance does not suit my research as it maintains that a scientific method would be the best method to investigate experience. My research requires a relativist’s understanding of reality, recognising that reality is subjective. Each participant exists within their reality, and insights into this lived world are the subject of my research.

Bakker, Cai and Zenger’s (2021) survey conducted for Educational Studies in Mathematics journal asked the global academic mathematics community what future mathematics educational research should focus on. Whilst the report claims that many different methodologies were mentioned, they list examples of “randomized studies, experimental studies, replication, case studies, and so forth” (p.11). This report's focus on mainly quantitative and mixed method methodologies highlights the dominance of positivist approaches in mathematics education research. When attending mathematical conferences, I have found that most papers discussed attempt to measure and quantify a degree of success in mathematics learning pedagogies or strategies. Even when exploring MA within the contemporary literature, a condition that has been shown to have a significant impact on an

individual's feelings and emotions, the majority of articles focus on different ways of measuring anxiety or the factors that contribute towards it (e.g., Lu, et al., 2021). In a blog for BERA entitled *Rethinking the Numbers* (Barrett-Rodger, in press), I comment on the dominance of positivist research in mathematics education and the danger that if researchers always approach mathematics learning mathematically, the human element of the learning experience may be missed.

My theoretical perspectives have shifted because I reflected on what the research requires from me. I approach my methodological considerations with the acceptance that subjectivity is vital in generating knowledge and recognise that absolute truths do not exist in education (Panhwar, Ansari and Shah, 2017). How people learn, interact and experience their lives is dependent on their perspectives and attitudes, which are ever-changing. Quantitative research does not provide the necessary tools and perspectives to examine the nuisances and contextual basis for the spoken word, which is at the heart of this research. A qualitative approach, however, allows for the uniqueness of words spoken to be analysed through multiple lenses, considering the importance of context and interpretation. Therefore, as this research aims to gain insights into the lived experiences of children's learning, a qualitative approach is deemed necessary.

Choosing the appropriate Methodology

To answer my research question, I considered several qualitative approaches to research before adopting my chosen methodology. This study aims to uncover the experiences of human participants. This is the main principle of many interpretive approaches (such as grounded theory, ethnography, and phenomenology). Therefore, it was appropriate to look at each one to evaluate its effectiveness in answering my research question.

Firstly, grounded theory was considered. Grounded theory, a term introduced by Glaser and Strauss in 1967, offers the opportunity to inductively "develop a theory or model of the phenomenon" (McLeod, 2003, p.88). This means that a grounded theorist would not start with a hypothesis but instead develop a theory as the research unfolds, led by the participants' experiences. There is little research on children's outdoor learning experiences, so this approach was appealing. Grounded theory also provides a "structured and systematic process of analysis" (Engward and Davis, 2015, p.2). As a researcher new to qualitative studies, a systemic process that provided broad guidelines for conducting the research was attractive.

Whilst grounded theory is uncommon in educational research (Prigol and Behrens, 2019), there are examples of where grounded theory has been successfully implemented in education settings (e.g., Grant, 2020). However, a vital feature of any grounded theory study is patterns in experience between participants. According to Charmaz and Thornberg (2021), the purpose of grounded theory is to "construct a theory that offers an abstract understanding of one or more core concerns in the studied world" (p.305). My research interest is in the experience of individuals as they live it rather than seeking to find patterns or develop theories. Grounded theory's focus on social phenomena is also poorly situated within my research. My question seeks to gain insights into individual meaning rather than shared understanding and socially constructed experience. As a result, grounded theory was discounted.

Ethnography was also considered as a potential approach to this research. Ethnography as a research methodology is rooted in anthropology and is interested in describing other cultures (Draper, 2015). Researchers within ethnographic studies are typically immersed within the culture and social context of a group of people whose lived experiences are of interest (Angrosino, 2007). Ethnography places a significant emphasis on the position of the researcher to uncover connections between individuals' experiences from within and, for that reason, is an increasingly popular methodology for insider educational researchers (Wright,

2020). Wright's (2020) study sought to understand children's learning experiences when engaging with artists within a museum setting. Wright successfully positioned herself as an insider artist-researcher and used this position to uncover themes. However, my positionality has led me to rule out ethnography. I am researching children whom I teach. My positionality as the children's teacher (and their deputy headteacher) does not allow me to situate myself within the cultural network of the children as one of them. Therefore, any ethnographic insights would be limited. Additionally, ethnographic studies aim to understand cultural rules and dynamics (Draper, 2015). In contrast, this research seeks to understand individuals' experiences rather than their relationships. As a result, ethnography was discounted.

Participatory Action Research (PAR) was also considered as a possible methodology. PAR develops collaboration between the researcher and the participants to understand the world by enacting change resulting from combined reflection (McIntyre, 2008). Lawson (2015) defines the five priorities of PAR:

1. Enable democratic participation by local stakeholders.
2. Conduct successive action research cycles.
3. Understanding is generated through local problem solving.
4. Knowledge generated responds to the practitioner's knowledge needs.
5. Impending threat associated with globalisation is defended by local knowledge.

PAR was initially appealing as it puts the participants at the centre of the process, as shown in the first principle above. Giving the children in my research ownership over the project's direction was tempting because of the additional insights it could have brought. As an insider researcher, I was also tempted by PAR's focus on local knowledge and attending to the needs of practitioners. However, PAR requires the participants to make informed decisions, and I had concerns about the effectiveness of PAR with children, particularly without an experienced PAR researcher to guide them. Cammarota and Fine (2008) developed Youth PAR (YPAR) to address this issue. YPAR is orientated to create solutions to problems faced by young

people and requires active engagement from participants, even to the level of establishing a research question and designing an approach to the research (Bozlak and Kelley, 2015). Whilst PAR has been used effectively to research participants' lived experiences, the methodology is a development of the more traditional action research methodology. It is based on the same process of acting, reviewing and taking further action. Whilst I want the participants' provision to improve, this misses the point of this research. I seek to understand the participants' experiences as they are now, not to change that experience or even to judge the effectiveness of the current provision on their experiences. Therefore, PAR was excluded as an appropriate way to frame my study.

After considering the previous qualitative research methodologies, I began investigating a phenomenological approach, which is increasingly used in educational disciplines (Stolz, 2023). Any phenomenological study aims to uncover embodied, experiential meaning (Finlay, 2009). In other words, researchers engaging with phenomenology seek to understand the lived experience of participants living through a specific phenomenon. It "is the study of the primal, lived, prereflective, prepredicative meaning of an experience" (van Manen, 2017, p.776). The appeal of phenomenological research is the focus on the individual experience. I understand that the participants will all have unique experiences of learning mathematics outdoors. My aim is not to compare these experiences, as to do this would be to judge the experiences. Instead, I aim to present the experiences as they are for the individual. With the understanding of 'how' it is, it is hoped that teachers and policymakers will be able to build on their previous understandings and seek a way forward.

Telford (2020) explains that phenomenology can be an effective methodology for studying outdoor learning as "they are often the sorts of experience that are incredibly difficult to give expression to" (p. 48). The prereflective element of phenomenology also makes it particularly appropriate for my research. To gain prereflective experiences is to harvest experiences

before the participant makes sense of them. All thoughts, once verbalised, are given meaning, but phenomenology seeks to uncover embodied, experiential meanings, enabling researchers to gain insights into 'how' it is for a participant (Finlay, 2009). Whilst a psychologist would be interested in their client's understanding of their experience, a phenomenologist desires access to the prereflective so that interpretation can be sought beyond the individual. Rather than repeating a rehearsed narrative or consciously processing their ideas before giving them, I want to get as close to the raw experiences of the children I teach as possible. Therefore, I have selected phenomenology as my chosen methodology because it provides me with a platform to investigate the prereflective lived experiences (also known as the *lifeworld*) of children learning mathematics outdoors.

Phenomenology is set apart from other qualitative research approaches due to its roots as a philosophical movement that has only recently been used as a research methodology (Dowling, 2007). Beginning in the 19th century with the philosophy of Edmund Husserl, phenomenology has been subject to many revisions in the hands of several philosophers (Carpenter, 2011). Each has built on previous thinkers' ideas and adapted to meet their needs and thoughts. As a result, there is no one phenomenology (Telford, 2020). Because of the differing forms of phenomenology, it is considered a complex minefield of thoughts and ideas for novice researchers (Converse, 2012). Therefore, the next section of this chapter details the philosophical thinking of Edmund Husserl before traversing through the thinkers and innovators of the methodology that have most influenced my approach to this research.

The Philosophy of Phenomenology

Phenomenology is a philosophical attitude derived from the ideas of Edmund Husserl. Husserl sought to uncover the essential structures of a human's experiences of phenomena. Husserl is often named the Father of Phenomenology, but his ideas emerged from his work with mentor Franz Brentano (Glendinning, 2007). Husserl developed the phenomenological

philosophy as the study of what *is* – what he referred to as the essence of an experience. His work focused on *Lebenswelt* (translated as lifeworld). *Lifeworld* refers to an individual's world of lived experiences before it is conceptualised. The phenomenological endeavour is to access the prereflective experience in its raw form before the existence of the experience is consciously conceived by the individual (Laverty, 2003). *Lifeworld* directs people to their embodied sense of self: a sense of time, space, relationships, and bodies. Phenomenology recognises that people share *lifeworlds*, yet an individual's *lifeworld* is unique, separate, and distinct. Therefore, phenomenology's overarching aim is to uncover experience as it is lived rather than how it is pictured. Consequently, phenomenology focuses on experiences "of the world in which they live and what it means to them" (Langdridge, 2007, p.4).

Husserl's aim in developing phenomenology was to seek principles on which science could be built. His view was for a philosophy which saw things as they appear, to search for reality and to come to a primal understanding of human experience. In his 1936 [1970] writing, *The crisis of European sciences and transcendental phenomenology,* Husserl described a crisis of science questioning "can the world, and human existence in it, truthfully have a meaning if the sciences recognize as true only what is objectively established" (pp.6-7). Citing the need for an interruption to the natural attitude, Husserl proposed that breaking free from the *taken-for-grantedness* of day-to-day life would allow the *lifeworld* to be questioned.

Husserl devised phenomenological reduction (*epoché*) to transcend the natural attitude (Cogan, 2023). Whilst acknowledging the interpretation of perceiver consciousness, Husserl believed that phenomenological bracketing could remove context and allow the perceiver to return to the things themselves. To understand the lived experience from a Husserlian approach, phenomenology studies subjects and objects without bias. In Husserl's vision, one's *taken-for-grantedn*ess and past knowledge could be transcended, enabling surprise and wonder by removing the certainty that something 'is*'* (Husserl, 1970).

Another critical element of Husserl's phenomenology was intentionality (Käufer and Chemero, 2015). Intentionality describes a person's relationship and directed consciousness of the object of their experience, focusing attention outwards on the objects of the world. Consciousness is not an entity of its own but an act of being intentionally conscious about something. Intentionality is the inseparable connection between individuals and the world (van Manen, 2016b). Intentionality is an essential aspect of phenomenological research because when questions are asked about the world, there is a desire to understand the very things that bring the world to human consciousness. The concept of intentionality also poses a problem for phenomenological researchers in that it suggests that an individual cannot reflect on an experience whilst in the experience. Therefore, phenomenologists must rely on an individual's recollection of their experience.

As explained above, Husserl aimed to describe the *eidetic structures* (universal essences) of those who had a first-hand experience of a phenomenon. Since the early work of Husserl, phenomenology has been further developed and taken in several different directions. Literature (Kakkori, 2009; Flood, 2010; Finlay, 2011) broadly agrees that there are now two main strands of phenomenological thought: Husserl's original descriptive phenomenology and his contemporary, Martin Heidegger's interpretative phenomenology. It is Heidegger's concept of hermeneutics that drives this study.

Heidegger and Hermeneutics

Husserl viewed human beings as primarily knowers. In contrast, Heidegger understood humans as creatures focused on their fate in an alien world. He developed Husserl's concept of phenomenology as purely descriptive into an interpretive discipline (Heidegger, 2010). Heidegger explains that it is by way of interpretation that one uncovers "the authentic meaning of being" (Heidegger, 2010, p.62). From a descriptive to an interpretive process, Heidegger dismissed one of Husserl's core principles – phenomenological reduction. Heidegger posited

that people are permanently embedded in their *lifeworld*. Therefore, context cannot be effectively removed. Understanding, for Heidegger, was not uncovering an essential meaning of an experience (as it was for Husserl) but becoming aware of the interpretative influences. Whilst many phenomenologists agree that consideration of subjectivity is essential, the debate over whether the phenomenological reduction is possible or desirable remains a contemporary issue (Dörfler and Stierand, 2020). The ontological question of *Being* was central to Heidegger's philosophy (Beck, 2021). *Being* is capitalised and italicised in this thesis, as is commonplace, when it refers to a Heideggerian state of being rather than as a verb or a collection of entities. Heidegger suggested that the difference between humans and other animals was their ability to show concern for their *Being*, which he called *Dasein*.

Dasein is a Heideggerian term to describe the human ability to be curious and question its existence (Inwood, 2019). *Dasein* is central to understanding how Heidegger sees the world and *Being* as co-constructed (Crowther and Thomson, 2020). According to Heidegger (2010), *Dasein* always finds itself thrown into the world and continually engaged in the world around it. Often the term *Being-in-the-world* is used to describe *Dasein*'s thrownness. *Being-in-the-world*, for Heidegger, is always *Being-with-others*. Heidegger's assertion that *Being-with-others* means that *Dasein* is never alone illustrates his understanding that experience is always constituted with the world and others. If *Dasein* is in a constant state of thrownness, the participants in my research are thrown into a moment of learning mathematics outdoors. A moment, phenomenologically, is not a quantifiable moment on a clock but a moment as experienced by the individual. Therefore, the concept of *Dasein* allows researchers to examine the essence of an experience within a moment of that experience as-lived.

While Husserl focused on description, Heidegger saw interpretation as critical in forming knowledge. This shifted phenomenology into the world of hermeneutics. Hermeneutics derives from the Greek word *hermeneutikos*, meaning translate or interpret. Hermeneutics describes

studies related to the science of interpretations, the goal of Heidegger's phenomenological modifications. Heidegger's hermeneutic approach to phenomenology refocused on interpreting lived experiences as a way of illuminating ways of *Being-in-the-world* (Cole, 2015). This new type of thinking created a different branch of phenomenological thought and attracted thinkers like Gadamer. In his 1960 [1989] text, *Truth and Method*, Gadamer agreed with Heidegger that "language is the universal medium in which understanding occurs. Understanding occurs in interpreting" (p.389).

Gadamer's Horizons

Hans-Georg Gadamer adopted a similar interpretive approach to phenomenology as Heidegger. Gadamer was interested in horizons of interpretation, which refer to the particular view offered to an individual. Gadamer posited that understanding texts comes from the fusion of different interpretative horizons. Interpretative horizons can be described as hermeneutic turns. In a phenomenological study, three turns can be observed. First, that of the participant, then of the researcher and then finally, the turn of the reader. When the participant gives their experience as text, they inevitably deliver an interpretation. As Gadamer says in his 1976 [1986] writing, *The relevance of the beautiful and other essays*, "When we interpret the meaning of something, we actually interpret an interpretation" (p.68). Second is the interpretive horizon of the researcher, who interprets the meaning of the experience. The final turn is that of the reader, who inescapably interprets the researcher's interpretation.

From Gadamer's perspective, understanding requires the interpreter to move alternatively between parts of the text and the whole, encapsulated by the hermeneutic circle process. Gadamer developed the concept of the hermeneutic circle further from the initial ideas of Heidegger (Debesay, Nåden and Slettebø, 2008). The hermeneutic circle aims to understand a text with reference to its parts. Similarly, the understanding of its parts is determined with regard to the text as a whole. Core to this idea is that an entire text or parts of the text cannot

be understood without reference to the other. Gadamer developed and reconceptualised the hermeneutic process through which a whole reality is understood via exploration of the parts of its existence.

Philosophical Summary

As described, phenomenology has a rich and complex history, undergoing several reinventions and philosophical adaptations. This research primarily follows the thinking of Heidegger and Gadamer in their philosophical descriptions of hermeneutics and horizons. However, Beck (2021) points out that Husserl's intention when devising phenomenology was not to create a methodological research approach. Instead, his ambitions were merely philosophical. Yet, the temptation of the phenomenological standpoint now sees it adapted into a qualitative research methodology aimed at understanding the *lifeworlds* of individuals (Morse and Richards, 2002).

Therefore, it is not sufficient to address the philosophical writings of Heidegger and Gadamer alone but to adopt an approach to applied research that sits on these as foundations. In the same way that there are numerous varieties of philosophical phenomenology, there are also different methodological approaches. Some approaches remain constant to Husserl's original descriptive phenomenology, while others adopt the interpretative stance of Heidegger. Finally, a third variety of methodologies combine the two approaches.

Phenomenology as Applied Qualitative Research

Phenomenological research is now a well-established qualitative methodology that aims to uncover embodied, experiential meanings of experiences (Finlay, 2009). However, many phenomenologies are available to researchers, each focusing on different research applications (Carpenter, 2011). There is also some concern that as phenomenology becomes increasingly diverse, some methodological approaches that bear the name phenomenology

are not sufficiently underpinned by its philosophical roots (van Manen, 2017). Therefore, in choosing an appropriate phenomenological stance, I needed to ensure that the chosen methodology was consistent with the research question and the philosophical underpinning of the study (Neubauer, Witkop and Varpio, 2019). Therefore, in this section, I illustrate some of the possible phenomenological approaches considered before defending my choice of direction.

Choosing a Phenomenological Approach

The first phenomenological approach considered was Interpretative Phenomenological Analysis (IPA). IPA has become increasingly popular with practice-based researchers (particularly in health and social care), with some suggesting that it has been the default methodology for those wanting to study individual lived experiences (Hefferon and Gil-Rodriguez, 2011). Indeed, the "thorough and systematic" (Smith, Flowers and Larkin, 2009, p.29) approach of IPA is appealing to a first-time researcher. However, IPA seeks to understand an individual's experience and the meaning ascribed to those experiences by the participants. Therefore, the focus of IPA is not on prereflective experiences – a fundamental element of my study. As a result, IPA was excluded as a research approach.

I also considered a descriptive phenomenological approach by investigating the possible use of Amedeo Giorgi's Descriptive Phenomenological Method (Giorgi, 2009). Giorgi's methodology is influenced by Husserl's ideas of phenomenological reduction. Giorgi's approach begins with the researcher assuming the correct attitude through bracketing and using *epoché*. Although Giorgi's approach is descriptive, he uses his background in psychology to make explicit "the psychological meaning expressed by the participants" (Beck, 2021, p.32). Giorgi's approach calls for applying imaginative variation – a concept first introduced by Husserl. Imaginative variation utilises a series of researcher reflections where elements of a participant's description are removed, and the effect is observed. If the removal

changes the structure of the description, then the element is an essential element of the description. Therefore, it is fundamental to the meaning of the experience. While Giorgi's work is appealing as it concerns reproducibility (something that most other phenomenological approaches are not), its procedural process and rigidity do not allow for the creativity that my research calls for. Moreover, a purely descriptive approach fails to appreciate the interpretive nature of research into the lived experience.

After looking at one purely interpretive phenomenology approach and one concerned with descriptive practices only, I sought a methodology that would merge both ends of the phenomenological spectrum to give a fuller view of the participants' experiences. At this point, I explored Max van Manen's hermeneutical phenomenological approach to research. van Manen's hermeneutic approach to research is influenced by the work of Heidegger and Gadamer and is rooted in education. However, van Manen proposes that the phenomenon can be explored more deeply through engagement with the five *lifeworld existentials*: lived space, body, time, relations and objects (van Manen, 2016b). The concept of the *lifeworld existentials* follows a more Husserlian phenomenological route of questioning. Therefore, van Manen's approach is somewhere along the continuum between purely descriptive and interpretive phenomenology.

It should be noted that van Manen's Hermeneutic Phenomenology is not the only hermeneutic approach to phenomenological methodology. For example, other phenomenological approaches adopt Heidegger's notions of hermeneutics. However, because of van Manen's focus on pedagogy, as described in the next section of this chapter, I have chosen to adopt van Manen's Hermeneutic Phenomenological approach as described in his 2016 book, *Phenomenology of Practice*.

Max van Manen's Hermeneutic Phenomenology

Born in 1942 in Holland, Max van Manen is a Canadian academic specialising in hermeneutic phenomenology as an applied methodology. Although his work is influenced by theorists such as Gadamer and Habermas, his ideas are greatly shaped by the Utrecht School (van Manen, 2016a). Pedagogy, in the view of the Utrecht School, includes all of the concerns of adults and children in education and childrearing (van Manen, 1978). Consequently, pedagogical questions may range from experiences of learning to parenting. A pedagogical approach to phenomenological research is "not to put us in command of our own or others' educational lives but instead to put us in 'touch' with those lives" (Brown, 1991, p.23). van Manen's work, influenced by the scholars of the Utrecht School, is concerned with the child's place in pedagogy. Therefore, van Manen's phenomenological approach to research is closely aligned with the aims of this study.

The phenomenology of practice was developed by van Manen to be used by professionals in their work context (e.g., teachers). Phenomenology of practice aims to enable professionals with innovative perspectives of their contexts to engage in phenomenological research (Errasti-Ibarrondon, et al., 2018). van Manen's inspiration for his hands-on coordination of phenomenology comes from the phenomenological approaches that academics in the professional disciplines navigate in their field (van Manen, 2016a). As a professional embedded within a professional context, the phenomenology of practice initially stood out in my search for a suitable approach to my research.

For van Manen, phenomenological research begins with wonder (2016a). Wonder causes the researcher to understand the world as it is ordinarily lived: the lived experience. van Manen discusses extensively the idea that phenomena under phenomenological analysis do not need to be unusual or extreme. Instead, instances that cause someone to ponder can be found within the everyday world. For example, I was brought my research by wondering how my

child experienced the lessons I taught them through a pedagogy of outdoor learning that I was so invested in.

Following van Manen's earlier work, the phenomenology of practice combines descriptive and interpretive phenomenological perspectives, recognising that neither approach alone is sufficient to understand the lifeworld of human individuals. van Manen points out that "phenomenology is, in some sense, always descriptive and interpretive, linguistic and hermeneutic" (2016a, p.26). He maintains that every description necessitates interpretation on behalf of the describer. This is a position I find myself agreeing with.

The final reason I decided to base this study on van Manen's hermeneutic phenomenology is the creativity with which van Manen encourages researchers to draw upon. Whilst providing a platform for research, van Manen does not prescribe a list of procedures for conducting research. Instead, his book (2016a) outlines a range of practices that may be useful for data collection and analysis phenomenologically. As van Manen claims, "relying on procedural schemas, simplified inquiry models, or a series of descriptive-interpretive steps will unwittingly undermine the inclination for the practitioner of phenomenology to deepen himself or herself in the relevant literature that true research scholarship requires, and thus acquire a more authentic grasp of the project of phenomenological thinking and inquiry" (2016a, p.22). Whilst the structure of alternative approaches was tempting, the freedom to invoke a range of creative techniques and to be led through the data with a phenomenological attitude gave me the sense that more justice would be given to the participants' experiences.

It would be naïve to think there were no criticisms or flaws in the phenomenology of van Manen. Indeed, some phenomenologists have criticised the Phenomenology of Practice for being abstruse and excessively complicated, citing contradictions in terminology and misinterpretations of classic phenomenological texts (Zahavi, 2018). Stolz (2023) also raises concerns that van Manen's approach taints participants' data, which sees it distorted and

removed from the experience as-lived. However, adopting the approach described by Phenomenology of Practice provides the best option for achieving my research aim.

In summary, I have chosen Max van Manen's Phenomenology of Practice as the basis on which I attempt to answer my research question for the following reasons:

- It acknowledges that a combination of descriptive and interpretive perspectives is required to understand the lived experience. This allows both the participants' voices to be preserved and my positionality as their teacher to be recognised.
- It provides an approach that adopts a practice-based orientation suitable for research in education and from the positionality of a teacher-researcher, which is an essential aspect of my study.
- Rather than procedures or schemas, it promotes creativity in data collection and analysis, allowing the researcher to be led by what the study requires. This means the research is guided by the data, promoting the participants' voices.

Phenomenology allows the researcher to understand the world by examining "the role played by embodied, perceiving, thinking, and feeling agents" (Zahavi, 2019, p.142). In my research, the 'agents' under investigation are the children learning mathematics outdoors. The participants are cogitating, responsive and sensitive individuals and have the ability to consider all of these nuances of an individual and their experience. Therefore, phenomenology is congruent with my research aim, making it the correct methodological approach.

A Focus on Prereflective Experience

In Phenomenology of Practice, van Manen (2016a) describes phenomenology as "the way of access to the world as we experience is prereflectively." (p.28). This centres the concept of prereflective experience at the heart of his hermeneutic phenomenological approach. Prereflective experience refers to the everyday experience before it is conceptualised.

Therefore, according to van Manen, phenomenology aims to describe the experience as-lived by an individual rather than understood. Whilst psychology is likely to be interested in what meaning individuals make of their experiences, this is not the pursuit of this phenomenological inquiry. Instead, this study seeks to break through the participants' conceptualisation to understand how the experience was as-lived. Naturally, the criticism here would be that how access is gained to the lived experience (through dialogue with the participants) is a method of conceptualisation. By retelling an experience, it is brought into reflective awareness. Hermeneutic phenomenology recognises this. However, van Manen supports the idea that the pursuit of glimpsing the lived sense of experience before being cognitively comprehended is worthwhile (2016a).

An emphasis has been put on the prereflective experience as a guiding principle of this study as an attempt to break through rehearsed narratives. Schools are frequently trying to engage children in their learning and the running of schools. School councils, pupil voice meetings and student-led committees are commonly held to gather students' opinions and give them a sense of belonging in the school community. While this is a worthwhile endeavour, this is not the purpose of this study. This study does not seek the opinions or attitudes of children about learning mathematics outdoors. Equally, this research does not attempt to measure satisfaction or perceptions to inform practice. Therefore, I do not want to collect participants' opinions about learning mathematics outdoors. Instead, this study aims to understand the children's lived experiences of learning mathematics outdoors and, therefore, trying to glimpse the prereflective experience is a crucial aspect of this thesis.

Researcher Positionality and Bias

White, et al. (2014) explain that the relationship researchers develop before entering their studies can be a danger in practice-based research. Being connected to the phenomenon under investigation provides me with greater opportunities to uncover meaning compared to

a researcher with no relationship to the experience being studied (Dibley, et al., 2020). However, insider-researchers also need to distance themselves from their professional context when conducting practice-based research because of their preconceived ideas of the phenomenon of interest (Costley and Gibbs, 2006). I acknowledge that removing myself as a teacher entirely from the world of teaching is impossible. Therefore, I must develop an awareness of my relationships and the effect my positionality inevitably has on the study (Bourke, 2014).

Hermeneutic phenomenology seeks to understand participants' experiences through the researcher's interpretation. Therefore, the position of the researcher (and the preunderstandings they bring to the research) must be closely examined and illuminated. The aim of exposing preconceptions in this study is to adopt a phenomenological attitude. This means being open to seeing beyond the *taken-for-grantedness* of everyday life. The phenomenological attitude can be adopted through a series of reflective and reflexive techniques.

The Phenomenological Attitude

The *epoché* and the reduction are central to van Manen's phenomenology as they are the philosophical methods which grant access to the prereflective experience (van Manen, 2016a). However, the *epoché* and the reduction are often interpreted differently (Zahavi, 2019). Therefore, I have set out how van Manen conceptualises the epoché and the reduction and how they are used in this study.

As already discussed, *Dasein* are always *Being-in-the-world*. Therefore, humans rarely reflect on the essences of their experiences. Instead, *Dasein* lives through the natural attitude where life is experienced through *taken-for-grantedness*. This means that humans do not stop to question what they believe they know. Attention is often only drawn to objects or events when

they do not perform as expected. The natural attitude is generally an effective way to live day-to-day life. However, researchers need to move beyond the natural attitude to understand what might not be expected.

The reflective attentiveness that needs to be adopted for phenomenological understanding consists of two philosophical moves: the *epoché* and the reduction. First, the researcher suspends their understanding and *taken-for-grantedness* through enacting the *epoché*. The *epoché* is often referred to as bracketing. However, the term bracketing is highly controversial because of varying understandings and definitions of the word (Dörfler and Stierand, 2020). The Husserlian transcendental notion of bracketing allows the philosopher to be "above his own natural being and above the natural world" (Husserl, 1970, p.152). This 'God's eye view' approach of bracketing suggests that it is possible to transcend knowing and humanness to see things as they are. However, this is not the interpretation of bracketing that van Manen posits. van Manen recognises that presuppositions are not thoughts which can be eliminated. Zahavi describes the *epoché* as "a suspension of a particular dogmatic *attitude* towards reality" (2019, p. 36). Therefore, the first step of adopting a phenomenological attitude is to look beyond what has previously been 'known' or 'proven'. This is achieved through reflexive practices discussed later in this thesis.

The second step is an attentive return to the phenomenon under investigation. This step is named the reduction from the Latin *reducere,* meaning to lead back (Mahoney, 2023). Phenomenological reduction calls for researchers to question their presuppositions, avoid the temptation of the taken-for-granted attitude, construct an approach to research as called for by the topic being studied, and take a step beyond established theory to understand the essence of an experience.

van Manen suggests that facing presuppositions through phenomenological reduction opens the researcher to continuously questioning their assumptions (2016a). Therefore, bracketing

does not mean ignoring experiences but examining them for “phenomenological sensibilities” (van Manen, 2016a, p.226). A focus on questioning assumptions aligns the concept of bracketing much closer to Giorgi, who considers bracketing as where “one looks at the data with the attitude of relative openness” (1994, p.212). Therefore, a researcher using a hermeneutic phenomenological approach must seek to draw their preconceptions and presuppositions forward into reflexive awareness to be transparent about the impact of the biases on how the study is conducted.

Due to the differences in understanding of phenomenological reduction and bracketing, I have chosen not to use these terms further in this thesis. Instead, I detail a reflexive approach to the study to describe my attempt to adopt a ‘phenomenological attitude’ throughout the research. The phenomenological attitude is a conscious attempt to move away from the natural taken-for-granted state in which people usually find themselves (Gustin, 2018). The phenomenological attitude is a state of reflexive awareness that can be arrived at by coming to know one’s involvements in the world.

As *Dasein*, people are always in the totality of the world, so researchers cannot simply step out of their knowing. I come to my research because I am part of the world of outdoor mathematics education, and it has meaning for me. Being authentic, therefore, requires me to recognise my everyday attitude and develop a questioning approach to my preconceived ideas and biases. In my research, I have moved away from the natural attitude of ‘the teacher’ by practising reflexive techniques.

A Reflexive Approach

Since the late 1990s, reflexivity has been used to manage the relationship between the researcher and the research (Dibley, et al., 2020). Reflexivity differs from reflection as it refers to an active process of dynamic self-awareness rather than a retrospective analysis of a past

event (Dowling, 2006). Furthermore, it improves research transparency as the researcher's positionality is illustrated openly (Darawsheh, 2014). Dodgson (2019) suggests that reflexive accounts within qualitative research "not only increases the creditability of the findings but also deepens our understanding of the work" (p.220). Therefore, throughout my thesis, I have detailed my reflexive activities to demonstrate my understanding of how my positionality has influenced this work.

One of the strategies I used for developing my reflexivity throughout the research process was making entries in several reflexive diaries. In these, I noted my thoughts and decision-making process to examine what influenced my choices. These diaries became the topic of conversations with my supervisory team as I considered the assumptions driving my thought process. There are points through the research process where my reflexive practices influenced changes in my decision-making to maintain an open phenomenological attitude to the research. Throughout the subsequent chapters of this thesis, I will return to my reflexive thoughts to remain transparent about how my positionality has influenced how this research was conducted. I begin here with a declaration of my preunderstandings.

Declaration of Preunderstandings

van Manen and Adams (2010) describe educational phenomenological research as "a project of careful and systematic reflection on the lived experience of educational phenomena" (p. 449). Their use of the word 'careful' is a reminder that phenomenological research must not be clouded by presupposition. While uncovering personal biases and presuppositions is an ongoing process of continual reflection and reflexivity, it is helpful to declare preunderstandings before beginning the research design (van Manen, 2016a).

I participated in a presuppositional interview to aid the uncovering of my fore-structures of understanding. The method of the presuppositional interview is detailed further in a peer-

reviewed paper written by myself and my supervisors entitled *Being in the Wood: Using a presuppositional interview in hermeneutic phenomenological research* (Barrett-Rodger, Goldspink and Engward, 2023a). The discussion aimed to draw out my biases through questions focussing on important research concepts from axiology to my understanding of my positionality. Using the transcript from this interview and other reflexive methods, such as my numerous research journals, I fore-grounded my presuppositions, which I interpreted using Heidegger's fore-structures of understanding.

> **My fore-having** is how I approach learning as a primary mathematics specialist and, therefore, previous experiences of the phenomena I bring to my research. I approach my research as a teacher curious about children's experiences learning mathematics outdoors. I am, therefore, professionally absorbed in the debates around the topic and the conversations I have with other professionals in the sector. I bring understandings from my years of teaching, having been taught at school and training trainee teachers in teaching mathematics. I am attuned to the wonder and freedom of learning beyond the classroom as an experiential pedagogy that can enhance learning and attitudes towards the subject. My fore-having highlights my preunderstandings of the issue and how that understanding would continually change throughout the research.
>
> **My fore-sight** illustrates how I approach the experience of learning beyond the classroom as immersive, active, and engaging. I saw learning beyond the classroom through a professional teaching lens, knowing the role of myself, the children and what needed to be achieved. In advance of my study, I have an understanding that mathematics is a tricky subject for some, yet somehow, learning beyond the classroom would make the experience better for children who might otherwise be 'math-phobic'. I also understand that children may see it very differently from me.

> **My fore-conception** demonstrates my expectation of what the study would show the children's experiences, influencing how I conducted the research, asked questions during the interview and analysed the data. I believe that learning mathematics outdoors is somehow different, better, and extraordinary. I arrived at this research by being drawn to wanting to understand the experiences of the children I teach – not a desire to prove what I think I already knew but to have a greater understanding of something I have a gut feeling about.

Foregrounding these preunderstandings was the first step in being transparent and open about my biases. However, the process of reflexivity is ongoing and present in every stage of the research. Each decision was made through how I made meaning of the situation and my anticipation of how the decisions I made would affect the research. Therefore, this study is uniquely mine. Whilst this brings originality to the study, there was also the constant threat that my positionality and fore-structures of understanding guide my research without my awareness. Therefore, I describe my thinking around my choices at different points throughout this thesis.

An Ethical Methodological Approach

Conducting hermeneutic phenomenology requires ethical considerations to be made from a methodological perspective. Firstly, I need to consider the ethics of my competency as a researcher. This is my first study that employs the methodology of hermeneutic phenomenology. Therefore, this thesis represents a development in my abilities as a researcher and an attempt to answer the research question. To conduct this research ethically, Dibley, et al. (2020) stress the importance of having a competent understanding of the writings of philosophers (such as Heidegger) that underpin the methodology of hermeneutic phenomenology. My discussions within this chapter clarified my understanding of the philosophical tradition that informs my research approach. To be ethical in this study also

means maintaining methodological congruence throughout the research process. Whilst phenomenology is a complex methodology, I have developed the competency to conduct this research ethically through my extensive reading and training courses.

A researcher's understanding of who they are and the position they hold is also vital in conducting ethical research (Dibley, et al., 2020). My support for outdoor learning as an effective pedagogy has been made clear since the beginning of the study. It would be tempting from my position to conclude that the participants' experiences of learning mathematics outdoors result in finding that it is the most effective way of teaching mathematics, overstating any positively-framed findings. However, this thesis has clarified that this is not the study's objective. This research does not seek to describe outdoor learning as either positive or negative but to outline how it is as-lived for the individuals in the study. To be ethically transparent, it is also important to note that my employer pays my doctoral tuition fees. As a school that prides itself on its outdoor learning provision, it could be perceived that there would be pressure on my research to conclude positively with the effects of the pedagogy. However, the funding has been granted to promote my professional development and as a retention strategy. Therefore, it has been made clear to my employer that the funding will not impact my findings.

As described in Chapter One, the preservation of the voice of the participants requires ethical consideration. Hermeneutic phenomenology places the interpretation of the researcher as central to the research. This appears to conflict with the aim of ensuring that the participants' experiences are ethically represented. In answering this tension, one needs to return to the purpose of hermeneutic phenomenology as an applied methodology. The goal is to arrive at *an* answer to the research question rather than *the* answer. Smythe, et al. (2008) capture this when they say, "Our quest is therefore not to prove or disprove, not to provide irrefutable evidence but rather to provoke thinking towards the mystery of what 'is'" (p.1391). In this

sense, while effort needs to be taken to remain faithful to the participant's words to access the prereflective experience, the research's product will ultimately be the researcher's interpretation to continue the conversation with the study's readers.

In this section, I have detailed some ethical considerations directly related to hermeneutic phenomenology methodology. Then, in Chapter Four, I will discuss the practical implications of ethics concerning recruitment, data collection and analysis.

Methodological Strengths and Limitations

The strength of hermeneutic phenomenology is that it provides a position the researcher can adopt to address the subjectivity inherent in any interpretive research, namely the phenomenological attitude (Dibley, et al., 2020). By doing so, findings are allowed to emerge from the experiential data of the participants rather than being imposed by the researcher. Furthermore, due to a combination of descriptive and interpretive techniques, hermeneutic phenomenology allows the researcher to provide an interpretive description of human experiences. The product, therefore, of the hermeneutic phenomenological method is a scholarly and reflective phenomenological text containing rich experiential data – presented in Chapter Five of this thesis.

However, there are also limitations to hermeneutic phenomenology. Firstly, phenomenology makes no claims of generalisability (Zahavi, 2019). As previously discussed, the aim of the phenomenological inquiry is not to find commonalities in experience or to say that how it is for one individual will be true for another. Therefore, this thesis will not claim that the insights gathered will be accurate for all children. To suppose this misses the point of phenomenological endeavours. Phenomenology aims to uncover singularities in experiences to understand them better (van Manen, 2016a).

Reliability usually refers to how successfully a study could be repeated with the same or similar result. Phenomenology is not concerned with repeatability as a method of appraisal (Crowther and Thomson, 2022). Hermeneutic phenomenology accepts that the result could be very different if the research were conducted on a different day, with other participants or a different researcher. van Manen (2016a) suggests that the non-repeatability of hermeneutic phenomenology can be seen as a strength of the methodology as it demonstrates the complexities of human existence and experience, which other qualitative approaches may overlook or simplify.

There are also potential methodological limitations when researching children. For example, to access the prereflective experience, phenomenology almost always relies on participants' linguistic abilities to provide experiential accounts, which can be particularly difficult with children (O'Reilly and Dogra, 2017). While it may be undisputable that language and communication develop in sophistication from birth to adulthood, it may be doing a disservice to the participants to assume that they cannot provide experiential accounts. Therefore, whilst adopting an attitude of openness towards the participants' abilities to provide rich data, I use methodological reduction to consider techniques and strategies that may enable children to provide prereflective accounts should they be required. Methods employed to collect rich experiential data from participants in this study are discussed in detail in Chapter Four.

Rigour & Trustworthiness

Generalisability refers to how confidently the findings of a study can be applied to other situations or contexts and is often considered a valuable way of measuring the success of positivist studies. However, as already discussed, hermeneutic phenomenology does not claim to make generalisable findings. Yet, it is still important that this research demonstrates its quality if the conclusions and recommendations are to be adopted by teachers and policymakers. Rather than arguing generalisability, Crowther and Thomson (2022) suggest

that hermeneutic phenomenological studies should demonstrate transferability, which “does not involve broad claims and rather invites the reader to make connections” (p. 221). This study shows transferability as it is rooted within the broader context of my professional practice. Throughout the thesis, I draw links to the extant literature, including accounts of practice and policy documents. The thesis instils resonance with mathematics teachers and policymakers by situating this research in the real-life context of mathematics education and outdoor learning pedagogy.

In addition to the transferability of its findings, this research also needs to instil trust in those findings by demonstrating its quality and rigour. Rigour refers to how research shows quality in how it is conducted and presented (Dibley, et al., 2020). Throughout this thesis, I present my research rigorously by detailing the process through which it was conducted. This provides transparency for the reader so that they can trust the results. Trustworthiness can be described as the “degree of trust, or confidence, readers have in results.” (Cypress, 2017, p.254) and can be achieved through transparency. Several methods have been employed in this thesis to instil trust in the reader. Firstly, my position as a researcher is transparent throughout this study. Secondly, Chapter Four details how the transition from raw data to insights was achieved. By demonstrating clear paths from raw data to recommendations, the reader can trace the study’s findings back to the interview transcripts to add credibility to the integrity with which this study was conducted. Throughout the thesis, methodological congruence is maintained, and a rigorous approach to research is demonstrated.

Smythe, et al. (2008) propose that a hermeneutic phenomenological study may be considered lacking in trustworthiness if it tells the reader about the experiences of the individuals rather than showing the reader. Therefore, my thesis demonstrates the essences of the participants' lived experience through the use of raw data, constructed stories and interpretations. The aim is to create a thesis which resonates with the reader so that they can appreciate the experience

for themselves. The resonance of the text creates credibility in the research and its findings. One way of achieving a credible account of lived experience is through investing sufficient time in the research, drawing nearer to the phenomenon being studied (Lincoln and Guba, 1985). The entire process of my doctoral journey has taken six years. As discussed in Chapter Four, the data analysis process took more than a year. Dwelling with the data and exploring possibilities through reflexive and philosophical techniques strengthens the reader's trust in my findings and recommendations.

van Manen (2016a) suggests seven criteria to evaluate phenomenological studies in response to phenomenological research often incorrectly being appraised on standards belonging to alternative (often more traditional) methodologies. By doing so, he sets out what effective hermeneutic phenomenological studies should be.

Criteria	Description
Heuristic Questioning	The study's success in stimulating questioning attentiveness in the reader.
Descriptive Richness	The extent to which the descriptions of the lived experience contain detailed experiential data.
Interpretive Depth	The demonstration of movement beyond the *taken-for-grantedness* of everyday life.
Distinctive Rigour	How the research is constantly guided by self-critical questioning.
Addressive Meaning	The extent to which the experience resonates with the reader.
Experiential Awakening	A demonstration of the prereflective nature of the described experience
Inceptual Epiphany	The contribution to knowledge that the study makes beyond that which is taken-for-granted.

TABLE 1 - CRITERIA FOR SUCCESSFUL HERMENEUTIC PHENOMENOLOGICAL STUDIES

Table 1 illustrates the seven criteria for effective hermeneutic phenomenological research described by van Manen (2016a). These are the criteria which have driven the quality of my

study and which assessment of the rigour and trustworthiness of my thesis should be assessed. In Chapter Seven, I return to these seven criteria to reflexively evaluate the extent to which my research can be justified as being a high-quality hermeneutic phenomenological study.

Chapter Summary

In this chapter, I have addressed the methodological considerations that underpin my research approach. I have detailed my reason for adopting hermeneutic phenomenology as my chosen methodology and considered the implications of this on my research design. In addition, my position as a teacher-researcher and my reflexive approach to this research have been disclosed. This chapter is the beginning of my adoption of the phenomenological attitude through the use of the presuppositional interview and my research diaries.

I have considered the ethical implications of conducting phenomenological research on children and reiterated my determination to present their experiences as-lived through the prereflective principle of this study. Finally, the strengths and limitations of the methodology have been described, and I have illustrated how my research should be considered both rigorous and trustworthy.

The content of this chapter sets the methodological scene for the thesis by establishing the principles of the study. Then, in Chapter Three, I will use this methodological approach to engage with the literature before applying the principles of my study to a research design in Chapter Four.

Chapter Three: Coming to Understanding through the Literature

"We try to come together with our assumptions, not in order to forget them again, but rather to hold them deliberately at bay and even to turn this knowledge against itself, as it were, thereby exposing its shallow or concealing character."

(van Manen, 2016b, p.47)

One of the first stages in hermeneutic phenomenological research is for the researcher to foreground their presuppositions (van Manen, 2016b). The literature review, used in almost every doctoral study, can be seen phenomenologically as a way for the researcher to grasp their assumptions. Conducting a thorough review of the literature within the specific field of enquiry allows the researcher to understand current thinking around the topic, bring their beliefs to the foreground and identify the area of study that deems an examination necessary (Peoples, 2021). This chapter details my engagement with the literature to widen my thinking and highlight my biases before beginning the research.

Dibley, et al., 2020 point out that it could be argued that conducting a literature review can contaminate the researcher's views and impact their findings. By reading existing studies, a researcher may form preconceived notions about what they will find, which could inadvertently inform the study's findings. However, from a phenomenological standpoint, there is never a place where the researcher is not spoiled in their thinking (Gadamer, 1989). This literature review, therefore, serves two primary purposes. Firstly, to demonstrate that the proposed research is necessary by identifying a gap in understanding. Secondly, as an exercise in openness towards the possibilities of the study to inform my preunderstandings (Spence, 2017).

This chapter describes my approach to exploring the literature and how my phenomenological methodology has informed this. Following this, two scoping reviews are presented to examine

the current literature around children's experiences (firstly) in encountering mathematics and (secondly) of being in the outdoors. I then provide a reflexive account of my engagement with the literature before establishing a gap in contemporary research.

Smythe and Spence (2012) explain that “the nature of a hermeneutic review is that there are few rules to follow; rather, there is a way to be attuned” (p.23). Therefore, this review may differ distinctly from literature reviews found in other doctoral theses. Rather than critically evaluating papers, this review informs my preunderstandings and identifies the gap in current understanding that this research intends to address. This is also why the chapter concludes with how the literature review, as a complex hermeneutic relationship between the researcher and existing evidence, influences this study and my reflexive positioning.

Approach to Exploring the Literature

There are a variety of different approaches available when conducting a literature review. Systematic, narrative, scoping and theoretical literature reviews are ways a researcher can interrogate existing research and position their study. This thesis employs a scoping approach to the literature review. Whilst other review methodologies may seek answers to more specific research questions, a scoping review is conducted to explore broader topics that provide context to a research area (Munn, et al., 2018). As this literature review aims to provide a general overview of the field of research and invite an attitude of openness, a scoping review is deemed appropriate.

To maintain methodological congruence, I have adopted a hermeneutic approach for this literature review, as described by Boell and Cecez-Kecmanovic (2014). Boell and Cecez-Kecmanovic (2014) assert that a hermeneutic approach to conducting a literature review means “the dialogical encounter is extended and the fusion of horizons broadened to texts reaching to each other’s as well as to the reader’s horizon” (p.263). Therefore, a hermeneutic

approach to the literature acknowledges the researcher's positionality and enables them to draw meaning from the included texts through their context. I am deeply situated within the professional context of my research, and as a result, how I engage with the literature should take account of my experiences and researcher positionality.

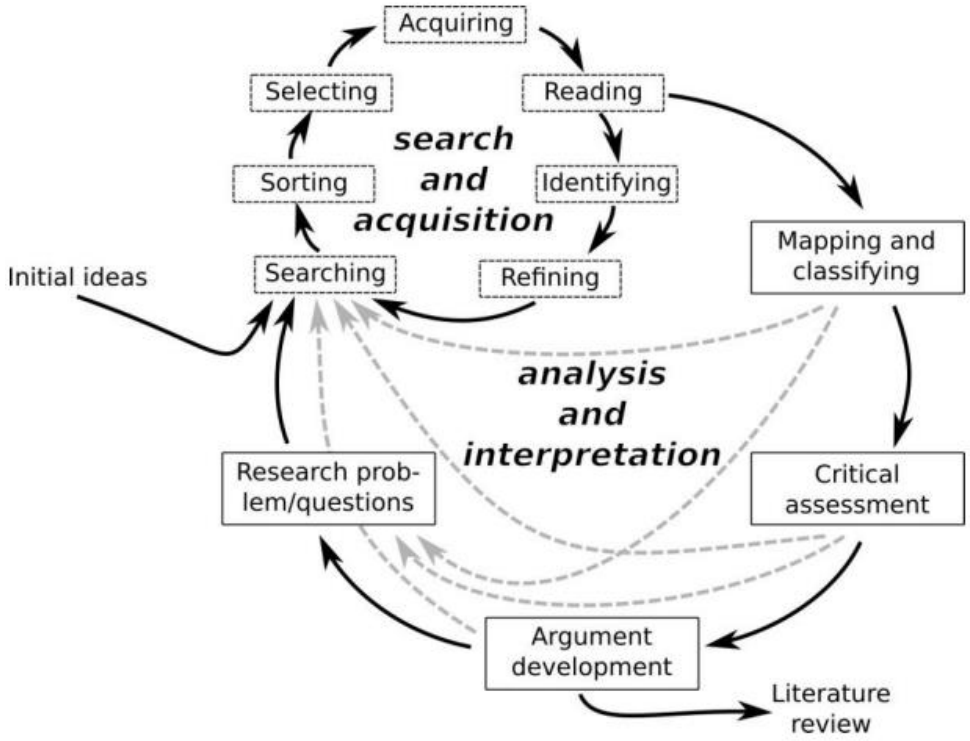

FIGURE 1 - A LITERATURE REVIEW FRAMEWORK (BOELL AND CECEZ-KECMANOVIC, 2014)

Figure 1 illustrates Boell and Cecez-Kecmanovic's (2014) hermeneutic framework for conducting literature reviews comprising two hermeneutic circles. Each circle demonstrates cyclical movements between interpreting individual texts and combining texts into a whole literature review. The process begins by searching and acquiring individual texts through searching, sorting, selecting, acquiring, reading, identifying and refining. The larger circle illustrates how these texts are mapped and assessed, leading to argument development which informs the research question.

Searching, Sorting, Selecting and Acquiring

Whilst this should not be considered a systematic literature review, which is commonly used in other research approaches (O'Brien and McGuckin, 2016), the approach to searching for and analysing the literature was conducted systematically. The benefit of this is that systematic approaches provide transparency and consistency (Green, Johnson and Adams, 2006).

Five electronic databases were used in all of the searches described below. They were: British Education Index, Education Abstracts (H. W. Wilson), Education Information Resources Center (ERIC), Professional Development Collection and Social Science Database. Each was selected to cover a range of disciplines and topics applicable to the research topic. These include education, social sciences and childhood studies. All searches were conducted in January 2023.

To aid in the identification of search terms, the SPIDER framework was adopted (Cooke, Smith and Booth, 2012). This was used to help identify the **S**ample, **P**opulation (or **P**henomenon) of Interest, **D**esign, **E**valuation and **R**esearch type to search for relevant research articles. However, after several searches, which only returned a few results, I decided not to use the **D** and **R** of the SPIDER framework in my search. This aim was to avoid missing important articles because of too many tightly-defined search terms. While I acknowledge that the reviews included in this chapter may have missed studies, a systematic approach to searching the databases sought to reduce the chances of this. Additionally, these scoping reviews seek to find plausible answers to the questions that inform the study. The aim is not to find *the* answer, as may be the objective of a systematic literature review.

First, it was essential to conduct a database search to identify if the question this research poses has already been investigated. To achieve this, I searched for specific terms for my research question.

	Term	Search terms	Location
S			
PI	Outdoor learning, Mathematics	Outdoor learning AND Math* [math; maths; mathematics]	Any field
D			
E	Experience	Experience* [experience; experienced; experiences]	Any field
R			

TABLE 2 - SEARCH TERMS FOR RESEARCH QUESTION

Table 2 shows the search terms I used. In this search, I decided not to use S as I wanted to find any research related to outdoor mathematics learning experiences. Unfortunately, the search returned no results demonstrating that it is likely that no published study has asked this specific research question. Therefore, I began searching for my first scoping review with the question: **what does the literature reveal about children's experiences of mathematics?**

	Term	Search terms	Location
S	Children, pupils, students	Child* [child; children; childhood] OR Pupil* [pupil; pupils] OR Student* [student; students] OR Learner* [learner; learners]	Title
PI	Mathematics	Math* [math; maths; mathematics]	Title
D			
E	Experience	Experience* [experience; experienced; experiences]	Any field
R			

TABLE 3 - SEARCH TERMS FOR EXPERIENCE OF MATHEMATICS SCOPING REVIEW

Table 3 illustrates the search terms used for this process. Truncation symbols were used to search for all derivations of a term. For example, Child* will retrieve child, children and childhood. The BOOLEAN operators OR enabled me to combine search terms to widen the search for synonyms. This allowed children, pupils, students, and learners to be used in one search. Consideration was also given to the location of the search terms. I decided that the sample and phenomenon of interest should be in the article's title, as these are the essential elements of the search. I discovered that some relevant studies do not use the term experience in their titles. Therefore, I decided to search for the term experience in any location within the article, including in the publication's abstract. Additionally, I used inclusion and exclusion criteria within the database searches to be more specific about the literature to be included in the review.

Inclusion Criteria	Exclusion Criteria
• Abstracts that contain one or more of the key search terms • Year of publication between 2000 and 2022 • Written in English • Peer-Reviewed Articles or Published Dissertations only	• Participants aged entirely below three years or above 16 years • Experience alternatively defined • Not focussed on children • Entirely quantitative designs • Not original sources • Full text not available

TABLE 4 - INCLUSION AND EXCLUSION CRITERIA FOR EXPERIENCE OF MATHEMATICS SCOPING REVIEW

Table 4 shows the inclusion and exclusion criteria applied to the search process. Whilst the inclusion criteria were input into the database to filter results, I used the exclusion criteria to refine the selection, exclude irrelevant literature and identify the articles to be included in the review. I did this by screening each of the titles and then by screening each abstract.

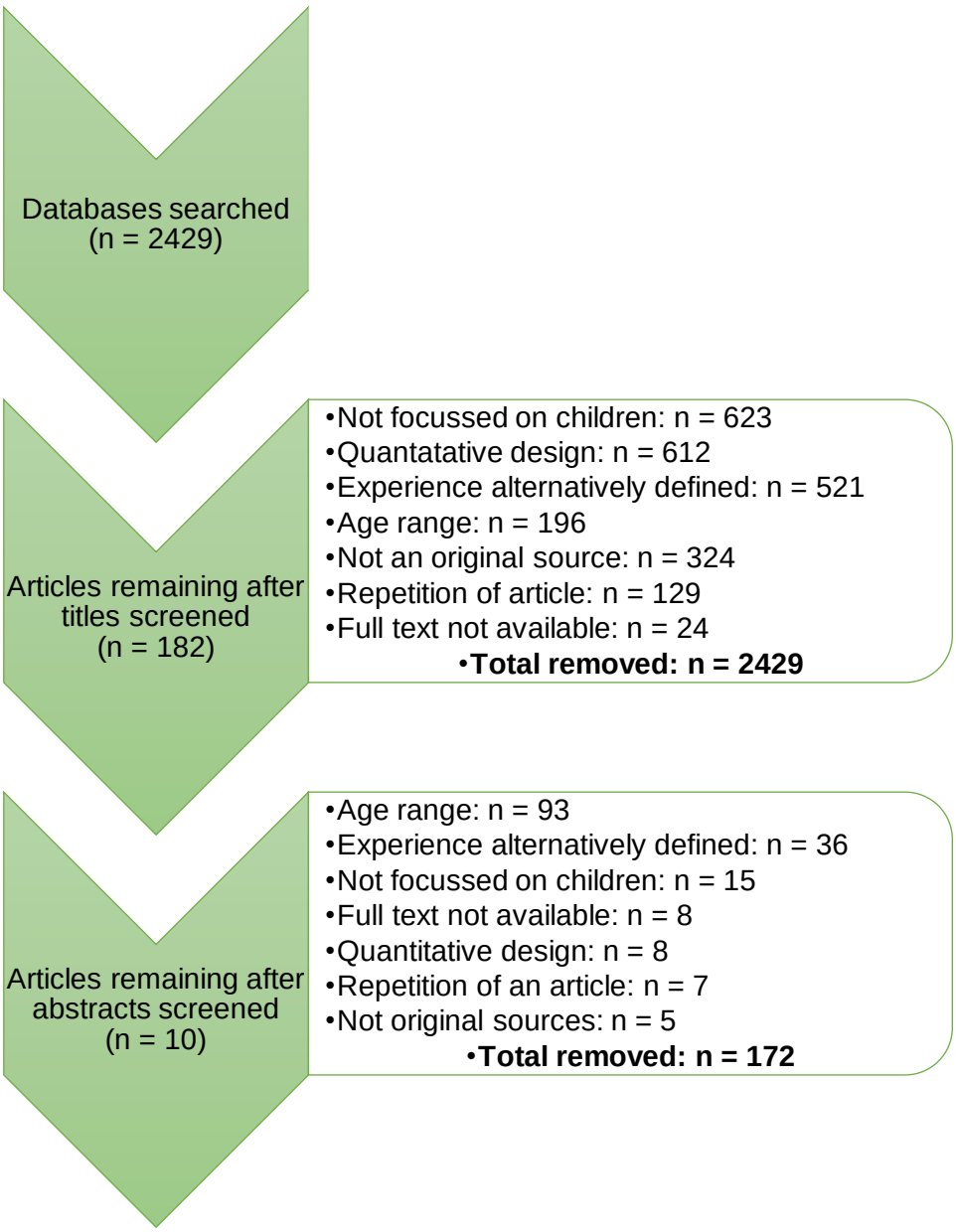

FIGURE 2 - FLOW CHART OF DATABASE SEARCH FOR EXPERIENCES OF MATHEMATICS

Figure 2 illustrates the number of articles that were first returned by the databases and then had their titles screened before having their abstracts read. Most articles screened were excluded due to their lack of focus on children. While these articles sometimes investigated children's experiences, they were conducted on the adults around the children (i.e., parents

and teachers). Although these papers did not go into the review of the literature, the finding that much research is still conducted *on* children rather than *with* children has reflexive implications. These will be discussed towards the end of this chapter.

Figure 2 illustrates that many research studies adopted an entirely quantitative approach. Whilst each article was not read in full, each had the word experience in its abstract. It was surprising that several experimental studies were included here. In Chapter Two, I ruled out a positivist approach for this research based on the understanding that studying experiences required an interpretive paradigm. Therefore, it is crucial to consider what different literature refers to as 'experience'. As Chapter Two clarifies, this study views experience as describing an individual's *lifeworld*. Other studies use attitudes and perceptions to measure experience. Therefore, some studies used quantitative questionnaires and surveys to measure participants' attitudes and make conclusions about their experiences. Whilst I understand the value of quantitative analysis in a different research context, these papers were excluded due to their difference in defining experience.

I decided not to restrict articles to those based in the UK. Whilst I only returned papers written in English, and this study takes place in the UK, only using UK studies to inform my research would mean missing valuable insights. Furthermore, as already discussed in Chapter One, many countries (particularly in Scandinavia) are more advanced in their use of outdoor learning. Therefore, it is appropriate to consider the research in those countries as helpful to this study.

The second scoping review aimed to ask what the literature reveals **about children's experiences of being outdoors.** Table 5 and Table 6 illustrate the search terms and inclusion and exclusion criteria used for this review.

	Term	Search terms	Location
S	Children, pupils, students	Child* [child; children; childhood] OR Pupil* [pupil; pupils] OR Student* [student; students] OR Learner* [learner; learners]	Title
PI	Being outdoors	Outdoor* [outdoor; outdoors]	Title
D			
E	Experience	Experience* [experience; experienced; experiences]	Any field
R			

TABLE 5 - SEARCH TERMS FOR EXPERIENCE OF BEING OUTDOORS SCOPING REVIEW

Inclusion Criteria	Exclusion Criteria
• Abstracts that contain one or more of the key search terms • Year of publication between 2000 and 2022 • Written in English • Peer-Reviewed Articles or Published Dissertations only	• Participants aged entirely below three years or above 16 years • Experience alternatively defined • Outside as alternatively defined • Lack of focus on experience • Not focussed on children • Entirely quantitative designs • Not original sources • Full text not available

TABLE 6 - INCLUSION AND EXCLUSION CRITERIA FOR EXPERIENCE OF OUTDOORS SCOPING REVIEW

I decided not to include 'learning' in this database search. This review aimed to understand children's experiences of the outdoors, whether educational or not. Of course, many of the results included outdoor learning experiences, whilst others did not. On the following page, Figure 3 shows how the database search results were filtered down to the articles included in the second literature review.

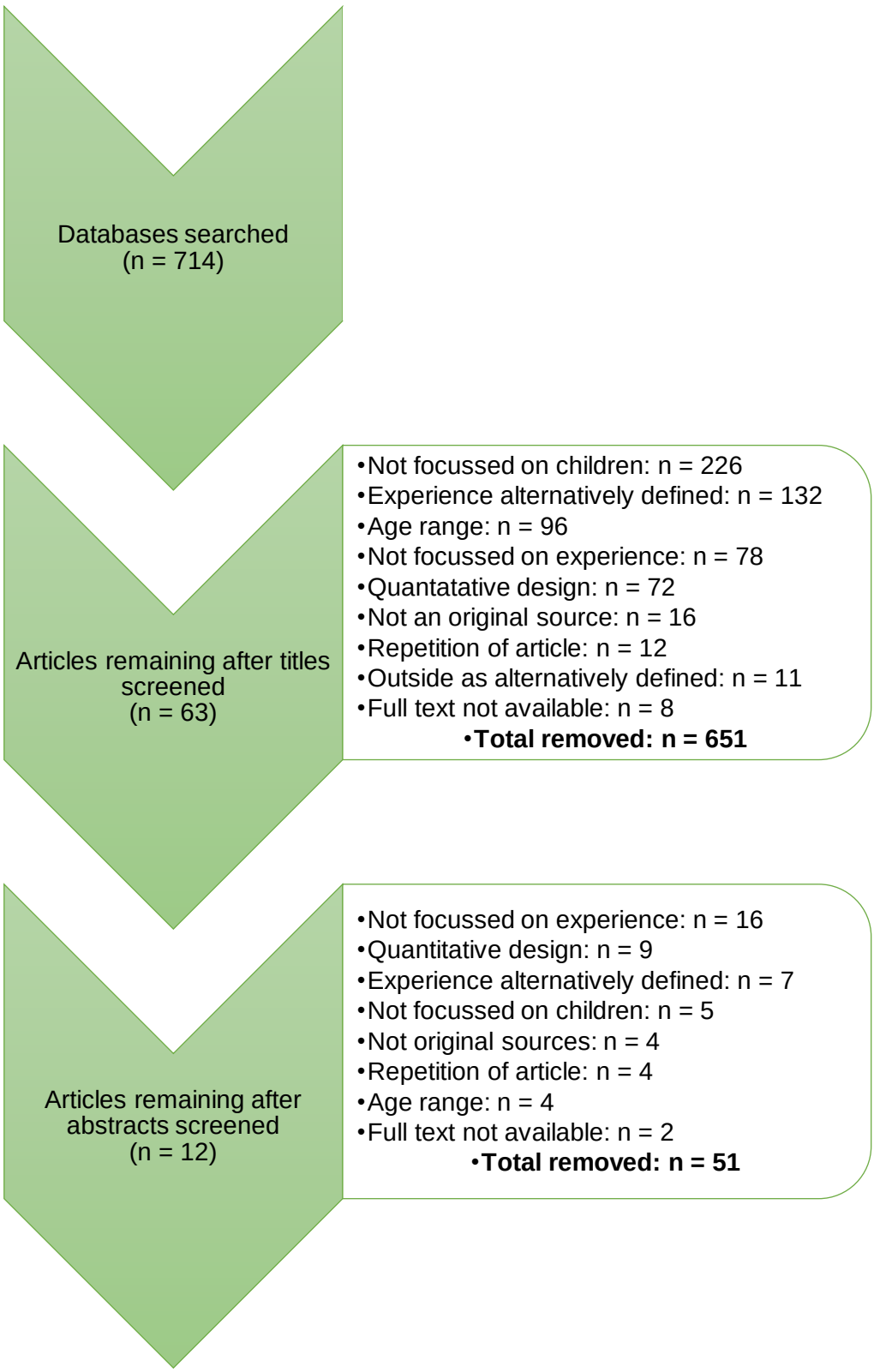

FIGURE 3 - FLOW CHART OF DATABASE SEARCH FOR EXPERIENCE OF BEING OUTDOORS

As in the first review, many articles were excluded because they focused on adults as participants rather than children. In addition, some were excluded because of what they meant by the term ‘outside’. For some papers, outside of school did not mean in the outdoor environment but outside of the establishment (e.g., at home). Again, several quantitative studies were excluded.

As Figure 2 and Figure 3 illustrate, some texts were not available in full. The hermeneutic framework for literature reviews that I followed clarifies that acquiring full texts can be challenging (Boell and Cecez-Kecmanovic, 2014). Therefore, where some texts were not available in full, and more information was needed than provided in the abstracts to understand the relevance of each study, these were excluded from the review.

Reading, Identifying and Refining

First, each of the papers was read in its entirety. Boell and Cecez-Kecmanovic (2014) describe the importance of *analytical reading* when conducting literature reviews. Analytical reading refers to dwelling with each text in depth to understand the parts of the text and the text as a whole. To achieve depth in my reading, I made notes on experiential material and findings of each article and followed this up with reflective comments. Next, I read and re-read the articles, each time making notes of the article’s findings and how these resonated with my own experience, demonstrating a fusion of horizons between myself and the literature.

Only a small number of studies followed a phenomenological methodology. Therefore, not all papers in the review focus on the prereflective experience. Yet, each included did provide glimpses beyond perception or opinion. When reading, I made notes of material and findings which explored the experience as-lived.

Boell and Cecez-Kecmanovic (2014) recommend that reading should lead to further research articles being read and analysed as the researcher refines their search question. However, I

decided not to follow these steps as they deviate from the scoping review methodology. As already detailed, a scoping review is helpful when there are few articles related to a narrow field of research. In this review, I sought to find what the research reveals are the prereflective experiences of children learning mathematics and learning outside. When I began to follow references from one paper to another, I found that the subsequent paper was not directed towards lived experience or was already included in my initial literature search. Because I conducted my database searches, I was confident I had enough material to describe the contemporary literature concerning my search questions adequately. However, I did incorporate further non-academic articles during the argument development stage, which I describe below.

Mapping, Assessing and Developing

Once all studies had been read and notes recorded, themes were developed. The themes presented in these reviews result from my engagement with and interpretation of the findings of each of the studies included in the reviews. They offer possible answers to the review questions that seek to inform this study and develop my openness towards my research question. Within my research journal, themes were constructed through similarities and differences between the papers' findings included in the review.

At the stage of argument construction, I also incorporated some non-academic literature beyond what had been found in the database searched. Grey literature, such as policy documents and opinion pieces, were included to deepen my understanding of how the findings in the scoping review support or contradict professional practice and pedagogy. The grey literature I chose to include also supported the foregrounding of my presuppositions. Because the grey literature was not found through database searches, it demonstrates writing I have previously encountered and resonates with my professional sensibilities. Grey literature did not form the themes of the scoping review. Instead, the themes and arguments were

constructed through what the peer-reviewed academic literature said about the lived experiences of children learning mathematics and learning outdoors. However, the grey literature builds upon these themes and brings them into my professional practice.

The primary purpose of a scoping review is to provide a “descriptive overview of the reviewed material without critically appraising individual studies” (Pham, et al., 2014, p.372). Therefore, critical analysis is not contained within this review. Instead, towards the end of this chapter is a reflexive account of how the literature has informed my preunderstandings of the field of enquiry and the impact this has on the study.

Children's Experiences of Mathematics

The purpose of this scoping review is to answer the question: **what does the literature reveal about children's experiences of mathematics?** In total, ten papers were reviewed as part of this scoping review. A table of these papers can be found in Appendix A.

Mathematics anxiety (MA), which can be defined as "a person's negative affective reaction to situations involving numbers, math, and mathematics calculations" (Ashcraft and Moore, 2009, p.197), is a topic covered in much of the research papers included in this review. However, where MA is discussed, it often concerns the causes and effects in an attempt to measure it quantitatively. Therefore, MA is not a topic covered in this scoping review. Instead, the content of this review uses the experiential material and findings from those reviews.

This scoping review acknowledges that there is no single way in which all children experience mathematics; that is not the nature of lived experiences. Instead, this review seeks to find possible answers to the review question found in the extant literature to develop an openness to the topic. Synthesis of the ten articles reviewed produced the four overriding themes of **interaction with others**, **a difficult subject**, **relevance to the world** and **modes of knowledge acquisition**. While there will inevitably be an overlap in experience between these themes, they provide a method to describe the lived experiences found in the literature.

Interaction with others

The literature suggests that children's experiences of mathematics involve a great deal of interaction with others. However, this interaction can take on many different forms. Firstly, interaction with others can be experienced as competition or negative attention. Carey, et al. (2019) conducted a mixed-method study into the experiences of primary and secondary students learning mathematics in the UK. Their participants reported being negatively evaluated and even mocked by peers for incorrect answers. In these cases, it is clear that

children's mathematics experiences can be influenced by those around them, particularly their peers. In Hintz's (2011) study of elementary students, one participant also reflected on the public embarrassment of getting a question wrong. In this sense, mathematics can be experienced as a high-stakes subject in which individuals are penalised if they get things wrong. According to participants in other studies, children worry that others will get a higher mark (Musa and Maat, 2021), indicating that children can experience mathematics learning as a form of competition. As a result, getting the most marks and beating others is crucial. In contrast, others found that getting questions right could cause tension.

Jensen and Hanghøj (2020) conducted a study on fifth-grade pupils in Denmark (ages 10 and 11). In their research, participants emphasised that being the first to finish could put friends in awkward situations. Consequently, there is tension experienced in mathematics lessons between getting things wrong and being embarrassed and getting things right and making others feel bad. Additionally, Hintz (2011, p.265) found that participants "experience mathematical and interactional demands", suggesting that learning mathematics is not just about the learning content but also concerns managing interactions with others in lessons. Children experience judgement from others and sense the burden of being unkind.

It is also evident that some children are aware of their position within the class. In Carey, et al.'s (2019) study, one secondary student with elevated levels of MA reported, "I was sat near people who were a bit higher level than me" (p.47). This demonstrates that children experience their learning with a sense of where they are academically about those around them. However, whilst interactions with others in mathematics lessons are experienced negatively for some, this is not the case for others who share connections with others as incredibly beneficial.

In their qualitative study of 10-11-year-olds in Australia, Russo, Russo and Roche (2021) found that children valued opportunities to collaborate and interact. Children experienced learning mathematics by sharing ideas to support their learning, a finding shared across

multiple studies. For example, a participant in Sneck, et al., (2022, p.15) stated that “working together makes you learn better than working alone.” Similarly, in Hintz’s research (2011), children claimed that listening to others helps individuals to become more knowledgeable. The authors argue that this demonstrates an openness to other ways of thinking. By collaborating with others, children experience being supported through their mathematics learning. There is a sense that this is a relationship that the children establish and maintain throughout their lessons.

Supporting others and being supported by peers is a theme common in many of the studies in this review. One participant said about a peer, “She will also help if I ever don’t understand” (Pepin, 2011, p.542), illustrating that children experience support as a two-way relationship that can be called on when needed. However, some describe their difficulty in not being able to help. For example, in a case study of Malaysian 16-year-olds, students reported that they were frustrated when they could not support others because of the difficulty of the subject (Musa and Maat, 2021). Therefore, whilst many children experience mathematics learning as a collaboration, for those who are unable to help, it is an uncomfortable experience. Collaboration and interaction are themes connected closely with the idea in the literature that mathematics is viewed as a complex subject.

A difficult subject

Throughout the literature, there is an emphasis on children experiencing mathematics as a challenging subject. According to Carey, et al. (2019), children described their mathematics experiences as frustrating, often resulting in their minds going blank and perceiving mathematics as a tricky subject. This is supported by Musa and Maat’s (2021) study, which found that children experienced mathematics lessons in a state of confusion. One of their participants claimed they were “lost throughout the lesson” (p.942), suggesting that children are often baffled by mathematics learning.

Sometimes the experience of difficulty in mathematics lessons is manifested in physical reactions. For example, in Carey, et al.'s study (2019), primary-aged children described stomach aches, feeling sick, experiencing 'butterflies' and becoming tearful due to frustration. This emphasises the negative experiences and discomfort children can live through when learning mathematics.

The theme of mathematics as a complex subject that induces fear resonates with the literature I have read beyond the articles in this scoping review. For example, in Kulkin's (2016) article, one child is reported to have said, "Fractions are hard. They burn like lava" (p. 28). Here the child's response to fractions is highly evocative and provides an effective platform for understanding how learning mathematics can be for that child. Burning like lava gives a physically painful dimension to learning mathematics. The child makes clear that it is because of the perceived difficulty of a topic in mathematics that they feel the pain and gives greater insight into the possible experiences of the participants in Carey, et al.'s (2019) study.

The literature shows that there is also a perception among some students that mathematics is a subject you are either good or bad at. For example, Francome and Hewitt (2020) conducted a qualitative study on Year 7 pupils in the UK. One of their participants said, "You have a certain amount of maths ability. You can't really change it" (pp.486-487). The views of this pupil echo the findings of a report by the Office for Standards in Education (Ofsted), which found that many children believe mathematics to be "the preserve of those who seem to be 'naturals'" (Ofsted, 2021, n.p.) It could be argued that these views demonstrate that mathematics is not an inclusive subject as some are able and some are not. Therefore, some children may experience mathematics learning through exclusion or segregation.

Furthermore, the participant's perspective that you cannot change your mathematic ability implies that some children experience mathematics through a fixed mindset. A fixed mindset is the acceptance that ability is static and that working to improve it is futile (Smith, 2020).

However, Francome and Hewitt's (2020) study is entitled 'My maths lessons are all about learning from your mistakes.' This title illustrates their main finding: children experienced success in mathematics learning due to difficulties and failures. This is a conclusion shared with Hintz (2011), which identified that participants felt that getting things wrong, whilst embarrassing, helped them to get it right the next time.

Pepin (2011) conducted a comparative mixed-method study of secondary students' attitudes towards mathematics in England and Norway. They found that students' difficulties with mathematics were partly due to the perception of mathematics as a theoretical study. Students had not experienced mathematics in a physical sense and saw little application or relevance to the world: another theme evident throughout the literature.

Relevance to the world

Studies found that participants had difficulties relating their mathematics experiences to real life. Jensen and Hanghøj (2020) gathered experiential material, which revealed that participants thought mathematics should be related to the world but had not previously experienced this, demonstrating that children often abstractly experience mathematics. I am reminded of a chapter in a book that resonates with my professional practice. Pratt (2011) describes how mathematics sometimes struggles to be relevant to learners and consistently tries to make itself 'based in the real world' (p.80).

Howley, Pendarvis and Gholson (2005) conducted a qualitative study investigating the experiences of mathematically gifted US students aged 7 to 14. They discovered that their participants experienced mathematics as procedural and routine. While the students did not dislike mathematics, they often did not relate their mathematics learning to practical or real-life applications. This is supported by Pepin (2011), who found that students experienced a

repetitive nature of mathematics lessons which, as one participant put it, “does not allow you to be creative” (p.541).

The perceived irrelevance of mathematics to children’s lives also results in children being bored in lessons. Simpson and Che (2016) conducted a descriptive phenomenological study of 13-14-year-olds learning mathematics in the US. While their research focused on the effect of single-sex classes, they observed behaviours that demonstrated boredom. Participants were observed with their heads propped on chins and yawning. They claimed that the boredom resulted from repetitive instructional practice, which had little resonance with the individuals. This resulted in mathematics being experienced as a boring subject.

Russo, Russo and Roche (2021) found that a narrative context within mathematics lessons made the experience of learning more purposeful for participants. This also made it more enjoyable. There are other occasions where they were excited about their mathematics learning, for example, within Carey, et al. (2019), although this was less commonly observed. This often resulted from working with others, but it also concerned how lessons were constructed to transmit knowledge.

Modes of knowledge acquisition

While reviewing the literature, two main modes of knowledge acquisition were evident, transmission and connectionist. Sneck, et al. (2022) conducted a qualitative study of nine-year-old pupils’ experiences participating in the Moving Maths programme in Finland. One participant described “learning from the board” (p.12). This represents a transmission form of learning where knowledge is passed from one to another. Whilst the ‘transmitter’ of expertise is usually the teacher, the pupil describes being fed knowledge by the board. The board here can be seen as an extension of the teacher as the deliverer of the learning.

Transmission of knowledge was the most common mode of learning described by participants in the literature reviewed. For example, Francome and Hewitt (2020) found that students who learnt in ability-set classes described their learning process as replicating what the teacher had shown them to do. Similarly, the role of the teacher as a facilitator was highlighted in Carey, et al.'s (2019) study. Participants commonly discussed a teacher's particular methods when describing their experiences. This highlights the significant role of the teacher in the experiences of children learning mathematics.

However, a different mode of knowledge acquisition was also demonstrated in the literature. Francome and Hewitt (2020) found that students taught in mixed-ability classes often experienced high levels of discussion and collaboration. This resulted in a more connectionist learning mode where knowledge is created through interaction with others. This was the focus of Hintz's (2011) study which examined students' experiences as listeners during mathematical discussions. They found that students took on and enacted the role of sharer or speaker. Students could set their thinking aside to listen and understand what others say. In this way, students experienced learning mathematics as a co-construction of their understanding and that of others. This demonstrates an alternative way of experiencing mathematics learning than may typically be seen inside a classroom with a teacher at the front and students sitting behind desks.

It was also seen in the literature that when children were given autonomy over their learning, rather than being directed by the teacher, it changed their learning experience. For example, in response to being given freedom in their approach to solving a mathematics question, one participant commented that "in usual math there would be just sums in a row, they're all like generic. But this kind of adds a splash of colour" (Russo, Russo and Roche, 2021, p.11). This demonstrates the change in experience when being about to conduct their project rather than

being directed by an authoritative figure. In this sense, children can experience mathematics as guided learners or through a series of autonomous choices.

Summary of Children's Experiences of Mathematics

This review sought to understand the current literature about children's mathematics learning experience. It is clear from the review that each child experiences mathematics differently. However, the review has drawn some similarities in the experience. First, it has been demonstrated that relations with others are a vital way in which mathematics learning is experienced. Learning relationships in mathematics can be positive (in the form of collaboration) or negative (in the sense of competition and embarrassment).

It is evident from the literature that many children experience the challenges of mathematics and perceive it as a difficult, even scary, subject. Some children's mathematics experiences drive a fear of the subject, which can result in physical pain, such as a stomach ache. The research also demonstrates that some children experience mathematics as abstract rather than practical and related to the real world. In addition, the literature reveals that children mainly experience learning mathematics through one of two modes. Most children experience being taught mathematics as a direct knowledge transfer from teacher to student. However, others experience mathematics learning as a construction of peer understanding through discussion and interaction.

The purpose of study for mathematics in England aims to engage children in creative, curious and beautiful mathematics learning (Department for Education, 2013). Whilst many of the studies included in this review are not from the UK, the limited amount of literature suggests that children experience mathematics through competition, collaboration, anxiety, lack of purpose and as a transmissive learning style. Therefore, it can be concluded that current mathematics pedagogy does not fulfil the aims of the purpose of study.

Children's Experiences of the Outdoors

This scoping review aims to answer the question: **what does the literature reveal about children's experiences of being outdoors?** Twelve papers were reviewed as part of the first scoping review. A list of these papers can be found in Appendix B.

In the same way as the first scoping review, this review of the literature does not seek to define how children experience the outdoors definitively. Instead, the literature discussed below points to possibilities. Reviewing the selected papers produced the five themes of **freedom**, **agency**, **collaboration**, **imagination** and **joy**.

Freedom

Literature suggests that children experience the outdoors with a sense of freedom. In their grounded theory study of children's experience of making music in the outdoors, Adams and Beauchamp (2018) found that their participants described the freedom of being released from the classroom. Their study examined 38 pupils aged between 7 and 10 years across five primary schools in Wales. One of their participants reported, "It's outdoors and you're free… you're just free" (Adams and Beauchamp, 2018, p.55). Adams and Beauchamp reflected that the sense of freedom experienced by their participants may have been due to the increase in physical space compared to the limited confines of the classroom.

Freedom is a theme echoed in Fasting and Høyem's phenomenological study of friluftsliv, a Norwegian term meaning "outdoor life" (2022). Fasting and Høyem conducted walking interviews with eight 24-year-olds who had been observed in outdoor play as children as part of a previous study. Participants recalled that freedom was central to their experience of playing outdoors as the adult's role differed from that of the adult indoors. Whilst this study relied on the long-term memories of participants, the fact that freedom was an emergent theme

supports the findings of other contemporary studies. This research also moves thinking from freedom of space to freedom of the control of adults.

Literature also reveals that the freedom children experience as a result of being released from the classroom and the dictatorial role of the adult also instils a sense of calm and peace. In a study by Coates and Pimlott-Wilson (2019), one participant explained, “I can finally stop worrying about maths and start thinking about happiness” (p.28). The child here reveals that the outdoor environment strips away school's opposing pressures and temporarily allows their worries to be forgotten. Peace is also seen in other studies where researchers uncover calm and relaxation in their participants due to immersion in the outdoors (Adams and Beauchamp, 2021). Adams and Beauchamp’s (2021) grounded theory research explored the experiences of children aged 7 to 11 taking part in mindful approaches in local nature reserves. The calm and relaxation their participants felt were also experienced as a slowing of time. They found that when being mindful, participants transcended the linear clock-time constraint due to being in the moment. Therefore, it could be claimed that being outdoors reduces worries and allows the individual to slow down.

For some, the calmness of being outdoors means that they can focus on their learning. A participant in Fägerstam and Grothérus’ study (2018) commented that “you need fresh air for thinking” (p.384). This demonstrates that, for this individual, freedom of the outdoors also provides an environment to think clearly and focus on learning. However, other research suggests that some children are distracted by the outdoors (Jørring, et al., 2020). Despite finding that a larger distributed learning area provided more space for children to spread out, Jørring, et al. (2020) found that for some, this diverted attention away from the learning focus. Therefore, whilst the literature supports the experience of outdoor learning as a sense of freedom, the impact this has on an individual’s learning is unclear. Whilst physical freedom is

evident in the literature, freedom is also experienced through freedom of choice, described by some researchers as agency or autonomy.

Agency & Ownership

Agency is a theme evident in several studies included in this review. For example, Adams and Beauchamp (2018) found that students experienced autonomy when learning music outdoors. Their participants reflected on the ownership they had over their learning. This is one of the critical effects of the freedom that children experience when learning outside. Because the teacher often dominates the classroom, the children follow instructions within the traditional learning setting. In addition, the literature reveals that children experience learning differently outdoors as they have more influence over their decisions.

A sense of choice is also evident in research by Berg, et al. (2021). They conducted focus group interviews with 7- and 8-year-olds participating in outdoor exploration sessions in Canada. One of their key findings was that participants experienced freedom of choice in their learning. As the purpose of the activity was exploration, children guided themselves (and each other), making their own decisions about how to proceed. Increased autonomy is also a common phenomenon experienced in Forest School sessions (Coates and Pimlott-Wilson, 2019).

Choice is closely related to the connection with nature that children experience when outdoors (Berg, et al., 2021). Manni, Ottander and Sporre (2017) conducted case study research on thirteen students in Sweden with experience in outdoor activities. They found that students interacted with the natural environment through tools and objects belonging to the space. This supported the children in learning about abstract concepts through concrete, natural artefacts. Exploration and investigation of the objects of the natural world are important ways children

experience being outdoors. The hands-on learning experiences in the outdoors also develop a connection to the formal curriculum (Berg, et al., 2021).

Through exploration and the objects of an outdoor environment, children experience different emotions in locations and develop an understanding of ownership over certain places (Janik, 2022). Janik (2022) conducted an ethnographic study of twenty-three 3 to 10-year-olds playing in natural environments in Poland. They discovered that children associated distinct emotions with different locations and preferred specific places depending on their moods. In this way, spaces become full of personal meaning for children. These personal meanings can be positive or negative, leading to a fear of particular locations. They found that one reason for fearing a place was other users' perceived appropriation of space. Children knew which areas were used by others and which they were not allowed into. This reveals that children can experience locations outdoors as a commodity. There are places for children and places where children know they are not to go. Despite a sense of ownership of locations in the 'real world', children also experience the outdoors through imagination and creativity in the 'make-believe world'.

Imagination and Creativity

Harwood, Huang and Somma's case study (2022) of 6 to 12-year-olds attending Forest School in Canada found that their participant's imagination and curiosity were constantly provoked within the natural environment. Through experimentation and exploration, children in this study revealed how the outdoors invited them into a world of make-believe. This theme is supported by other studies, such as Neville, Petrass and Ben (2021). Their Australian case study of students participating in outdoor writing workshops found that students could write more imaginatively in an outdoor environment than in a classroom.

Whilst conducting phenomenological interviews with children participating in Forest School in the UK, Coates and Pimlott-Wilson (2019) found that children freely engaged in imaginative play when outside. The literature reveals something about the outdoors that engages children in creative thinking that may not be as easily achieved indoors (Fasting and Høyem, 2022). This is echoed in a participant's response to a music lesson outside. "We were playing like everyone was giving a message to the clouds" (Adams and Beauchamp, 2018, p.57). The child uses a simile to glimpse what it might be like to play music outside. It reveals that seeing the clouds outside provides an imaginative audience and gives a purpose to the playing. The use of 'we' and 'everyone' also hints that being outdoors is a social experience.

Collaboration and Teamwork

The theme of collaboration and teamwork is evident throughout many of the papers included in this review. For example, Smith, Steel and Gidlow (2010) conducted video-elicitation interviews with thirty-two secondary school students participating in school camp programmes in New Zealand. While these were only temporary experiences, the analysis revealed that the temporary social community was an essential element of the experience. Being with others outdoors was also central to experiences in several other studies (Neville, Petrass and Ben, 2021; Manni, Ottander and Sporre, 2017).

One participant in a study remarked, "I can learn a little bit more than I already did about something with someone." (Coates and Pimlott-Wilson, 2019, p.33). This suggests that having others to connect with, particularly when learning outside, is important. This is supported by Fägerstam and Grothérus (2018), who found that participants experience a community of co-operation when outdoors. They revealed a sense of working as one and being all in it together. The social dimension of being outside for children is also responsible, in part, for the joy experienced when outdoors (Fasting and Høyem, 2022).

Joy

Fasting and Høyem (2022) found that the joy experienced in the outdoors was more substantial when it was a shared experience. Other studies also share joy as a phenomenon of being outside for children. For example, Jørring, et al. (2020) conducted a comparative case study of students involved in Education Outside the Classroom in Denmark. One of their participants revealed, “You actually do not notice you are doing math because it’s fun.” (p.421). Fun and enjoyment are words used widely in many of the studies within this review. For example, when children are involved in writing outside, they not only enjoy the outdoors but also have more enjoyment in the task of writing due to the reduced noise and minimal distractions (Neville, Petrass and Ben, 2021). Here, the quiet space of the outdoors provides the enjoyment of learning, which may be harder to achieve through quietness in the classroom.

The experience of joy can also be the antidote to boredom. Fägerstam and Grothérus (2018) conducted a case study of fourteen secondary-aged students with experience of being taught outdoors in Sweden. One participant commented, “I am not so good at maths […] To be able to learn, you need to think that something is fun, otherwise it doesn’t work. With outdoor lessons you don’t get bored and you learn easier” (p.383). This reveals that being outside is a more enjoyable way of learning mathematics for this student, making learning more accessible. Although the study did not describe participants as having lower ability, students identified as ‘not so good at maths’. This may mean that, particularly for underachieving students, learning mathematics outdoors delivers enjoyable learning in an otherwise potentially dull and challenging subject.

Summary of Children’s Experiences of Being Outdoors

This scoping review has sought to summarise what the contemporary literature reveals about how children experience being outdoors. Firstly, many children experience the freedom of

large spaces away from the control of the class and, often, the dictatorial role of the teacher. For some, this is calming. When pressures are removed, time appears to slow, and many children can focus more on their learning. However, for some, the distractions of the outdoors take their focus away from their education.

The literature has revealed that children experience freedom of choice when outdoors. Children experience the opportunities to be self-directed and have greater autonomy when not inside. In contrast, the literature demonstrates that spaces can also be seen as commodities that different groups of people can inhabit. Children explore the ownership of space through their interactions with the objects of the natural world, which invite their creativity and imagination.

The social element of being outside is central to children's experiences in the literature. They see themselves as part of a community and, when learning outdoors, rely on others for support. Furthermore, in contrast to perceptions of regular mathematics learning, children experience being outside as exciting and fun. Whilst these themes are not intended to represent all children's experiences of being outdoors, they help identify some commonalities in contemporary research as a starting point for developing an attitude of openness to this study's goals.

Themes from the Literature

The literature reviews aim to identify the gap in current research and develop an attitude of reflective openness to the research question through exploring contemporary studies. Here, I combine my thoughts with the findings of both reviews. Table 7 outlines the themes and sub-themes developed in each review due to engaging with the literature.

Scoping Review 1: Children's Experiences of Mathematics	**Scoping Review 2:** Children's Experiences of Being Outdoors
Interaction with others • Competition • Negative attention • Sense of place in the class hierarchy • Support from others • Collaboration	**Freedom** • Large spaces • Calm • Removal of pressures • Time slows • Distractions
A difficult subject • Physical reactions from anxiety • Abstract and theoretical concepts • Fixed mindset approach	**Agency & Ownership** • Freedom of choice • Ownership over space • Appropriation of spaces • Objects of the natural environment
Relevance to the world • Lacking purpose • Procedural and routine • Boring	**Imagination and creativity** • Practical hands-on learning • Learning through play
Modes of knowledge acquisition • Through transmission predominantly • Teacher provides the learning • Lack of autonomy • More rarely connectionist or through first-hand experience	**Collaboration** • Social interaction • Teamwork • Community
	Joy • Enhanced through being together • Makes learning fun

TABLE 7 - OVERVIEW OF THEMES AND SUB-THEMES FROM SCOPING REVIEWS

The temptation may be to conclude that each experience's themes may somehow balance when combined. For example, it could be claimed that the joy experienced outdoors will

counteract mathematics' perceived tedious nature. However, this approach is overly simplistic and does not consider the complex nature of lived human experience. The combination of opposing experiences does not necessarily result in a balance between the positive and negative effects. Instead, one needs to consider the strength of each of the experiences and how the different complex elements of the experiences may interact. Therefore, the synthesis of the findings here does not represent a hypothesis but a description of the possibilities of experiencing mathematics in the outdoors with the understanding that there is only so much that the current body of evidence can tell us.

It is clear from the literature that interaction with others is an essential essence of both experiences. When learning mathematics, this can be through competition or collaboration. When outdoors, children experience partnership with others through social interaction, teamwork and a sense of community. Therefore, it is likely that children also experience learning mathematics outdoors as a social experience through complex interactions with others.

Additionally, the literature suggests that children usually experience mathematics learning through the transmission of knowledge from teacher to student. However, the experience of being outside is very different. Outdoors, children experience freedom from the authoritarian role of the teacher. This will be an interesting dynamic to explore further when analysing data collected in this study.

Furthermore, mathematics is often experienced as an abstract subject which lacks purpose and application to the real world. In contrast, being outdoors is experienced through hands-on engagement with objects of the natural world. It may be that learning mathematics outdoors bridges the gap between abstract and real-life contexts. How these two experiences combine through learning mathematics in the outdoors may become a concept further developed during this thesis's data analysis.

Reflexive Response to the Literature

There have been points where my engagements with the literature have resonated with my professional experiences. Throughout the literature review process, I kept detailed notes in research journals about my reflections on the emerging themes and how these echo or contradict my preconceptions. Whilst it is impossible to describe all of the times the literature has informed my understanding, below, I present a summary of the key ways the literature presented above has confirmed or challenged my presuppositions.

Unsurprisingly, the review reveals that children often experience mathematics as challenging, abstract and dull. I see this common perspective in my daily practices with children and adults. My inclusion of Kulkin's (2016) paper, appropriately named 'Math is like a scary movie?', also demonstrates my presupposition that children can all too often find mathematics a frightening subject to study. In my professional practice, I am always trying to find new ways to engage children in fun mathematics learning to counter the apprehension I perceive many of my learners will have.

I am also unsurprised that much of the literature emphasises an instructional teaching style. Many of the lessons I have taught and training I have been on focus on the importance of teacher modelling and instruction in mathematics learning. Whilst I acknowledge that precise models for learners are important, the lack of creativity in instructivism is, in my view, the cause of some children's belief that mathematics is a boring and dull subject.

Prime Minister Rishi Sunak recently commented that in the UK, "We make jokes about not being able to do maths. It's socially acceptable […], but we'd never make a joke like that about not being able to read" (Sunak, 2023, n.p.). The Prime Minister illustrates in this speech that it has become socially acceptable to not be good at mathematics in the UK. This rings true with my professional practice as I often hear adults telling children not to worry about being

good at mathematics. The literature reveals that many children experience mathematics as a difficult subject, and I believe that this is what has caused the social acceptance of poor mathematical ability. Therefore, the literature reinforces my presuppositions in this respect.

However, there were also surprising themes that came out of the literature. I was surprised that interactions with others played a significant role in learning mathematics. I see the traditional pedagogy of mathematics learning as children working independently on an activity set by the teacher, which emulates the model provided by the teacher. Whilst this situation is often found in the literature, it is interesting that children's perceptions of others and themselves within the class play a prominent role in the experience. Before this review, I believed that interaction with others would only be found in the research on outdoor learning. This is an example, therefore, where I have been taken beyond my everyday thinking and reminds me that whilst my classroom practice has brought me to this research, it also gives me new insights that impact how I conduct this study. The literature also indicates that interaction with others plays a significant role in outdoor learning. This would suggest that interactions between learners will likely be significant in learning mathematics outdoors.

Reading the papers in this review has impressed me with how children, as research participants, can convey their understanding and experiences. As previously discussed, experiences are often difficult to verbalise to others. I am reminded again of my adult axiology and my tendency to believe that children need support in engaging with studies about themselves. In concluding, Janik (2022) also commented on children's abilities. They found that "children have the competencies to deeply value their living and playing conditions from different angles" (p.11). This reveals that children can make meaning from their outdoor experiences and understand this from different perspectives. As an adult researcher studying children's experiences, I am reminded that children are best placed to describe these.

Whilst I have drawn some conclusions from the scoping review, these result from an exercise in openness. This undertaking has informed new suppositions but has also called previously unidentified assumptions forward. It has been an essential step in my reflexivity, aiming to adopt and sustain a phenomenological attitude throughout this study.

Terminology

Engaging with the literature has also revealed varying uses of terminology. For example, adults providing and supporting learning opportunities are referred to as:

- teachers (e.g., Carey, et al., 2019)
- educators (e.g., Harwood, Huang and Somma, 2022)
- practitioners (e.g., Coates and Pimlott-Wilson, 2019)
- facilitators (e.g., Neville, Petrass and Ben, 2021)

While these terms may have slightly different definitions and meanings depending on the research context, they are often used synonymously. For clarity, from this point on, this thesis will refer to the role of adults in a child's learning as the 'teacher'. I have chosen to use the term teacher as this is the word that the participants used within the interviews, and it accurately describes the relationship between the researcher and participants within the context of this study. However, as discussed in Chapters Six and Seven, the insights gained from this research may have implications for settings and professionals where the term teacher would not be suitable.

Similarly, the literature uses several terms to describe the young people in the studies, such as 'children', 'pupils', 'students', 'learners' and 'participants'. I have decided to use these terms interchangeably within my thesis, depending on the purpose of the writing. For example, the term 'participants' is most appropriate when detailing the research design, the word 'children'

is suitable when discussing the experiences of young people beyond this study and the term ‘learners’ may be most fitting when describing experiences during lessons.

Finally, the terms ‘lessons’, ‘sessions’ and ‘learning opportunities’ are used within the literature to describe the time periods of interest to this study. Again, throughout this thesis, I use these phrases synonymously as each represents a slightly different perspective on the participants' experiences. As discussed in Chapter One, this thesis uses the term ‘outdoor learning’ to describe the practice of learning in an outdoor environment.

The Gap in the Research

Through extensive and systematic database searches and my wider reading, it appears that no study has sought to understand the lived experiences of children learning mathematics outdoors. Instead, the literature provides glimpses of how children may experience mathematics learning and being outdoors. As previously described, there are some similarities and contrasts between the two experiences. However, the combination of those two phenomena is yet to be explored. Therefore, my research question seeks to address this gap in the literature by asking: **What are the lived experiences of children learning mathematics outdoors?**

Whilst this literature review has demonstrated that the limited studies suggest that some children have negative experiences of mathematics, this is not the problem that this study is concerned about addressing, nor does this thesis seek to find solutions to improve children’s experiences of mathematics. Equally, although this literature review has gained insights from studies conducted in formal indoor mathematics classrooms, this study does not seek to compare the indoors and the outdoors. Instead, the purpose of this study is not to compare experiences inside the classroom to those outside the classroom. Instead, this research aims

to understand the experiences of children learning mathematics outdoors to understand what implications that knowing may have for pedagogy and practice.

Chapter Summary

This chapter has described my engagement with extant literature as I approach my research. I have detailed my systematic approach to conducting the literature review and detailed the purpose and limitations of this method. The findings of two scoping reviews have been illustrated, compared, and analysed to glimpse new insights. Additionally, I have detailed how new presuppositions have been uncovered due to engagement with the literature.

This chapter had two aims. Firstly, the literature review aimed to determine the gap in the current field of research. The second aim was to engage with the literature reflexively to develop an openness to my research question. By completing this review, I have foregrounded the thoughts of the current literature and come to a better understanding of my presuppositions and the purpose of this research. In the next chapter, I describe how my methodological foundations and reflexivity from the literature review have shaped my research design decisions and implementation.

Chapter Four: Gaining Sight of the Lived Experience

"Phenomenological method is always a matter of attempts, bids, and hopeful risks."
(van Manen, 2016a, p.29)

In this chapter, I detail how the philosophy of hermeneutic phenomenology, described in Chapter Two, has been developed into a research design and how the resulting study was conducted. Hermeneutic phenomenology is a developing practice towards a greater understanding of the human experience, meaning there is no single method to follow or procedure to enact (Gadamer, 1989; van Manen, 1990). Instead, a hermeneutic researcher must engage with the phenomena and make thoughtful choices about how to surface interpretive meanings whilst remaining congruent to the philosophical notions that underpin the methodology. Beck (2021) cautions against "method slurring" (p.117) in phenomenological research and advocates for a rigorous research design based on philosophical traditions. Therefore, the following pages detail the framework I developed to conduct my study and the decisions I made based on what my research question required of me, my understanding of phenomenological methodology and the practical limitations I faced.

As an ongoing process, the development of a research design was not mapped out ahead of time and followed. Instead, conducting this research was a series of attempts at gaining access to rich insights into the lived experiences of the individual, resulting in many changes to the research design as I reflected critically on my bid to apply empirical research methods to a philosophically rich methodology. Throughout this chapter, I describe how the design was altered according to specific strategies' success. Although I describe the research design in this chapter as linear, I experienced it as an evolving series of phenomenological steps, moving forward, sideward and backward to achieve certain milestones. As van Manen

suggests above, these stepping stones were not laid out for me in advance but have been developed by what the data (and my development as a phenomenologist) called for.

Participants

All the research took part at the school where I am the deputy headteacher, Kendall CE Primary School. Five children in Year 6 of primary school (aged 10) participated in this research. In this section of the thesis, I describe recruitment-related issues, including ethical considerations, and my reflexive response to enlisting the children to participate in the research, starting with a discussion on sample size.

Sample Size and the Hermeneutic Project

Whilst a sample size of five would be considered too small for some methodologies, phenomenological studies recruit small numbers of participants to gain deeper, detailed insights into an individual's experience of a phenomenon. However, an essential aspect of the phenomenological analysis is that it does not attempt to generalise findings to a specific population. Therefore, van Manen (2016a) asserts that the notion of sample size refers to a term that does not belong to the methodology of phenomenology. What is more, a large number of participants could result in shallow experiential data or analysis.

Although Dibley, et al. (2020) recognise that hermeneutic phenomenological studies can be successfully conducted on small sample sizes, they go on to say, "in a taught Masters programme […] four to six participants may be considered appropriate as less depth is expected" (p.60). Dibley, et al.'s comment assumes that studies with more participants provide greater depth. I argue that the depth of a hermeneutic phenomenological study is not predicated on the number of participants but on the quality of data collection and analysis. Although it could be legitimately claimed that a study with more participants may provide a greater breadth of experiences, this is not the aim of hermeneutic phenomenology.

Whilst others, such as Peoples (2021), discuss the term saturation (meaning reaching a sufficient point where no more new data can be observed), in place of sample size, van Manen (2016a) makes clear that saturation does not belong in phenomenological studies. The principle of saturation supposes that, at some point, an individual's experience will be similar enough to another's that it will not add anything new to the research. However, saturation is not congruent with my chosen methodology, as phenomenology looks precisely at an individual's lived experience in its embodied uniqueness. van Manen explains that phenomenological understanding is "not a matter of filling up some kind of qualitative container until it is full or of excavating a data set of meaning until there is nothing left to excavate" (van Manen, Higgins and van der Riet, 2016, p.5). Ironside (2006) also suggests that achieving data saturation in hermeneutic phenomenology is impossible because something new always lies beyond the study's grasp.

Whilst acknowledging that there may be similarities in experiences, there would be no number of participants at which recorded experiences would stop being unique. Therefore, a sample number is unimportant to measuring the quality of this research, which recognises that the generalisation of its insights is impossible. Instead, this research should be judged on the suspension of bias, the originality of its insights and the scholarly treatment of its sources (van Manen, 2016a). What is essential in hermeneutic phenomenology is that it contains the right amount of rich experiential data, which can be achieved with any number of participants.

However, I needed to choose a number of participants to recruit. I decided to recruit five participants in total. As a researcher new to hermeneutic phenomenology, I wanted to ensure that I recruited enough participants to allow me to develop my skills. I was concerned that only choosing two or three participants would not allow me to practise different phenomenological interviewing and data analysis strategies. However, due to the time restraints of the study, I

did not want six or seven participants as this would not allow me to dwell with the data in the depth that I needed. Therefore, five participants were selected.

Ethical Recruitment

Ethical recruitment of participants is essential when designing research to ensure that participants are fully informed and consent to participate (Dibley, et al., 2020). In this study, no participants were recruited until full ethical approval was given by ARU's HEMS FREP (Appendix C). Additional ethical approval was also gained from ARU's HEMS FREP to conduct face-to-face research with human participants during the Covid-19 pandemic (Appendix D).

The headteacher and governing body of the school approved the research, and the headteacher at my school acted as the gatekeeper for the study, responsible for making initial contact with potential participants before providing me with any personal information. All personal information collected strictly followed ARU's General Data Protection Regulation Policy, and all participants have been given pseudonyms throughout this thesis to protect their privacy.

Care was taken to consider my power influence over potential participants and their parents as the school's deputy headteacher. Participants and their parents were initially sent an introductory letter and invited to reply with interest in the research if they wanted to learn more. Participant information sheets were developed for both parents and the participants and informed consent and assent were gained via consent forms before the names of the participants were passed to me. Participants and parents were reminded throughout the data collection process that they had the right to withdraw and that this would have no negative consequences for them.

Due to this research being conducted with children, consideration was also given to safeguarding the participants and myself. ARU conducted a Disclosure and Barring Service

check on me before granting ethical approval, and the Safeguarding and Child Protection Policy of the school was always followed. Participants were reminded at the beginning of each interview that if they did not want to continue at any point, they could stop the interview. Any concerns raised by the children's responses to questioning were to be reported to the school's designated safeguarding lead. However, no safeguarding concerns were raised during the research process.

Participants were recruited through purposive sampling because this research concerns the particular experiences of children who are used to learning mathematics outdoors since their experienced allows me "to be able to render the full significance of its meaning" (van Manen, 2016a, p.313). A brief study description was sent to all thirty children in my Year 6 class. The participants were all ten years old and had experience of learning mathematics outdoors. No further criteria (such as academic achievement or gender) were applied during the recruitment process as, phenomenologically speaking, these factors were unimportant. The key criterion was that all participants should have experience learning mathematics outdoors, as the experience of this activity was central to the research question.

In addition, approaching participants in the same year group provided benefits. Firstly, all of the participants were taught by me regularly. Therefore, I developed a positive working relationship with them. Furthermore, choosing participants from different age groups would have resulted in some children being interviewed by their teacher whilst others were interviewed by their deputy headteacher. Whilst acknowledging the power dynamic and a shift in positionality from the class teacher to the researcher, conducting research with the children I teach was considered beneficial overall. Additionally, the participants and the other children in the class would all participate in the same stimulus lessons – a method I discuss later in this chapter – and all have several years of experience in learning mathematics outdoors.

The headteacher, acting as the gatekeeper, initially sent a letter to all children in the class with a brief description of the study. This letter invited the children and parents to register an interest in participating. Next, the gatekeeper sent participant information sheets to those who registered an interest. At this point, all correspondences were managed between the gatekeeper and the prospective participants. This meant that I, as the researcher, did not know how many had registered an interest and who these individuals were. Of those parents and children who informed the gatekeeper that they would like to take part, five participants were selected at random. The names of these five were passed on to me. I contacted the five participants and their parents to answer their questions and gain informed consent and assent.

Throughout this thesis, I also refer to participants using gender-neutral pronouns and have selected gender-neutral pseudonyms for each. I decided to do this for two reasons. Firstly, using gender-neutral pronouns would help protect the identity of the individual. There were only 30 children in the entire cohort when this research was conducted, 15 boys and 15 girls. Therefore, giving the participants gender-neutral pseudonyms doubles the number of possible children and helps to maintain anonymity.

Secondly, and more methodologically important, gender-neutral pronouns within the data help to remove assumptions based on whether the participant is male or female. Referring to participants as ‘they’ removed pre-existing notions and ideas that a reader may have about gender roles. Gender-neutral pseudonyms also reduce the temptation to conclude that girls experience this, while boys are more likely to experience that. Not only would this type of finding serve to underestimate the complexities of the nature of the individuals beyond their gender, but it also would not be in the spirit of the hermeneutic phenomenological endeavour. Whilst I knew the genders of the participants, as will be described in more detail in subsequent sections, my consciousness of the individual’s characteristics faded as I dwelled on the content of their experiential data.

Reflexive Response to Recruitment

Despite the benefits of having already established relationships with the participants I had recruited, I was keenly aware that my fore-structures of understanding were not only of the experience I was studying but also of the participants themselves. I used my research journal extensively throughout the recruitment process but needed to reflect deeper on my presuppositions about the individual participants. To achieve this, I wrote a narrative description of each participant. These soon become penned illustrations of the individual with exaggerated features, allowing me to reveal my assumptions about each of them. Because of my research context, I found it helpful to break down my character profiles into four sections: personality, academic ability, perception of mathematics and experience of the outdoors. These descriptions contained my perception of each participant, illustrating my view of them and my anticipation for what each would reveal about their experience of learning mathematics outdoors. The example below illustrates my reflexive commentary on one of the participants, Alex.

> **Personality:** Alex is a happy child. They work hard and contribute generously to the class lessons. They are on the fringes of being popular within the classroom and are eager to get within the inner sanctum of popularity. Alex is sensitive and would result in tears if confronted or faced with an intense argument. They often overreact to others being unkind. However, they always have a positive work ethic and obey the rules. A twitch/squint is a tell-tale sign of their fragility and nervousness.
>
> **Academic ability:** Alex is able and confident. They ask the right questions and make good progress in their learning. However, Alex becomes frustrated if they cannot solve a problem, which sometimes holds them back. In addition, Alex's presentation is poor. Their mathematics is good, and they have good ideas for writing, but this is not always

presented in the best way. Alex tries hard with their presentation but does not always succeed.

Perception of Mathematics: Alex likes mathematics and enjoys being good at it. They work hard in lessons. Alex enjoys the logic of getting things right; this is where they struggle in more 'creative' endeavours. Alex's listening skills are not fantastic; however, they sometimes miss key instructions and get things wrong.

Experience of Outdoors: Alex likes the outdoors, but their fragility means that cold and wet weather is a barrier to learning. They would prefer to be inside on winter days, and the weather is a significant factor in whether they enjoy being outdoors. Alex is not a fan of getting their hands dirty and will often watch while others jump in at the deep end. Alex prefers mathematics indoors, giving Alex the structure and security needed to learn effectively.

This example demonstrates an exaggerated view of my beliefs about the participant before beginning the research. The process was complex, and I reflected in my research journal, "I found it surprisingly hard to face my assumptions and opinions of the children I teach." I realised that I have many preconceptions about the participants, which come from my encounters with them and through my experiences with other children I have taught previously with whom I associate them. This process did not eliminate these presuppositions but brought them to my attention. By explicitly confronting my assumptions of each participant, I was able to be more open to their individual experiences before beginning data collection. I have written about the development of the penned illustration method in a peer-reviewed journal article (Barrett-Rodger, Goldspink and Engward, 2023b). This demonstrates a creative approach to research and evidence of the methodological *epoché*-reduction.

Methodological *Epoché*-Reduction

In his 1927 lecture course, *The Basic Problems of Phenomenology*, published in 1975 [1988], Heidegger claimed that "there is no such things as one phenomenology, and if there could be such a thing it would never become anything like a philosophical technique" (p.328). Therefore, each approach phenomenological study represents a distinct approach to exploring the *lifeworlds* of its participants. Acknowledging that phenomenologists employ empirical research methods, such as interviews, he also stresses the importance of the phenomenological researcher engaging in creatively developing tools for data capture and analysis, which he calls the methodological *epoché*-reduction (van Manen, 2016a). van Manen warns that "repeating past methodological approaches prevents and stultifies original thinking" (2016a, p.226). Therefore, phenomenological researchers must think beyond conventional techniques to construct an approach that most appropriately suits the research.

In my thesis, I demonstrate a "methodologically informed inventiveness" through the methods and techniques I have adopted and adapted (van Manen, 2016a, p.227). Throughout the remainder of this chapter, I illustrate the methods adopted and describe how these maintain methodological congruence. It is not simply enough to adopt a technique without consideration for how it supports or conflicts with a phenomenologist's ontology and the traditions of the phenomenological philosophy (van Manen, 2016a). Therefore, throughout the design phase, consideration is given to each method and how it supports or conflicts with my ontology and the traditions of the phenomenological philosophy.

The majority of methods are rooted in previous literature and studies. However, there are elements of my research, such as the integration of Artificial Intelligence (AI) for insight cultivation, which are unique to my study and demonstrate an original contribution to the methodology of hermeneutic phenomenology. Therefore, the uniqueness of my research design shows a "challenge to contemporary research behaviours" (Thomson and Crowther,

2019, p.5). In this section of the chapter, I describe the data collection methods before explaining the adopted methods for data analysis.

Methods of Data Collection

The primary data collection method utilised in phenomenological research, as it is within most qualitative research studies, is interviews (Englander, 2012). Interviews enable researchers to gather experiential data that can be used to develop an understanding of human experiences (van Manen, 2016a). Høffding and Martiny (2016) point out that the focus of the phenomenological interview should be to understand the consistent phenomenological essences of an experience, setting the phenomenological interview apart from those of other qualitative research studies.

In a hermeneutic phenomenological interview, the interaction of the participant and researcher is where meaning is created (Brinkmann and Kvale, 2018). In this sense, the interviewer can be seen as a traveller, journeying through the participants' experiences rather than a miner digging for an existing truth. Phenomenological interviews aim at eliciting experiences by asking questions such as, “How do you experience…”, “Can you give an example of…?” or, “What is it like…?” Questioning is deliberately conversational and open-ended, allowing participants to narrate their own experiences, which can be followed up with adaptable, supplementary probing questions (or prompting questions if required) to develop the richness of the experience as it is described.

A one-to-one unstructured interview was conducted with each participant. The interview was unstructured so that it could be steered in a different direction by the researcher in response to what the participant said. However, an interview schedule was created (Appendix E) to carefully elicit experiences from participants and act as a prompt for questioning. In several interviews, responses were short, and the schedule was used extensively. However, in other

interviews, participants' responses caused a diversion away from the schedule. Therefore, it was used as a dynamic working document that served as a guide to support my development as a researcher.

Interviews enable researchers to gather experiential data that can be used to develop an understanding of human experiences of phenomena (van Manen, 2016a). Høffding and Martiny (2016) point out that phenomenological interviews should be oriented towards the essence of an experience, setting the phenomenological interview apart from those of other qualitative research approaches. However, phenomenological interviews rely on participants' ability to describe their experiences orally, and clarity of language is an essential factor in this (Punch, 2002). Therefore, there needs to be some consideration of how effectively child participants can give experiential accounts. It is widely recognised that children generally are much less able to verbalise their experiences during interviews than adults (Fargas-Malet, et al., 2010). Therefore, it is crucial to consider which strategies may support children in delivering experiential accounts while being aware that the assumption that they may not be able to do this without support is an adult-centric viewpoint.

van Manen (2015) suggests that "when researchers […] ask students to tell about school experiences, they tend to receive general descriptions *about* experiences rather than descriptive accounts of experiences as they happened" (p.160). To alleviate this issue and provide a platform for accessing the lived experiences, I selected four strategies to support experience elicitation during the interviews, as illustrated in Figure 4.

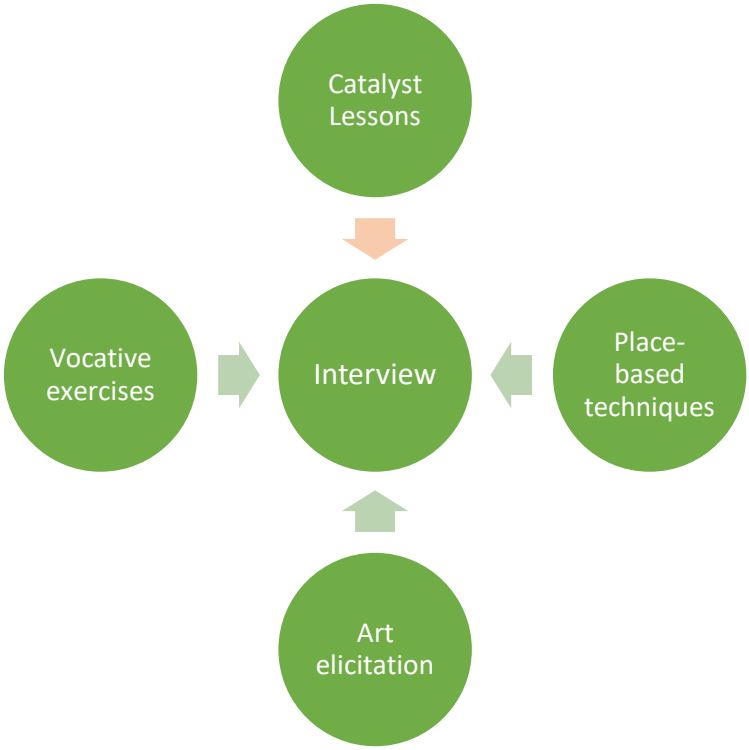

FIGURE 4 - DIAGRAM OF INTERVIEW METHODS

Interview methods in Figure 4 are not data collection methods in the empirical sense but techniques used within the practice of the phenomenological interview. The methods do not generate data for analysis independently. Instead, they should be seen as instruments of the interview, which combine to produce the research data, namely the interview transcripts.

Whilst each was used in all five interviews, they were sometimes enacted at different stages of the interview and lasted for different periods of time. In this section, I describe each of the strategies in turn, explaining how they were conducted and the impact of their implementation. This includes references to their usage in literature and their inclusion in this research due to my methodological reduction. Extracts from the interview transcripts are used to illustrate these points.

Catalyst Lessons

In Figure 4, an orange arrow has been used to link the catalyst lessons to the interview. A different colour arrow has been used to signify that the catalyst lessons occurred before the interview and were referenced within the interview process. Before embarking on interviews with the participants, I decided a preparation stage was required. To access children's experiences through their narratives, I wanted a reference point I could draw on throughout the interviews to bring them back to a moment in time if necessary. Therefore, I chose to involve the children in catalyst lessons.

Beck (2021) suggests that drawing on participants' descriptions of specific examples of their experiences is helpful if their responses are generalisations. Therefore, I decided to create catalyst lessons to refer to during interviews if necessary. Participants took part in three catalyst lessons with the rest of the class before taking part in interviews. Catalyst lessons covered mathematical national curriculum objectives outdoors, following my school's everyday practices. Outdoor lessons are a regular occurrence for the participants and should not be seen as an intervention in the action research sense. Instead, they functioned as a reference point for participants to draw on during interviews. Children could give real-life examples by thinking back to specific instances, giving a more profound richness to their narratives.

Sydney: *Um, the one from yesterday. I like it when we went in the forest and had to like complete different like, like long question and all stuck on the trees. I just like enjoyed that because like my partner really like helped because like if he couldn't do it and then like I couldn't do, he tried. We both gave ideas to see are we doing this bit right or are we doing this bit wrong?*

In this extract from an interview transcript, Sydney recalls their experience during one of the catalyst lessons and demonstrates that they could provide specific details. For example, rather than simply giving a short answer to the question *'What is it like for you to learn mathematics*

outside?' such as *'fun'*, Sydney has access to a reference point from where to draw concrete examples that help me to understand the context of their experience better.

Each of the catalyst lessons took place in a different outdoor location. One on the playground, another in the school's smaller woodland and the third in the school's larger woodland. Participants are very used to learning in all three of these locations. Still, it meant that participants could easily distinguish between the three lessons if asked to recall specific events during the interview, which would prove helpful during later data collection when participants were asked to choose the location of their interview and then questioned why they had chosen that specific spot.

During these catalyst lessons, I observed the participants and made notes about the session, my perception of their experiences, and the keywords or phrases the children used. My field notes enabled me to develop my reflexivity further, unearth my *taken-for-grantedness*, and prepare specific interview questions. For example, in one of the lessons, Paris spoke to their partner about a sense of freedom, which became a topic that I wanted to explore further. So, in the interview, I asked Paris, *"What does freedom mean to you?"*

Paris: *What it feels like to me to be free is because when you're free that you can, like, run around but not in the forest because it's really slippery and but like in the playground as well, I still feel free, but not as much in the forest. And in the playground, it's just like fun to run around with your friends because it makes me happy. Freedom is important to me is because sometimes I can get claustrophobic if I'm in the same place for quite a long time or in a small place.*

In this extract from their interview transcript, Paris reveals that freedom refers to their spatial sense of the environment. Being free for Paris is not confined or restricted to (or within) physical locations. Freedom has alternative meanings, such as freedom of expression or freedom to do what you want without being stopped. Without the catalyst lessons, this may

have been overlooked; therefore, this preparatory stage before the interviews helped me make meaning in how the individual intended (or experienced).

Place-based techniques

One of the benefits of conducting my research within my school is that I could interview the participants within the environment where the experience under investigation occurred. At the beginning of the interview, participants were asked where they would like the interview to happen. Participants could choose between the three locations outside in which the catalyst lessons took place. This gave the participants ownership over the location and enabled them to discuss their experiences within the environment in which they occurred. Allowing children to be in familiar surroundings during the interview was also aimed at reducing the inevitable power dynamic between myself and the participants (Clark, 2010).

Early in the interview, I asked each participant why they chose a particular location. Whilst some chose the playground as it did not require them to change into their wellies, other participants' explanations gave rich insights into their experiences of the different outdoor locations.

Interviewer: *So, why did you choose to come up here?*

Paris: *Because in the top woodland, there's lots of space and it's nice and calm. Yeah. And like with all the animals in the background it's just very peaceful.*

Before asking Paris about their experience of learning mathematics outdoors, Paris already reveals some meanings they attribute to this location. These initial reflections allow me to tailor my questioning to elicit rich insights into the lived experience. I also found it a positive way to begin the conversation-like interview process, allowing the participant to lead the direction of the conversation.

During the interview, I asked the participants to guide me through different locations to help me understand their experiences. Participants were free to guide me to an area where I then asked them to describe their experience in this place. van Manen's third existential, lived space, refers to "felt space, our subjective experience of the spaces we find ourselves in." (Rich, et al., 2013, p.501). By allowing participants to identify a space in which their experience existed and describe their experience from within that space, it was hoped that children would be able to access and verbalise their prereflective experiences with a richer quality.

Kvale and Brinkmann (2009, p.48) explain that phenomenological interviews should involve "wandering together with the participant". Although used here as a metaphor, the technique of walking interviews enabled the participants and me to journey together and gain a deeper understanding of the experience being studied. Furthermore, as Hall (2009) suggests, walking provides a more authentic environment in which to conduct an interview. For child participants, the idea of a formal interview may seem daunting and an unnatural way for them to share their experiences; walking and talking is much more accurate to life than sitting across a desk from someone with a voice recorder in the middle.

Kinney (2017) suggests that one advantage of the walking interview is that it helps to reduce the power imbalance, which is particularly important in research with children. Robinson and Kellet (2004, p.85) state that "the central adult characteristic of having power over children" cannot be ignored. And yet, researchers must find ways to negotiate this power imbalance to engage in meaningful research. The researcher is responsible for fitting into the child's world rather than expecting the child to conform to theirs (Christensen, 2004). The docent method, developed by Chang (2017), may help rebalance the power dynamic between child participants and adult researchers. In the docent method, the participant leads the walking, drawing the interviewer to meaningful places of interest, resulting in the researcher playing the role of a novice and the participant becoming the expert. Whilst Chang's research follows

a grounded theory methodology, the concept of the docent method is also congruent with a hermeneutic phenomenological approach. Therefore, in my study, participants took control over the interview using this method, leading me to better understand the experience by being shown on a journey of meaning.

Walking interviews are increasingly used in qualitative research to explore the link between self and place (Evans and Jones, 2011). Self and place are two critical aspects of phenomenological inquiry, space being a *lifeworld existential* through which experience can be explored (van Manen, 2015). If interviews occur in the location of the phenomenon, it may provide a deeper description and a more comprehensive understanding for the researcher. For example, during my interview with Alex, they took me to a hill at the side of the playground where one of the catalyst lessons had taken place.

Alex: *Doing like chalks on the ground. Everybody would always try and get to the football pitch to try and like get one of these spheres or circles or squares.*

Interviewer: *Yeah. And how would that and how was that for you when you were doing that? If you can remember back?*

Alex: *I always found it like I had my own little like sphere like I always had my little like area and then if somebody tried to come in, I could always like. [Hissing noise] Angry mode.*

Interviewer: *Yeah?*

Alex: *And if they like tried to steal like ideas.*

Interviewer: *OK, and what about sitting on the hill watching [TEACHER NAME] do her coordinate work, what was that like?*

Alex: *I felt that was like really like nice because I like sitting on hills like at the park or like sit on the hill and just think about life. And it just brang me to then, just*

> *sitting on the hill listening to her talk and then it would just feel relaxing, not like inside where it was like really closed in because you could hear the echoes and all the like leaves rustle and the squirrels.*

By being in the location of the experience, Alex can recall specific details that help me better understand how it was for them. Not only does the place spark memories in the participants, but it also allows them to re-enact certain parts of the experience. This allowed me to see how it was for Alex from their perspective. For example, when Alex makes the 'hissing noise' and talks about 'angry mode', they re-enact the experience as it was in the moment. This is an example of how this method can access the participant's experience by getting to the voice behind the thinking rather than observing what they said or did in real-time.

Whilst I found this technique valuable for deepening the richness of the insights, it was important to remain attentive to the lived experiences of the children by being aware when my own experience of being within the location began to seep into my interpretations. In phenomenological research, it is rare for the researcher to have any first-hand experience of the phenomenon being studied – auto-hermeneutical studies are a relatively new pursuit in qualitative research (Gorichanaz, 2017). Not having direct first-hand experience of the phenomena makes it easier for the researcher to distance their own experiences, which may otherwise influence their interpretation of the participant's experience. However, if the researcher is within the new environment of the experience, this can affect their interpretation and needs to be managed carefully. I managed this with my reflexive diary and by carefully considering my openness to the possibilities of the children's experiences – adopting a phenomenological perspective.

Artwork Elicitation

Consistent with van Manen's phenomenological approach, several qualitative research studies have used arts-based methods to collect experiential data from children and engage

them in meaningful conversations (Reavey, 2021). For example, Boden, Larkin and Iyer (2018) suggest that drawings circumvent the initial need for language. In my interviews, I asked participants to draw what learning mathematics outdoors looked like. I then asked them to explain what they had drawn and referred this back to their description of their experiences. The artwork the participants produced enabled them to access the language required to describe their experiences more fully. The artwork also became a symbolic representation of the participants' experiences, which they could use to provide richer experiential accounts.

Visual methods, such as drawing, are becoming increasingly accepted within qualitative research because they engage participants in meaningful conversations (Reavey, 2021). Providing child participants with opportunities to create artwork whilst being interviewed may allow them to retrieve information and otherwise unreachable experiences (Salmon, 2001). Since drawing is an ordinary form of expression for children, it has the potential to uncover aspects of their experiences (Leonard, 2006).

In their research, Todres and Galvin (2008) found that through drawing during interviews, participants seemed encouraged to draw on rich aesthetic qualities of language, suggesting that this technique engages participants in more profound reflection of their experiences. However, this raises concerns about using this technique within phenomenological research, which aims to engage with participants' prereflective experiences. There is a need to use drawings to access vocabulary, which will provide experiential material rather than as a way for participants to reflect on their experiences actively and make their meaning (Fargas, et al., 2010). However, Zahavi (2011) argues that reflecting is not a distortion of prereflective experience but the unconcealing of it – the purpose for which it may be utilised.

While accepting that explaining an experience will always involve participant reflection and interpretation, Driessnack (2005, p.420) points out that there can be a shift "from what children draw to what the children say about what they draw". There is an important distinction to be

made here. Phenomenological researchers are interested in the meaning behind what the children draw, not their reflections on what they draw. The latter is of more interest to the field of psychology. Despite this, Malchiodi (2005) proposes that visual images, similarly to metaphors (a vocative method commonly used in phenomenology), can simultaneously access more than one sensory register and are rich with meaning. Kirova and Emme (2006) build upon this point, commenting that drawings can provide a means to capture participants' bodily knowing whilst bypassing the need for complex vocabulary. During their phenomenological research, Shinebourne and Smith (2011) found that drawings were useful in disrupting rehearsed narratives. They supported participants to engage with the phenomena anew, leading to gaining new insights. This may be particularly useful for children keen to please and say what they believe is expected or what the researcher wants to hear. If the use of drawings can interrupt participant-bias responses, then it may be that researchers can gain more meaningful insights into the experiences they are studying.

Within my research, participants used their drawings as springboards for conversation. They also allowed me to delve deeper by asking questions about the different aspects of their drawings. For example, whilst four participants decided to draw in near silence and describe their drawings once complete, Casey narrated their entire drawing process and chose to talk while drawing.

Casey: *So, here's the like the apparatus and stuff here. And then here you have people (I'll just draw stickman, because why not?) And then someone holding a chalk, I'll probably colour that in. And then you can do like. You know, those pyramids we did, where we add them up? Just put random things and some others and the, of course, draw the rest of the. I don't know, it's just not really a bird's-eye-view any more. Someone else - I can signify it's a different person with a blue collar. Let's say this is someone from another group and their thinking about maths. Let's just put 1+2+3 because, why not? And then we have other people*

here making their pyramids. And I'll draw them in a green colour. And then draw their pyramid. So, it's like some of them are going over to check the other pyramids people have made and then some of them are doing their own. And then you'll have someone from this group. [PAUSE] And then we're going to have the teacher, who is going to be in, let's say, a red colour. They're going to be helping this group. I'll draw an arrow, so you can see their talking to that person. "One plus, two plus, three equals 6!" And then there's going to be Another teacher, which I'll colour in green right now. Helping, let's see, this person, who I'll colour in pink. Helping them with their maths question. And then there's going to be, wait, this isn't going to be the apparatus, this is going to be the, this is actually going to be the door into the side of the, into the classroom. And then we're going to have a tree over here to define that it's outdoors. Just shade it in like that. Let's say in yellow colour, we'll have another group working on something different, like one of the diamonds instead of the things. I think we did these in Mathletics. I think this is how they look. So, this is sort of like how outdoor maths works, so I got the teacher helping a person on a maths question, got this person making the pyramid out of the chalk. Then you've got person figuring out the other group's pyramid and then this person drawing that pyramid that they're working on. Then you have a teacher helping someone with a maths question and then you have the people who are like greater depth, I assume, working on this diamond for them.

Casey's commentary demonstrates their process of thinking throughout their drawing. As they recalled different parts of the experience, they adapted their artwork. For example, the apparatus was modified into a door to the classroom. Casey also gave justifications for the decisions they were making. For instance, they drew a tree because it indicated that the picture was set outside, and they drew arrows to show who was talking to whom. At times the image also 'spoke' back to Casey as they drew and then reflected on why they had drawn certain objects in a particular way, "the people who are greater depth, I assume, working on

this diamond for them." Whilst intriguing in many respects, I needed to use this narrative to question Casey further and access more of the prereflective content of their experience. Whilst there seem to be many advantages of using drawings to enable children to describe their own experiences, there are considerations regarding the extent to which drawings may accidentally encourage participant interpretation of their experiences rather than the researcher's interpretation. To this end, I extracted certain prereflective aspects of the experience from Casey's narrative whilst using the rest to formulate my questioning and lines of enquiry within the interview.

The drawings were never intended to be considered data—instead, a technique to elicit the data in spoken words. I have used some illustrations in Chapter Five to represent the insights gathered from the interview transcripts. The participants' illustrations were not the direct subject of phenomenological analysis.

Vocative Exercises

Using vocative methods is central to phenomenological writing (van Manen, 2016a). Vocative methods are literary devices (such as metaphor and poetry) that embody meaning in phenomenological language and are usually applied once the transcripts' thematisation has occurred. However, I decided to allow the participants to use their vocative methods to describe their experiences. As their teacher, I understood that the participants knew how to use similes and metaphors to enhance meaning. So, during the interview, I asked them if they could give me a simile or metaphor to describe what learning mathematics outdoors was like. What followed was proof that children can be perfectly capable of providing detailed descriptions of their lived experiences.

Although some participants reverted to simplistic, rehearsed similes that felt forced and gave little rich data, for example, Casey said it was “as exciting as a [hesitation] roller-coaster - I guess?” others provided sophisticated responses.

Sydney: *It’s just like an outside version of a lullaby.*

Sydney describes the sounds they can hear in the background during a mathematics lesson. These vocative examples from the participants proved to be very useful when analysing the data as they provide rich examples from which possible meaning can be derived and insights gained. Additionally, using vocative methods within the interviews enhanced resonance in the text. Although care needed to be taken to recognise where rehearsed narratives slipped through as cliched analogies, I found that the vocative elements of the participants’ accounts were amongst the most powerful and insightful moments.

Reflexive Response to Interviews

Throughout the data collection phase of the study, I continued to make reflective notes in my research journals. Whilst formal analysis had yet to begin at this point, as meaning-making individuals, it was impossible not to reflect on what the children had told me and what I thought it meant for my research. At the end of each interview, I spent considerable time writing freely in my journals regarding my initial thoughts about what I had just heard. It was vital to record this at this stage, as I have since returned to my notes and ideas when conducting my analysis. Reflexive writing has allowed me to reflect on my positionality and presuppositions at different stages of the study and examine my immediate ideas following the interviews.

One of my most illuminating reflections was my initial thoughts about how insightful each transcript would be. How I ‘measured’ the expected insightfulness of each transcript was based on how long the interview lasted and how excited I was about what the children said. However, I later understood that the transcripts that I felt would yield little in the way of

phenomenological insights were rich with details and ideas that would have been easily overlooked without a systematic and rigorous approach to data analysis.

Ethical Considerations for Data Collection

There are several critical ethical factors to consider when conducting any research interview, especially with children. Firstly, even though informed consent had been gained, I began each interview with a reminder of the purpose of the interview and asked if they were happy to continue. I explained how the voice recorder worked and told them they could stop the interview at any point. Although I understand that refusing to participate at this point would have been difficult for the children due to the power dynamic, I was eager to make them feel at ease and comfortable with the interview process.

Secondly, the location of the interviews was an ethical decision and a methodological one. The aim was that situating the interviews within the school grounds would be less intimidating than conducting them in my office behind a desk. Additionally, letting the participants physically lead the discussion around the space gave them a sense of ownership and autonomy. While inevitably conducting the interview, I wanted to create an understanding of the interview as being something produced collaboratively. Finally, of course, the location of the interviews also needed ethical consideration regarding safeguarding. With agreement from the headteacher and FREP, I ensured that the interview sites would be used simultaneously by others (at a distance). This follows the school's safeguarding policy, which clarifies the potential risks of working alone with a single child when out of view of others. Although the noise of others sometimes interrupted the interviews, the safety it provided me and the participants made it the appropriate choice.

Finally, my position as the participants' teacher gave me insights into their abilities and preferences. Although I understand that my insights are based on my assumptions, having

prior knowledge of the children's abilities and attitudes towards the tasks I was asking them to complete was helpful in this instance. For example, I knew some participants had an excellent grasp of vocative language and some needed support. My role as their teacher means I need to teach and assess them on literary devices such as similes and metaphors. I used this knowledge to appropriately support each of the participants whilst being sensitive in allowing them to recount their experiences without too much intervention. For example, for one child I knew was skilled with similes and metaphors, I asked, 'Can you use a metaphor to describe how that is?' However, if needed, I could be prepared to provide other children with an example. Of course, it could be argued that the examples here could influence the child's response.

All of these considerations were made before conducting the research. However, throughout the interviews, I remained attentive to the needs of the participants. I thought carefully about my lines of questioning and dynamically adjusted questions when I felt the child could have been overwhelmed. The aim was to conduct the interviews pleasantly and be conscious of conducting them ethically.

Methods of Data Analysis

As with the data collection methods described above, analysing data phenomenologically is neither straightforward nor a prescribed process. Again, a hermeneutic phenomenological researcher must attend to what the data calls them to do and formulate their strategy for developing phenomenological insights. van Manen (2016b), whilst not prescribing a procedure for data analysis, does provide a series of data analysis methods which may be employed at specific parts of the process should it be required of the data. The data analysis activities have formed the basis of my framework for data analysis.

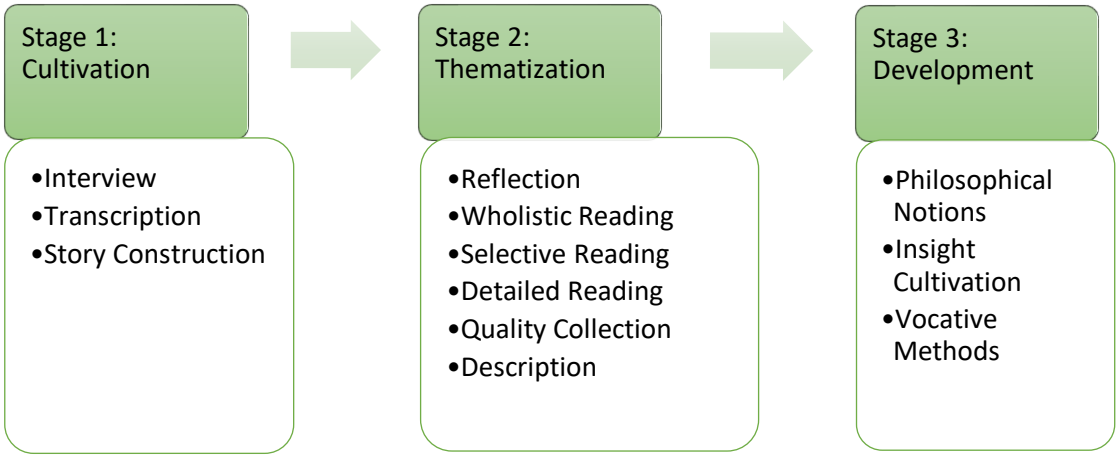

FIGURE 5 - DATA ANALYSIS MODEL

Figure 5 illustrates my model for data analysis comprising three distinct stages. These are separated by arrows, which show how the data flows from the interview to a developed piece of academic writing. Whilst each stage involved constant alternation between the data and the research question, the data never flowed backwards. When the endpoint of each stage was met, the data became the starting point for the next stage. Each stage is then broken down into steps to analyse the data. Unlike the stages, the steps within stages 2 and 3 often 'spoke' to each other. As a result, several iterations could occur before the stage was completed, with some steps repeated multiple times. Figure 5 represents these steps as linear, but they should be considered with greater fluidity than this suggests.

Similarly to the data collection methods, the framework for data analysis was not planned ahead of time and then adhered to. Instead, it was a series of activities that were constantly modified and redesigned over time. Therefore, the final result of my data analysis looks very different to what I had previously imagined. The remainder of this chapter presents the dynamic yet systematic model for hermeneutic phenomenological analysis produced as a

result of this thesis. I aim to describe how I developed my data analysis framework and decisions based on my desire to be led by the data and remain methodologically congruent. Whilst the intention of this chapter is not to describe the findings of the research, experiential data is included here as a means of explaining the process of data analysis and in a bid to remain transparent.

This research did not employ thematic analysis. Thematic analysis seeks to identify patterns of meaning or themes within research data (Braun and Clarke, 2022). However, hermeneutic phenomenology uses a “complex and creative process of insightful invention, discovery, and disclosure” (van Manen, 2016a, p. 320). Rather than a concern for coding transcripts or counting the frequencies of words and phrases, phenomenological thematization involves a series of techniques (as explained in this chapter) to uncover meaning. For example, a particularly emotive expression may resonate with the researcher and demonstrate a more profound insight than a repeated phrase in the interview transcripts. Therefore, phenomenological thematization, as used in this thesis, should not be confused with thematic analysis.

The data analysis begins in stage 1 (cultivation). In stage 1, the experiential accounts were extracted from the transcripts and prepared for phenomenological reading. In turn, each extracted description underwent stage 2 analysis (thematization), where phenomenological themes, called qualities, were uncovered, and each participant’s experience was described phenomenologically. Next, in stage 3 (development), the descriptions of the individual experiences were combined with philosophical notions to move the interpretations beyond the obvious. In this final stage, the descriptions underwent a series of vocative methods to produce a scholarly and reflective phenomenological text containing rich experiential material – the content of Chapter Five.

Stage 1: Cultivation

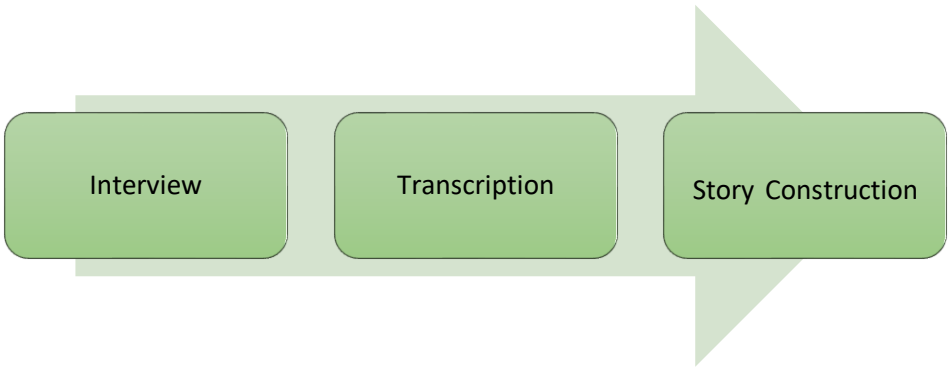

FIGURE 6 - STAGE 1 PROCESS MODEL

Stage 1 of the data analysis aims to reveal the experience as-lived from the interview data and prepare that data for phenomenological analysis. Figure 6 shows how this was arranged into three distinct steps. After conducting and recording each interview, I transcribed all of the interviews manually (Appendix F1 to F5). Whilst transcribing, I was conscious of retaining the contextual qualities of the data. As Dibley, et al., (2020) note, the self-transcription of interviews allows the researcher to note critical contextual information that may be helpful during analysis. Furthermore, the act of transcribing is also a form of analysis in itself (Dibley, et al., 2020). Whilst listening to the audio recording and typing what is said, the researcher cannot help but make interpretations. As I transcribed, I noted key reflections in my research journal, which I returned to throughout the data analysis process.

Once the transcripts had been created, I began to analyse the data. However, I soon realised that the transcripts were hard to navigate. Participants would often jump between their recollections, resulting in a lack of cohesion in the texts and material, which was difficult to analyse effectively. There were also many asides, conversations off of topic and postreflective comments to navigate. At this point, I decided to construct a story from each transcript to

prepare the experiential material for analysis (Appendix G1 to G5). In phenomenological research, stories are examples through which deeper structures of meaning can be explored (Crowther, et al., 2017). Crafting stories can be seen as preparing and intuitively structuring the data whilst delaying open interpretation. If carefully managed, story construction privileges the voice of the prereflective experience in the text (van Manen, 2016b). This means the anecdote is a way of 'showing' the experience rather than 'telling' it.

Some may consider story construction as falsifying the data. This would be true if the verbatim transcripts contained data with factual relevance. On the contrary, story construction is about formulating a narrative that provides a possible description of a human experience. Whether the story is true can never be known, nor does it need to be (van Manen, 2016a). Instead, through this process, concealments are uncovered. A phenomenological account allows the reader to understand better how the experience was-lived through. Hermeneutic phenomenology recognises that the researcher's interpretation is central to gaining insights and uncovering meanings from the data (Zahavi, 2019). However, by being transparent and systematic, my story construction aimed to demonstrate a clear route from transcript to meaning.

Crowther, et al. (2017) suggest that the first step in crafting stories is to "remove extraneous detail" (p.829). In addition, I also chose to remove words that I considered to be postreflective noises. Postreflective noise refers to opinion or perception, which demonstrates the participant's interpretation of their lived experience rather than an experiential account of how the experience was lived through. The removal of evident postreflective noise was intended to leave me with a prereflective understanding of learning mathematics outdoors, providing the experiential data I could use to begin phenomenological thematization. Table 8 describes the transcript content I deleted and the rationale for this.

Content Category	Rationale for deletion	Example
Interviewer input	To focus on the participant's lived experience rather than the interviewer's questioning.	“Can you draw what a maths lesson outside looks like?”
Off-topic content	To focus on the phenomena being studied rather than an experience beyond the scope of the study.	“It just makes me feel upset because, like, in 2019, used to be all happy, like I can’t wait for 2020. It’s going to be the best year ever.”
Response to preparatory questions	To focus on the phenomena being studied rather than the organisation of the interview.	“What do you think the word experience means?” “Does it mean like when you are trying to find a new job?”
Unnecessary repetition of words	To provide a concise retelling of the possible experience.	Alex’s transcript uses the word ‘like’ over three hundred times.
Blatant opinion or perception	To focus on the prereflective aspects of the lived experience.	“It’s fun.” “Other people think…”

TABLE 8 - TRANSCRIPT MATERIAL REMOVED FOR STORY CONSTRUCTION

Whilst I removed much of the postreflective noise, some postreflective phrases remained in the constructed stories as this provided context to the narratives and ensured that the stories were coherent. Although postreflective noises are not likely to reveal insights into the participants’ lived experiences, I was conscious while analysing that some of these remained in the text. Therefore, I used them only to provide additional background information when reading the texts wholistically.

I then grouped the experiential details by putting them into rough sub-headings. Children often would go back to specific details in the interview and expand. However, the events did not occur like this as they were lived. Therefore, re-shuffling the recollections was essential to portray the experience as it was (or as it could have been).

The third step was to construct the lived experiential description into a story. To achieve this, I changed the verbs into the present tense, linked ideas and added small words to ensure a coherent chronological sequence of events. Apart from small additional terms to connect sentences, I used the participants' exact words. If specific phrases were repeated, I repeated them in the story. The aim was not to change the meaning but to recreate the participants' lived experiences through their own words. From this point on, the constructed stories would be the data subject to analysis as they concealed the meanings of the experience for the participants, and the original transcripts were not returned to.

Stage 2: Phenomenological Thematization

Each constructed story (one per participant) was individually analysed using thematization – a process named so by van Manen (2016a) to separate it from other forms of qualitative thematic analysis. Thematization aims to recover structures of meaning from within the stories. Thematization begins open analysis and is a starting point for later philosophical development of the insights gleaned from the text. Phenomenological thematization differs from other forms of thematic analysis in that thematic analysis is often seen as a perfunctory process of counting or coding significant terms. Instead, phenomenological thematization involves creative insight on the researcher's part to see and uncover meaning through adopting the phenomenological attitude.

The process of thematization produces qualities of an experience. These are similar to themes that may be uncovered in other qualitative methodologies but differ in that these are not the

result of counting or coding. Instead, qualities are words or phrases which reflect the researcher's interpretations and meaning-making of the text. Thematization also requires the researcher to wait and dwell with the data to glimpse the experience as-lived.

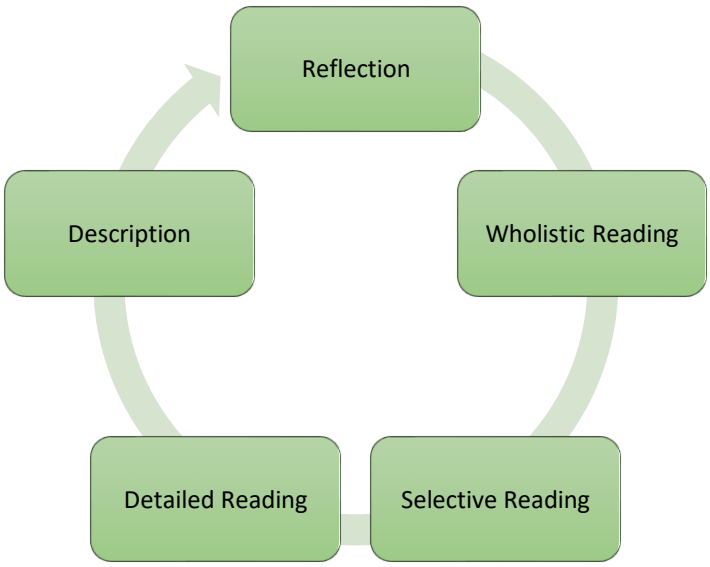

FIGURE 7 - STAGE 2 PROCESS MODEL

As demonstrated in Figure 7, the thematization is best modelled as a circular process that begins with reflecting upon the qualities that show themselves in the lived experiential data. Figure 7 was used as a framework for my data analysis, which offers a general direction. However, the direction and order were often deviated from. At times in my analysis, I would skip between different steps in this stage as I felt it was required by the data I was analysing. For example, while collecting qualities after detailed reading, I often felt called to return to my selective and wholistic reading before describing the qualities and beginning the reflection step again.

Moving between and reflecting on wholistic, selection, and detailed reading is akin to the hermeneutic circle, whereby the researcher directs their attention between the meaning represented in the whole text and its parts. During stage 2, the move between wholistic, selective and detailed reading saw the qualities develop into a detailed description of the lived experience.

FIGURE 8 - FLOW OF DATA IN STAGE 2

Figure 8 illustrates the different forms that the data took throughout stage 2 analysis. First, the research data entered from stage 1 as crafted stories. Next, initial reflections on the lived experiences were made before qualities (phenomenological themes) were collected due to wholistic, selective and detailed reading. Finally, precises of each of the experiential accounts were developed before the lived experiences were described in preparation for development in stage 3 analysis.

Initial Reflections

Before beginning the reading stages, I decided to make some initial reflections based on my familiarity with the data through transcribing and story construction activities. While writing down my initial thoughts, four essential qualities showed themselves:

- Materiality (objects in the lived experience)
- Spatiality (spaces in the lived experience)

- Relationality (self-other in the lived experience)
- Auditory sensing (noise in the lived experience)

These qualities came from my interpretations, as I had yet to begin formal interpretation, but they also represented my fore-conceptions of the data analysis. From this, I knew what I expected the data to tell me. I then had to balance my unconscious predictions with an attitude of openness. The qualities I had identified might have been the same as I concluded at the end of my research. Equally, they may be different. Through conscious mindfulness of this understanding, I proceeded with my analysis.

Wholistic Reading

To begin the process of thematization, I first began wholistic reading. This involved reading a story in its entirety several times and making initial interpretations in my research journal. My aim for each story was to produce a phrase (or several phrases) that captured the central significance of the text. To support me in doing this, I first identified critical phrases in the texts that invoked my responses and appeared central to the experience. Reading a story enters the reader into a dialogue with the text. Each story is idiosyncratic because each experience is unique. In the same way, each person's reading of a text is distinctive and represents a new horizon of understanding. In hermeneutic phenomenological research, it is the hermeneutic turn that takes place between the text and the researcher that produces rich insights into the lived experience of the individual.

From the key phrases I had identified, I created possible overall themes. These included:

> *When we learn mathematics outside…*
>
> > *we require energy and external input from others (including objects) to continue our journey.*

we are helped by the objects of the natural world.

pressures and bad thoughts are lost, and we experience a sense of calm.

we undergo a change in our being as we move from one location to another.

we can help others as the environment calms us.

we are greeted by the familiarity of the environment with landmarks and treasured natural objects.

These statements represent possible essential themes of the experience. Some of these were borne out by further interrogation of the data, whereas others were not. Wholistic reading was a starting point for my analysis and provided a platform for deeper examination.

Selective Reading

After wholistic reading and producing phrases core to the experience description, selective reading was undertaken on each story. Selective reading intends to consider sentences (or clusters of sentences) that seemed especially significant to the experience for further development. This process was started by returning to the wholistic reading process and selecting sentences that spoke to the identified key statements. Additionally, I returned to my research journal and selected additional clusters of sentences I had written down during my initial readings of the transcripts. I then asked, “What do these sentences reveal about the experience of learning mathematics outdoors?” From my reflections, further questions arose. Finally, I provided possible answers to these questions, making interpretations of the insights it was possible to gain from these answers.

Sentence	Questions that arise:	Possible Answers	So, what might this mean?
"I have my own little sphere – my own little area which I can defend from others if they try to come in or steal ideas."	• How is little significant in the description of the area? • In what way do you defend? • Come in how? • What ideas? Is there some value in these ideas?	The journey is with others but not as one. As individuals who need to look after our own interests but may need the assistance of others to achieve success. At the same time, protecting own our achievement.	When learning mathematics outdoors everyone makes their own journey, aware of others who are taking theirs simultaneously. Space is a commodity – a place to work, a place to think and a place to be defended.
"The person gives me the syrup and then I'm back in action."	• Who is the person? • What is the syrup? • Why would they give it to you? • What does it mean to be back in action? • How does this sentence relate to the statement "*You can never work completely alone"*?	A pupil, a teacher, the environment, the sounds, the sun, the warmth. A boost of energy. Determination and resilience but needed from external sources rather than internal stores. A return to the journey indicates a moment of being out of or apart from the journey. Are we ever alone? Can we ever be alone? Is the environment with us?	External sources of energy are provided when learning mathematics outdoors. In part or whole, by the environment. Individuals take their own path on the journey, sometimes departing from the journey (taking a rest) and re-joining at a later date. People don't all finish together, they are not in sync, but sometimes paths cross, deals are made, and progress depends on the skills of the communication and bargaining between them.

TABLE 9 - EXAMPLE OF SELECTIVE READING INTERPRETATIONS

Table 9 illustrates selective reading for two sentences taken from Alex's story. Both examples in Table 9 reveal insights about how relationships with others are experienced when learning mathematics outdoors. By taking an individual sentence and exploring its meaning in depth, I drew out possible examples of how it was for the child. Later, these possibilities may have been supported by other anecdotes from within the constructed stories or refuted. Each

possibility requires further analysis before deciding whether the insight is borne out in the rest of the data.

Throughout the thematisation process, I adopted a phenomenological attitude. I consciously attempted to remain aware of emerging possibilities and move away from the everyday thinking of the natural attitude. I achieved this by writing in my research journal and practising reflexivity techniques to foreground my fore-conceptions: what I anticipated the data to reveal. I also tried to write freely and creatively without the restraints of what my logical brain told me was possible.

Detailed Reading guided by the Lifeworld Existentials

The most detailed step of Stage 2 analysis was conducted on each sentence within the story – detailed reading. I approached the detailed by reading by asking each sentence, “What does this sentence reveal about the experience of learning mathematics outdoors?” To support my detailed reading, I was guided by van Manen’s *lifeworld existentials* (2016a). *The lifeworld existentials* allow access to the lived experience and cultivate a more extensive appreciation of the nature of day-to-day experiences. Each existential provides researchers with a way to describe and interpret an aspect of the *lifeworld*. van Manen focuses on five *lifeworld existentials* that permeate all human experiences: lived space, body, time, human relation and things. These five themes are considered by van Manen as fundamental to all human experience and essential for phenomenological questioning, reflecting, and writing. Each guides the researcher to ask, “How is this existential experienced concerning the phenomena being studied?”

> **Lived space (spatiality)** refers to the spatial dimension experienced daily. Lived space is separate from space in the mathematics sense. Rather than a geometric understanding of dimensions, lived space relates to an experience of the world.

Spatiality refers to the world people find themselves in and navigate experiences through.

Lived body (corporeality) relates to *Dasein* being present in the world. Corporeality reflects how the phenomena being studied are experienced through the body. In their 1945 [2012] seminal book, *Phenomenology of Perception,* Merleau-Ponty focussed much of their work on the lived body and saw embodiment as fundamental to understanding human phenomena.

Lived time (temporality) refers to time as it is experienced in the subjective form rather than in how a clock records the passing of time. Temporality is the way of *Being* in the world through time. Heidegger's *Being and Time* (2010) regards temporality as fundamental to understanding the human experience since there would not be *Being* without time.

Lived human relation (relationality) incites questions of how self and others are experienced. Relationality reflects the connected nature of human *Being* with others and the perception of *self* within day-to-day experiences. Rationality uncovers the interpersonal space people share with others and themselves.

Lived things (materiality) prompt researchers to ask how objects are experienced. All experiences inevitably involve things which can be physical objects people interact with or abstract items such as thoughts or ideas. Materiality can also refer to animals or nature and distinguishes itself from the experience of other humans (relationality).

The *lifeworld existentials* are ways of looking at lived experiences and assist in the reflective inquiry to explore phenomena in a heuristic manner. However, as Rich, et al. (2013) point out, their use can be dangerous. For example, if a researcher were only to use the five existentials

in analysing a lived experiential account, they could be at risk of missing essential insights that do not fit within these predetermined categories. Similarly, there will be an overlap and interaction between each of the existentials, which could be omitted if conducted in isolation. While there are considerations to be made when implementing the *lifeworld existential*, they will become central to how the data in this study are analysed as they provide a platform for which analysis to begin. Rather than being an endpoint and how the experience is presented, this study uses the *lifeworld existentials* as lenses to begin data analysis systematically and heuristically.

When I first began the detailed reading, I adopted one existential at a time and began to go through each sentence. However, I soon felt this method was not intuitive and did not allow me to dwell on each sentence in depth. Focusing on one existential at a time, I was missing a larger picture and insights that existed where the existentials merged. For example, I found that the environment could act in a spatial, relational and material way in the participants' experiences. Participants saw the environment as the space they navigated through and as a facilitator of learning filled with objects to be used, where the objects were part of the environment – separating the existentials as bluntly as I had attempted did not help gain rich insights. Therefore, I changed my method to read each sentence at a time and expose it to each existential in turn before moving on to the following sentence.

Trying to understand experience through different lenses was a helpful tool. However, each lens only demonstrates a single aspect of an experience and overlooks how the elements interact with each other as-lived by the individual. For example, if I listened to an entire orchestra, it may be difficult to distinguish each instrument. If I listened to each instrument in separation, I would be able to understand the instrument in isolation. However, this ignores how the instruments work together to create a composition as experienced by the listener. Moving from reading large sections of the crafted stories with a single existential lens to

reading a single sentence through multiple lenses is an example of where my relationship with the data led to the process of data analysis and an ongoing and changeable process.

Using my revised approach, I read a sentence at a time. I adopted the perspective of each of the existentials to understand better what the sentence could unconceal about the individual's experience. Whilst not every sentence related to every existential, using them to question the words in the sentences assisted me in unpacking the meaning to a greater extent. This step aimed to identify and capture thematic expressions illuminating the experience's phenomenological sense. This was achieved by noting my interpretations of each sentence and then assimilating shared insights into broad groups called qualities. Table 10 illustrates the qualities identified from Alex's story, which would become the material on which I would develop my phenomenological writing in stage 3.

Participant	**Identified Qualities**
Alex	• moving upwards • journeying • draining/receiving energy • with/against others • game-like • need to escape • environment as a facilitator of learning • time as stress • time as calm • recurring time • space to learn

• autonomy • senses

TABLE 10 - QUALITIES IDENTIFIED FROM ALEX'S CRAFTED STORY

Description

Gems, statements from the text that spoke powerfully about the nature of the experience (van Manen, 2016a), were also collected, such as: *my own little sphere – my own little area; gives me the syrup and then I'm back in action.* I then used the qualities and my interpretations from both the wholistic and selective reading to create a precis of insights for each story.

> Learning mathematics outdoors is experienced as a journey for children – a realm traversed in time and space. Throughout this game-like journey, energy is drained and needs to be replenished to reach the ultimate goal of completion and escape. The environment and others provide this energy. In learning mathematics outdoors, relationships with others are experienced through the dichotomy of needing others while remaining autonomous. Each child is on their own journey, running in parallel but not synchrony. Where paths cross, delicate negotiations take place for assistance (re-energising qualities) whilst guarding against one's own property of space, ideas, and learning. The experience of learning mathematics outdoors is greatly affected by the individual sensing the outdoor environment. Sounds are consciously intercepted, and the environment reaches out and touches the individual. This has the effect of calming, energising, and enabling learning. The experience of time when learning mathematics outdoors changes, beginning quickly with a deadline and immediacy and turning to endless opportunities for time whilst always holding on to the aspect of telos. Different levels within space play a role in the experience of learning mathematics outdoors. Things are described as above, below, low and high. Objects of the natural world (trees, sun,

wind, noise) support the individual's learning. They facilitate learning and enable the learner to concentrate and slow the world down to ensure this can happen.

Precis of insights from Alex's Story

The precis composition step allowed for the insights and interpretations to be pulled together to represent the individual meanings of the experience before bringing them towards a shared understanding. From each of the precises, relevant philosophical notions were identified. For example, in Alex's story, there is a clear call to investigate how objects play a role in their experience of learning mathematics outdoors. The intention was to use each identified philosophical notion as a starting point for the third and final analysis stage.

However, I struggled to develop a piece of phenomenological writing with only a collection of qualities and precises. Finally, I realised I had missed a step and the output of stage 2 needed to be completed. Therefore, I decided to return to the precises, qualities and crafted stories and develop them into descriptions of each participant's lived experience. Below is an extract of my interpretative description of Alex's experience.

Alex's relationships with others are experienced through the dichotomy of needing others while remaining autonomous. Alex is on their own journey, running in parallel but not in synchrony with the class. Individuals in the lesson take their path on the journey, departing whilst resting before re-joining sometime in the future. Individuals don't all finish together as they are not in sync. However, where paths cross, delicate negotiations take place for assistance (re-energising qualities) whilst guarding against their possession of space, ideas, and learning.

Extract of the description of Alex's experience

Description of each of the experiences involved taking the collected qualities and precis of thematisation and applying it back to the crafted story whilst referencing notes from initial reflections, research journal and maintaining phenomenological sight of the experience.

Applying the qualities to the crafted stories deepened my insights into the lived experience and went beyond the obvious. My reflexive journals reveal that I tried to skip this step because writing descriptions of the experience felt repetitive when I had already collected the qualities and crafted stories. However, the descriptions were vital as they formed the starting point for my phenomenological writing. Finally, with five illustrations of the lived experience, I was ready to begin developing a phenomenological text.

Stage 3: Development

This stage aims to present my interpretations using the experiential "material that creates a scholarly and reflective phenomenological text" (van Manen, 2016a, p.353). In this sense, the development stage aims to present the 'findings' of the research. However, phenomenological writing should be viewed as a process and product (Dibley, et al., 2020). Writing hermeneutically, therefore, is an interpretative process. Whilst qualities and descriptions are gathered in earlier stages of the analysis, the development of the writing can be seen as an additional layer of interpretation where the parts of the thesis are brought together and combined to deliver a rounded sense of the experience.

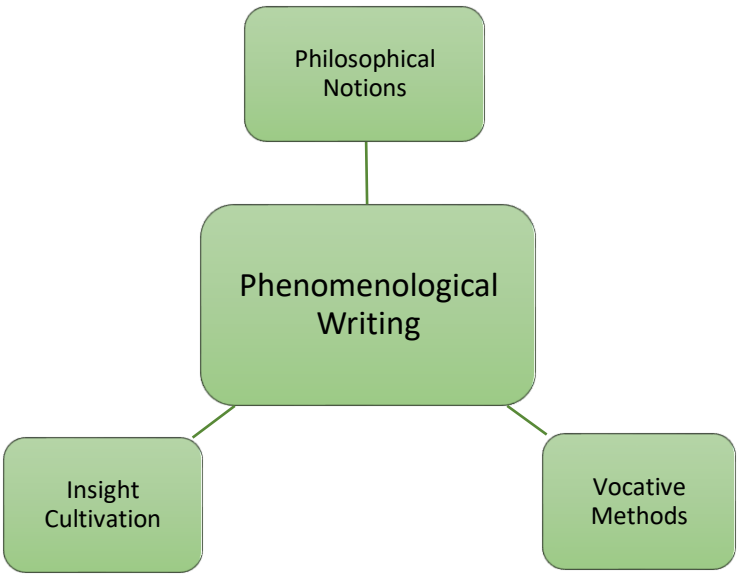

FIGURE 9 - STAGE 3 PROCESS MODEL

As illustrated in Figure 9, developing phenomenological writing was not conducted in a series of linear steps. Instead, the writing was created by combining my interpretations with philosophical notions, vocative methods, and insight cultivation. This layered process involved using experiential data in the form of crafted stories and descriptions of the lived experience from stage 2. Taking one quality at a time, I developed an evolving piece of phenomenological writing, leading to qualities being grouped where my reflective practices identified connections.

This was the most challenging data analysis stage, requiring me to reconsider how to present my interpretations constantly. Knowing where to begin and how different collected qualities related to each other was also challenging. The phenomenological writing also led me to several dead ends. For example, at one point in my writing, I presented the findings through the notions of *Being* with others, self and nature. Whilst there are some critical elements in these concepts, I realised that this did not capture the essence of the experience as described

by the participants' lived accounts and, secondly, presented a simplistic view of the experience, which did not take conceptualisation beyond the *taken-for-granted*. At points such as this, I used reflexive methods (such as journalling) to consider what had led me to this end and relied heavily on the techniques described below.

Philosophical Notions

Philosophical notions refer to philosophers' ideas, concepts and writings, which may provide a lens through which to view the interpretations of lived experiences. By engaging with (primarily phenomenological) philosophical notions, Finlay (2013) claims that frames of reference should be integrated to illuminate meaning in interpretations. The aim is to weave philosophical concepts that resonate with the insights by describing the lived experience to deepen understanding. As this study follows a hermeneutic phenomenological approach to research, there is a particular focus on "Heidegger's notions to offer more than mere descriptions" (Crowther and Thomson, 2020, p.2). Therefore, many of the philosophical notions used in my data analysis were derived from the work of Heidegger and philosophers following his approach.

In my research, the notions provided a way to group uncovered qualities and showed a way into the writing. In some instances, they offered a way to explore an interpretation in a way that moved my thinking beyond the obvious. For example, stage 2 analysis revealed that children experience co-operation that sees children supporting others to achieve goals. Rather than giving each other the answer, children provided the resources and support needed to help others achieve their goals. This connected with Heidegger's concepts of *leaping-ahead* and *leaping-in*. Using the writings of Heidegger and others on these philosophical notions, my thinking about the experience as-lived by the participants was deepened and moved beyond the taken-for-granted.

Whilst it could be argued that using the existing writings of philosophers could impose predetermined concepts that lead to misinterpretation, the notions were not accepted as truth. Instead, they were employed as openings to my thinking. At times, the revealings in the data contradicted phenomenological ideas, and I used these as opportunities to extend understanding and reveal more about the experiences as-lived. This reinforces the premise that seeing interpretations through philosophical notions is a strategy for developing phenomenological writing rather than the method of phenomenological analysis.

Vocative Methods

van Manen's approach applies the concept of the vocative dimension (Peoples, 2021). The vocative dimension concept follows the principle that a text can speak to a reader. van Manen describes this as a philological method that ties the phenomenology of practice to its philosophical roots. Through writing, the vocative dimension becomes active as the researcher seeks to "express the noncognitive, ineffable, and pathic aspects of meaning that belong to the phenomenon" (van Manen, 2016a, p.240). The vocative aims to create a response in the reader and bring the experience into the reader's mind as it was for the individual who experienced it. For this to be successful, the reader must appreciate the interpreted experience as plausible regardless of their encounters with the phenomenon. Through a series of linguistic methods (such as metaphor, symbolism and anecdotes), van Manen invites researchers to produce detailed descriptions of experiences that evoke deeper understanding within the readers' minds. Using the vocative highlights van Manen's appreciation and enthusiasm for creative data collection and analysis methods. Rather than being a prescriptive method of step-by-step processes, the phenomenology of practice demonstrates methodological phases to research to be adapted and enhanced by researchers who adopt the phenomenological attitude and remain faithful to the philosophical principles.

Having used vocative methods within my interviews, it seemed appropriate to use them to interpret and describe the lived experience. Whilst I could use the participants' vocative words, I could also use my literary technique to create resonance with the reader. Vocative methods allow the reader to interpret what is important and essential about the lived experiences of the individual, aiming “to be addressive and speak to our whole embodied being” (van Manen, 2016a, p.377).

Insight Cultivation

Hermeneutic phenomenology requires the researcher to move beyond their *taken-for-grantedness* and adopt a position of reflexive openness. One way I achieved a phenomenological attitude when analysing my data was through insight cultivators. Insight cultivators are external sources that “stimulate further creative insights and understandings concerning the phenomenon under investigation” (van Manen, 2002, p.126). This means that insight cultivators, such as poetry or philosophical writing, may broaden the researcher's thinking beyond their experiences and everyday thinking. Insight cultivators do not make interpretations on behalf of the researcher; the sources merely point to different ways of thinking and possibilities that had previously not been considered.

While van Manen encourages using the text of philosophers and academics, other hermeneutic studies, such as Crowther (2014), have employed poetry and prose to develop their phenomenological thoughts. Throughout the development of my phenomenological writing, I searched phrases online to see if the results resonated with the essence of the participants’ experiences to unfold their deepening meanings. Most did not. However, sometimes, gems were found that ideally addressed my interpretations. I used these to develop my thinking and understanding. For example, in understanding the ‘oneness’ felt by the participants when learning mathematics outdoors, I drew on the words of spiritualist Sri Chinmoy (Wells, 2021, p.58).

Oneness is the perfect expansion

Of our inner reality.

Let our heart's oneness only increase

To make us feel

That we belong to a universal world – family

One of the difficulties of using insight cultivators is finding worthwhile sources of material that resonate with insights and deepen the researcher's interpretations (van Manen, 2002). van Manen states that "insight cultivators are only found through a process of extensive reading and scholarly study" (2002, p.126). However, extensive reading is very time-consuming and does not guarantee the acquisition of valuable cultivators. Therefore, I decided to generate new cultivators using Artificial Intelligence (AI).

AI-generated artwork results from "machine learning algorithms and deep neural networks" (McFadden, 2023, n.p.). It is important at this point to put the use of AI in this study into the context of Heidegger's thinking on technology because of Heidegger's concerns regarding the commodification of human thought (Dibley, et al., 2020). In his 1954 [1977] writing, *The Question Concerning Technology and Other Essays*, Heidegger argues that technology is inherently dangerous as it risks people only seeing the world through a technological lens. Heidegger warns against the dangers of understanding *'Being'* through a technological framework that sees people viewing the world through control and domination. However, Heidegger's concerns are with humans thinking only technologically rather than the technology itself, which is neither good nor bad (Huttunen and Kakkori, 2021). Heidegger warns against using technology to replace or condition human thinking (Heidegger, 1966). However, using AI-generated artwork as an insight cultivator catalyses creativity in human thinking rather than conditioning the research analysis computationally. Therefore, I argue that using technology to stimulate human interpretation is not at odds with Heidegger's philosophy

because of his concerns with technological thinking rather than using technology as a tool. Furthermore, AI may provide a way for researchers to transcend humanness.

Previously, insight cultivators have been found in philosophic sources and those in academic writing across human science disciplines (van Manen, 2016a). Using a cultivation source, a researcher moves beyond their own thinking but adopts the partial perspective of another human. Using sources provided by AI removes the human, thereby disrupting the *taken-for-grantedness* of human nature. For example, when using the words of a poet, the researcher assumes the knowing of another *Dasein.* However, AI produces the stimulus for deeper thinking not through *Being-in-the-world* but through algorithms and machine learning.

Using Bing Image Creator (https://www.bing.com/create), I entered words from the constructed stories to see what images would be generated. I found that rather than searching for poetry that resonated with my insights, AI-generated artwork provided immediate access to images that helped aid my reflection. Whilst most artwork was unhelpful, some generated images stimulated my thinking about the participants' experiences and allowed me to practise a state of phenomenological openness. AI art generation has not been used previously in a hermeneutic phenomenological study. Therefore, this approach contributes to methodological understanding and is an example of creative methodological *epoché*-reduction within this study and a disruption to the status quo of research design.

A possible pitfall of searching through generated images is confirmation bias (McSweeney, 2021). It would be tempting to find pictures that supported my preformed conclusions. However, this would equally be the case for all insight cultivators, whether prose or philosophical writing. Insight cultivation is not an objective process, as it relies on the sensibilities of the researcher (van Manen, 2016a). However, the hermeneutic phenomenological endeavour is not objective but depends on the reflectively aware researcher to make informed choices. The images were not created to represent my

preformed interpretations but as a stimulus to move beyond the bounds of my interpretive sensibilities.

FIGURE 10 – AI-GENERATED ARTWORK OF 'AS FREE AS A FOREST'

Figure 10 is an example of AI-generated artwork in response to the following quote in Paris' crafted story.

> *It makes me feel freer because there's so much space. As free as a forest. (Paris)*

I entered 'child, forest, free' into the AI art generator to create this image. I chose this image as an insight cultivator as it triggered new thinking and broadened my interpretation. How the image portrays the child's arms wide, with a shaft of light coming through the trees, influenced my interpretations and opened my thinking to new possibilities. Whilst remaining attuned to

the words of the participants within the crafted stories, the images provided new possible insights that had not previously revealed themselves in my interpretations.

The resulting images would likely differ if my keywords were again entered into an AI art generator. However, this is not a disadvantage of the method. Phenomenology is not concerned with repeatable outcomes or generalisable findings. The inconsistency of output from AI is a potential advantage as it demonstrates that AI could have the ability to provide almost endless new stimuli for further analysis and interpretation. Yet, it is essential to be aware that it is not the image being interpreted in this process. The interpretation remains on the research data in the form of crafted stories, but alternative perspectives influence the interpreter's thinking as a result of the cultivator.

As described in Chapter Five, both the words in the poetry and the evocative images created by AI led me deeper into my interpretations. Linked to philosophical notions and vocative writing methods, insight cultivation proved a helpful technique in developing a rich phenomenological text that moves beyond simple description and demonstrates a phenomenological attitude of openness to the possibilities of the experience.

Ethical Considerations for Data Analysis

Throughout the data analysis, I remained reflexively aware of the need to present my interpretations of the participants' experiences faithfully. As well as a methodological consideration, this has ethical implications, as previously explained. Many qualitative studies will employ member checking to validate the trustworthiness of data analysis (Birt, et al., 2016). Member checking involves returning to participants to confirm that the researcher has accurately described their experiences. It may also include returning to participants to ask further questions if the researcher wishes to clarify their interpretations or the responses acquired in interviews. Whilst this may be considered a way to represent an individual's lived

experience more ethically, consideration needs to be made as to the methodological unity of this process.

McConnell-Henry, Chapman and Francis (2011) consider member checking incongruent with phenomenological studies due to Heideggerian concepts of the multiple nature of truth. They claim that member-checking, in fact, "threatens the rigour of phenomenological studies" (p.37). Furthermore, member-checking does not consider Heidegger's understanding of memory and remembering. Heidegger says remembering "is the making-present of something which has been" (2001, p.170). This means that memory is always subject to the context in which it is retrieved by the individual (Mølbak, 2007). Therefore, a participant who disagrees with an interpretation of their experience does so through their understanding at this moment rather than at the moment it was experienced. This makes member-checking unhelpful in the phenomenological pursuit of experience as lived.

Whilst some hermeneutic phenomenological research has employed member checking (e.g., Crowther, et al., 2017), the exclusion of member checking as a valid method in hermeneutic phenomenology is supported by van Manen's emphasis on gaining the prereflective experience (van Manen, 2016a). Checking what a participant means invokes meaning-making within the participant – a postreflective account – which is not the pursuit of hermeneutic phenomenology. Therefore, whilst an attitude of attentiveness to represent the lived experience of the participants ethically is adopted, member-checking was not employed within this study.

Ethical consideration is also called for concerning my presuppositions of the participants during the data analysis process. Throughout the stages of analysis, I continued to write in my reflexive journals, reflecting on how my presuppositions played a role in how I interpreted their experiences. However, because the gap between the interview and completing the analysis was nearly two years, I found that the participants' identities faded in my mind. Dwelling with

the content of the experiential data caused a drift away from the characteristics of the individuals. Now, whilst I have some memory of the participants, I could not confidently say the names of each pseudonym. I became aware of the distance between the data and the participants' identities, mainly through stage 3 of the analysis. At this point, I was very familiar with the pseudonyms. This was also the moment at which the individual experiences were brought into discussion with each other. Realising I had forgotten some of the original names, I was tempted to look back through my journals to remind myself. However, I chose not to do this as I felt it would influence my interpretations. I realised what I had achieved (even if only to a certain extent) was a phenomenological attitude of openness. Forgetting who the participants were was different from transcending my knowledge of them, but it helped develop my interpretations. I believe that using gender-neutral pronouns also aided in this.

Chapter Summary

This chapter has detailed how the methodological principles of my study were applied in practice. Through a series of reflections, trials and adaptions, this chapter represents my completed research design. The design is unique to my study as it is informed by my research competencies, reflexive practices and (most importantly) the experiential data collected from participants. In this chapter, I have described how I implemented a unique combination of data elicitation techniques during the interviews and how the philosophy of phenomenology drives these decisions.

In this chapter, I have presented how the data was analysed in three stages. Each stage was constructed as a result of my bids and attempts to deepen my understanding of the lived experience of the participants and the adoption of the methodological reduction. Whilst phenomenological analysis can be a fluid and complex process, my aim in this chapter was to present a systematic approach where the reader can follow the data from the interview to what

is shown in the following three chapters of this thesis: the phenomenological accounts of learning mathematics outdoors.

Chapter Five: Grasping Meaning

"[Phenomenology] primarily aims to 'show' how meaning reveals itself."

(van Manen, 2016a, p.48)

In this chapter, I present the 'findings' of the research as a reflective phenomenological text. However, neither the terms 'findings' nor 'themes' are methodologically congruent with this study. Rather than concluding or identifying common patterns, this study arrives at 'revealings' through a series of developed insights. As a result, I have decided to use the term poiesis, from the Greek word ποίησις (meaning to bring something into existence), as it is more methodologically suitable for this study. The term also highlights that the 'findings' of this research are not facts awaiting discovery but rather a product of the combination of the description given by participants and my interpretations. These findings, therefore, illustrate possible experiences so that insights may be gleaned as the children lived them.

The following poieses illustrate the essential essences of the participants' lived experiences. Each essence provides insight into the meaning and nature of what it is to learn mathematics outdoors. Therefore, as described by van Manen above, this chapter aims to show how the meaning of the experience has been revealed through the interrogation of the data. Gadamer's hermeneutic ontology uses the term 'fusion of horizons' to describe the unique combination of the researcher's understanding and the participant's experiences (Gadamer, 1989). Therefore, the three 'themes' described in this chapter demonstrate an arrival at a fusion of horizons between my interpretations and what the individuals describe.

The three poieses explored in this chapter illuminate the essential essences of **connection**, **enthrallment** and **serenity**. The purpose of the poieses is to allow the reader to "walk a mile in the shoes of the participants to learn firsthand what that experience is like" (Beck, 2021, p.1). Therefore, these poieses aim to move beyond a simple summary of the interview

transcripts to a descriptive interpretation that delineates the meanings of these uncovered essences. Eisner (2017) encourages phenomenological researchers to fill their writing with vocative energy that reaches out to the reader. Therefore, my writing in this chapter is deliberately written to captivate through powerful and emotive language.

Each poiesis begins with a picture that participants drew during the interviews. Although these images were not subject to phenomenological analysis, they depict essential elements within each poiesis. Therefore, they have been used in this chapter as a starting point for the reader to engage with the meanings behind the experience of outdoor mathematics.

Similarly, each poiesis begins with an audio narrative. These narratives are excerpts from the crafted stories that illuminate the meaning of the exposed essences through the participant's own words. Each audio narrative draws on quotes from several participants and is voiced by volunteer children at my school, not the study's original participants. Parental permission was obtained for each of the children who voiced the excerpts. Initially, the excerpts were used in my presentations at conferences. Feedback from those presentations has resulted in their inclusion in this thesis as listeners explained how listening to the voices of children representing the words of participants allowed the listener to be drawn into the moment of the experience. A natural soundscape ties the voiced quotes together.

I have chosen to place the interview images and audio narratives at the beginning of each poiesis as an invitation for the reader to engage with my interpretive text. In each audio clip, developing qualities are presented that foreshadow this thesis's insights for the reader, aiming to 'show' rather than 'tell' the participant's experiences. The combination of image, audio and text aims to create resonance with the reader's sensibilities and guide them through the experience as-lived by the participants. The reader is also welcome to return to these clips after reading each poiesis to reflect on how the insights have been formed directly from the words of the participants.

The poieses are not intended to be linear or hierarchically described. Nor should they be seen as separate and distinct. Instead, each poiesis is the uncovering of a series of complex and closely connected qualities that overlap and rely on each other to uphold the boundaries of the phenomenon. The poieses are the results of moving between the qualities of the experience and the experience as a whole with the understanding that each informs the other and neither one alone nor both, in combination, can ever reveal the completeness of the lived reality.

Writing the poieses is a central part of the analytic process of this study. Therefore, the poieses are not endpoints or conclusions. Instead, they attempt to represent the revealed essences of the experience so that meaning and implications can be made in subsequent chapters. As van Manen asserts, “To write is to reflect; to write is to research” (2016a, p.20). Consequently, the following poieses are my reflections on the participants' lived experiences. Throughout the writing process, the titles of my poieses developed as I organised my interpretations into a coherency that guides the reader through the story of what it is like to learn mathematics outdoors. As a result, these poieses are not my study's insights but essences that point towards a deeper meaning when explored.

Poiesis One – Connection

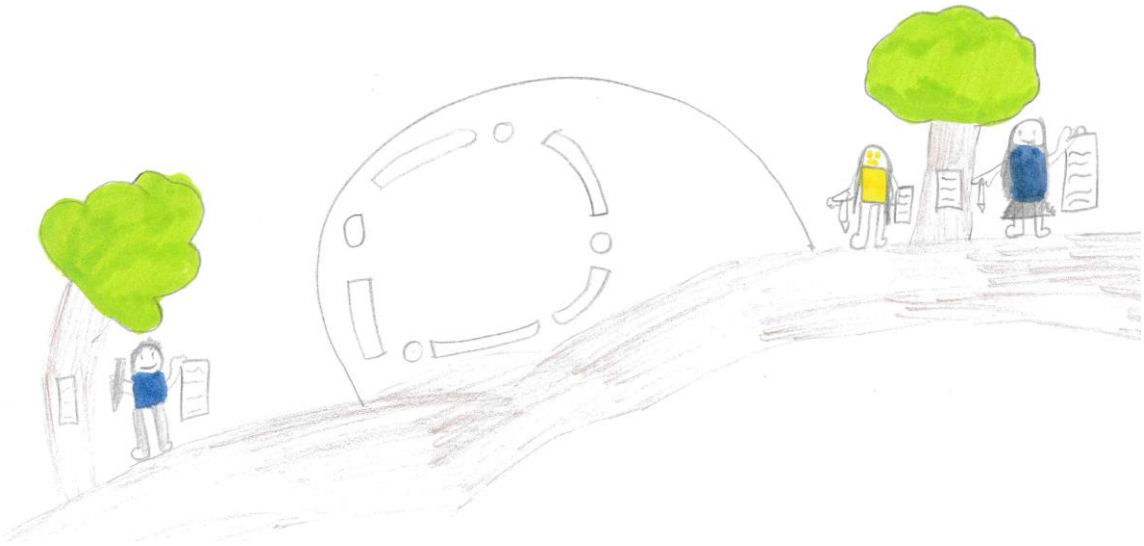

FIGURE 11 - A DRAWING OF CHILDREN WORKING INDEPENDENTLY AND COLLABORATIVELY

Poiesis One – Audio Link

The centrality of interacting with others is revealed throughout the participants' stories. Woven within the descriptions are individuals' connections with those around them. Even when participants work independently, they are reminded of their strong link with their classmates. A sense of learning alongside others is uncovered as an essential essence of learning mathematics outdoors. As Figure 11 shows, some participants work together whilst some work alone. Regardless, Poiesis One argues that all participants work in an environment that connects them with others. The participants experience the kindredness of belonging through their connections with others.

A deep connection with those around the participants is not surprising. Phenomenologically speaking, the relations people make and maintain with others in everyday life are core to

human existence (van Manen, 2016a). Heidegger (2010) explains that “so far as Dasein is at all, it has Being-with-one-another as its kind of Being.” (p.163). Heidegger describes *Being-with-others* as an essential structure of being human; the world is a shared world, and an individual’s experiences are deeply intertwined with those around them.

Relationality refers to the lived interactions people establish and manage with others within the shared world (van Manen, 2016b). Relationality calls into question how *Dasein* (one’s own consciousness of itself) is experienced in relation to others. In this first poiesis, I describe the relationality the participants’ experience due to my dialogue with the crafted stories, supported by extracts of participant transcripts and my reflective narrative. I begin here with Alex’s description, which explains that outdoor mathematics lessons are experiences as a journey.

> *Whenever these types of things happen, I feel like it’s a little journey.*
> *(Alex)*

When interrogating the data, I found that the experiences were described from the participant’s perspective as navigating the mathematics lessons. Alex captures the element of navigation when depicting the experience as ‘a little journey’. As is typical in journeying, participants’ stories reveal that there are waypoints on the route to the destination where their interactions with others change (as they navigate their relationships), move apart from one another and reconnect. The participants' opening words highlight the importance of their unique journey.

> *We leave the playground.*
> *(Paris)*

> *Everybody is trying to get the worksheets down from the trees.*
> *(Alex)*

> *…we’re working outside!*
> *(Casey)*

As we go outside…
(Robin)

We're in the forest for maths…
(Sydney)

The words 'we' or 'everybody' come within the first sentences, signalling that this is not an experience involving just me but a concept of us. The participants begin together and have a sense of *Being-with* from the outset. Heidegger uses the term *Being-with* (written originally as *Mitsein* in German) to describe one way in which human existence finds itself in the world (Heidegger, 2010). Humans find themselves permanently connected with others and are therefore shaped by others. From a phenomenological perspective, being human is *Being-with*, and it is through connectedness with others that experiences are formed. Consequently, it is no surprise that for participants learning mathematics outdoors has a significant social element in which connections with others play an essential role.

Alex's use of the word 'everybody' suggests no exceptions. Learning mathematics outdoors is experienced as an inclusive activity where no one is left out. However, inclusivity does not mean that all are equal. As will soon be discussed, participants are very aware of their position within the group of learners. Position here refers to mathematics ability. Participants have an understanding of where their mathematical abilities 'rank' in comparison with their peers. Nonetheless, learning mathematics is where everyone has a role to play and feels a sense of inclusion. Inclusion develops a sense of oneness within the group of learners.

Combining these opening phrases gives a sense of oneness experienced at the lesson's beginning, all doing the same thing. The words of spiritualist Sri Chinmoy (Wells, 2021, p.58) perhaps give a glimpse of the role of oneness:

Oneness is the perfect expansion
Of our inner reality.
Let our heart's oneness only increase
To make us feel
That we belong to a universal world – family

The works of Sri Chinmoy brought me to question whether the experiences of oneness when learning with others give individuals a sense of belonging and illustrate the Heideggerian concept that individuals always exist towards (and for the sake of) others. As will become apparent in this chapter, others have a significant role in the participants' experiences. This insight is merely glimpsed at through interrogating the opening words.

Whilst the experience illustrated here begins together with a sense of unity, this is not to say that these journeys run in perfect synchrony, with each individual sharing the same experience. On the contrary, soon after the opening phrases, several descriptions reveal that individuals are on their unique path through the lesson.

People have started working out the questions. I start my first question…
(Paris)

Paris reveals a separation from others and a focus on the individual's task. After becoming aware that others are engaged in their activities, Paris takes ownership of their first question. Each individual has their own first question, illustrating that, whilst deeply connected, only 'I' can have 'my' first question. There is no indication of whether the first questions are all the same, but 'my' instance of this first question belongs to me. Casey demonstrates this further when they explain:

Another teacher is helping another person. I'm now the person asking for help since I don't know how to do the question.
(Casey)

The text above shows that Casey observes others requiring help before finding themselves in the same position. Casey does not describe whether asking for help is positive or negative, but it illustrates the nearness of the experiences of others. In this way, alongside others can be viewed as the individual's knowledge of others around them who are all working to achieve a common goal. The participants are aware of each other and of participating in an activity within the same context as another without being directly involved in each other's work. They have their own set of tasks which share similar characteristics. For example, Casey explains that:

> *Another group are working on something different – a diamond instead of a pyramid. (Casey)*

In this scenario, another group of children completed a mathematical diamond instead of a pyramid. Whilst different groups may be working on slightly different tasks, each shares similarities, such as filling in missing gaps and using inverse calculations to find solutions.

Casey describes the children as having taken on the role of 'the one who does not know' and demonstrates a conscious understanding. They know their connection with others in the lesson, even when not working directly with them. Individuals' journeys may not always be directly with others, but lived human relations exist throughout. The connection to others is felt in the participant's stories, even those working alone.

<u>Working 'Alone'</u>

As previously stated, Heidegger asserts that *Being* requires *Being-with* (Heidegger, 2010). However, humans are not constantly 'with' others in a physical sense. Whilst people's experiences and world are shaped by other people and interactions with them, humans can still experience a sense of being alone. Alex's experience reveals that, for some, working alone is an option when learning outdoors and one that Alex chooses to pursue.

> *I manage to get one of the circles to work in. I have my own little sphere – my own little area which I can defend from others if they try to come in or steal ideas. I enjoy having my own space because it feels like I can't become crowded or hurt. I have my own space, and I can do whatever I want in that space. It doesn't feel crowded in a box. Not like inside where it is really close in. I can go somewhere else if there is someone I don't like. I don't have to go near them. I have my own space without them coming and hurting my feelings.*
>
> *(Alex)*

For Alex, relations with others are challenging. The availability of locations outdoors provides Alex with the ability to manage their interaction with others through their control of the space around them. They identify the need to own their part of the playground to work in. Here, space is experienced as a commodity – a place to work in, a place to think, and a place to be defended. They celebrate successfully acquiring the prime location and are prepared to protect it, if necessary, from those who might want to take the space, invade it or steal ideas. Lived relations here are experienced through the need to distance oneself from others. The connection Alex has to others within the lesson requires them to put in place structures to control the relationship. Only when the systems are in place can they focus on learning. Exploring Alex's experience has led to an understanding that comfort and security for some are attained through independent learning. However, whilst not discounting the advantages of team learning, Alex's preoccupation with the importance of guarding space illustrates that working with others for Alex could be a barrier to learning.

In contrast to Alex, Casey chooses to work with others but provides their understanding of those who are more comfortable working alone:

> *That person's working alone – it doesn't feel right working in a group for some people. They're able to be more concentrated since they're probably pretty anxious doing things with groups. They're happy and feel relieved that they can work by themselves without having to work in a group. Being outside is an easier working environment, which means you can work together as a team, but some people struggle with it.*
>
> *(Casey)*

Through the third person, Casey is conscious that others do not feel 'right' working with others. They recognise that some people struggle to work in a team and feel relieved to work alone outdoors. For Casey, being outside is a platform for learning within a group. Whereas for Alex, it is an opportunity to better guard against it. The contrasting perspectives demonstrate the individual's empowerment when learning mathematics outdoors. They both describe the ability to be self-directed in their learning. They can choose to work independently or with others. Alex and Casey demonstrate that the outdoors enables them to work more effectively in the most comfortable way, providing a first glimpse into the self-directedness offered to the participants when learning outdoors, a quality of the experience that will be revisited in later sections of the thesis.

In the above extract, Casey states that 'being outside is an easier working environment which means you can work together as a team'. Casey recognises that the environment enables working together to be more easily achieved through being in a more manageable habitat. Casey is comparing a more awkward conventional classroom and the outdoors. Something about the outdoors enables connections to be more readily established and maintained.

Despite Alex's reservations about working with others, even they acknowledge the benefits of having others around.

> *Because there are people near, if I ever do need help, they can always come and help me. You always need people to help you. You can never work completely alone.*
> *(Alex)*

In a seeming paradox with their guard against others, Alex recognises that their connections with others are vital. Whilst they have protection over their own space, others are close. Alex is not 'completely alone'. Even while working independently on their tasks, learning exists as a process in which all children participate, often brought into sharp focus when reminded of the ever-present sounds of others.

> *I hear screaming of other children getting the question wrong. Now, soon after, they're screaming, "Yes!" they got it right.*
>
> *(Alex)*

The screams of others are never far away and permeate Alex's recollection several times. Alex is constantly connected with (and reminded of) others in the lesson, illustrating that, despite the self-directedness afforded to learners in the outdoor environment, connection to others is an essential essence of the experience. Alex's conscious choice demonstrates that connection to others is part of a self-selecting learner-centric process. Rather than being put into groups by others (namely teachers), Alex shows self-directedness in their approach to working with others. The affordance to be self-selecting in working with others will be important when Alex finds that they need to rely on peers for support later in their journey.

Collaboration and Co-operation

Although they have remained independent, Alex describes their need for others.

> *As the questions get harder in the lesson, I feel like a bee when they get sugar and water. They drink the syrup and then they go really fast and crazy. It feels almost like that. When I get a question wrong, I am the bee trying to rest, waiting for somebody to come and help. The person gives me the syrup and then I'm back in action.*
>
> *(Alex)*

The importance of having others for support is highlighted through Alex's description of themselves as the exhausted bee waiting for someone to provide them with the 'syrup' to continue. The journey analogy is reinforced with the concept that pauses are required. During a long journey, people often become tired and take breaks before continuing. The exhaustion for the traveller may result from walking, cycling, or sitting in one position in a car for an extended period. For Alex, their energy is drained as a result of incorrect answers to mathematics questions. The more complex the questions, the more mistakes are made, and the more power is needed, continuing until the individual is depleted of energy and others are

required for support. Alex's account illustrates that support from others is essential. Without the person giving the 'syrup' (support with answering the questions), Alex would not have been able to make progress. In this example, others are on hand and seemingly provide support freely as required. However, other stories of collaboration reveal that these lived relations are experienced through a series of negotiations and mutually beneficial arrangements.

> *I work in a two. Working with someone else in the woodland is really good because, if you're stuck on a question, they can help you. The same as if they're stuck, you can help them.*
>
> *(Paris)*

> *My favourite question is on this tree here. It rattles my brain a bit. I can't really think of it on the first or second try, so I keep trying with my partner. They motivate me, so I have motivation. We both give ideas to see if we are doing this bit right or this bit wrong. It gets hard, I get a little annoyed – a bit frustrated. Being outside helps the frustration, and then suddenly, I get it. I'm really surprised; I want to scream.*
>
> *(Sydney)*

Paris describes a mutually beneficial relationship where children work collaboratively to support each other. Support is reciprocated. For the participants, relationality is experienced as mutually beneficial. Sydney describes how working together is an integral part of learning mathematics outdoors. For Sydney, peers can be a source of motivation for an individual and can be called upon when an individual cannot solve a problem independently. The partner gives motivation to the learner. The support requires reciprocation when needed from their peer – 'they motivate me, so I have motivation'. That motivation is required suggests that giving up is an option but not desirable. For Sydney, learning mathematics requires incentive and drive, which need to be acquired from others. Working with peers requires that each person supports the other; it is a joint effort. Sydney's description also suggests that learning mathematics outdoors provides opportunities to leap-ahead.

Leaping-ahead is a philosophical notion, first conceptualised by Heidegger, that describes the actions of one who cares for others by enabling them to carry out their own projects (Glover

and Philbin, 2017). *Leaping-ahead* is in contrast to *leaping-in*, which is concerned with taking over another's project and completing it for them. *Leaping-in* leads to domination, whereas *leaping-ahead* allows others to become more transparent to themselves in their coping. Rather than providing the answer and *leaping-in*, Sydney experiences their partner providing motivation, thereby *leaping-ahead* to provide Sydney with what they need to move forward. The motivation enables Sydney to continue trying, resulting in success worthy of screaming in delight. For Sydney, having a partner *leaping-ahead* for them is a central part of their lived experience, which may be better understood alongside a traditional proverb:

> *Give a man a fish, and you feed him for a day.*
> *Teach a man to fish, and you feed him for a lifetime.*

Giving the fish (or the answer to the mathematics problem) would be seen as *leaping-in*. Whilst useful because it allows the person to eat now (or move on to the next question), the time soon comes when they are hungry again (or struggling with the following question). As a teacher, I have been trained not to give children the answers but to lead them in a direction whereby they can find the answers for themselves and learn from that process. Outdoors, Sydney experiences being leapt-ahead-of, but not by a teacher. Therefore, the outdoors can be viewed as an environment where children can leap-ahead of others, collaborate and cooperate to support each other in learning. This insight is reinforced by Robin's description of working with partners.

> *Sometimes you don't have to get along with everyone, but because we're in partners and doing partner work, we're in a thing. We're doing some really good maths and we're doing really good team.*
> *(Robin)*

Robin clearly illustrates that individuals combine to make a single unit, the 'thing', building on the idea that, individually, the children are part of a greater whole – a connection of lived-others. Robin reveals that this is not so much a social entity – getting along is not a prerequisite

– but a functioning unit working towards a shared goal to continue the journey and achieve success. However, working together and relying on each other also brings pressure.

> *I become aware that if I get stressed, the whole team will get stressed and then it will all crumble.*
>
> *(Alex)*

Alex's experience reveals that being relied on by others can be burdensome. In phenomenological terms, *leaping-ahead* and *leaping-in* are both modes of solicitude. Solicitous care, according to Heidegger, is the activity of caring of and for others (Dahlstrom, 2013). In their description, Alex is caring for their team. The team rely on each other to achieve success, and Alex experiences the weight of being a team member. Words from Katlyn Showers' poem Release (2022) may give an insight into Alex's experience:

> What happens when what I have to give,
> Who I am,
> Is not good enough?

Alex anticipates that 'it will all crumble' when they do not have enough to give, demonstrating some also experience that relationality through anxiety, tension and burden. There is a delicate tension between others *leaping-ahead* to support and the pressure to leap adequately in return. This may be one reason Alex seeks comfort in working independently through much of their description. Whilst they see the benefits of combining efforts, the sense of burden is sometimes overwhelming. It then perhaps falls on teachers to give children the skills required to work effectively in teams, a concept that will be further explored in Chapter Six. Whilst others exist both as supporters of learning and ever-present reminders of the connectedness of human existence, many of the participants' stories demonstrate that other groups of children within the experience exist: the others.

The Other Others

In this analysis, it has been established that participants form deep connections with each other when learning mathematics outdoors and create teams that act for the benefit of the whole. Equally, other children construct their own groups, and participants describe how they experience encounters with these different collections of individuals.

> *Another group are working on something different – a diamond instead of a pyramid. They're greater depth and are very concentrated on what they're doing. Because they're greater depth, they're doing something that's a lot harder than everyone else. (Casey)*

Greater depth is a term commonly used in English primary education to describe when a pupil works more deeply within the expectations for their year (McIntosh, 2015). These are more able pupils who will likely work on more complex activities. Casey identifies that these 'others' are set apart from the rest. They are distinct as they have different work – 'a diamond instead of a pyramid'. For Casey, these individuals form another unit working together as one, as indicated by the repeated use of 'they'. However, despite the different work, this other group is still part of Casey's experience, highlighting the importance of working alongside others as an essential element of the experience. Casey illustrates effectively that the participants' journeys are experienced as running in parallel, if not in synchrony. It also demonstrates that Casey knows their position within the class and the 'identity' of those around them. For teachers, it is important to be alert to how children may be aware of their standing within a lesson. In Casey's description, there is little indication of whether their understanding of their position has a positive or negative impact. Still, teachers must be conscious that either could be the case.

As well as other groups of children sharing the location at the same time as the participants, Paris's description also reveals that the experience of learning outdoors is impacted by others who are no longer there.

> *I start my first question at what looks like one of the oldest trees. It's surrounded by quite a few dens made by last year's Year 6.*
>
> *(Paris)*

Paris has a sense of the age of the trees and the existence of artefacts left behind by previous users, pointing out that learners are entering the forest at a point in time; others have been before them, and others will follow. The learning environment does not belong to the individual; it exists beyond them, came before them and will continue after they have gone, revealing that relationality is also experienced throughout the history of the environment and is not bounded by time.

Historicity is a phenomenological concept which calls for the consideration that an intentional object (an object as the subject of human attention) has its history, made up of the historical events of the object and the history of the person making sense of it. Humans are embedded within a pre-existing world and bring their understanding, experiences and cultural norms to their interpretation of each object. The knowledge that others of the past created dens calls these others to mind and makes them part of Paris' experience. The outdoors provides a shared learning environment for the children in the lesson and between the participants and those who have since moved on.

I am reminded of my practice of hearing children talk about past learners during lessons outdoors. In classrooms, much evidence of previous learners is wiped away as the new class begins each September afresh. Outdoors, artefacts of those of the past, exist for days, months, weeks and (in Paris' description) years. Chalk is left on the playground from a previous class and, at break time, becomes a focus for others. I have heard children explaining what they have been learning to children in other classes using the objects of lessons left outdoors. The learning spills out of the time of those lessons due to the environment in which they took place.

As a consequence, learning mathematics outdoors also enables connections to be made beyond the time limitations of that lesson. The uncovering that moments and people of the past are brought into the present in Paris's description underscores the centrality of connections with others in the experience of learning mathematics outdoors, which is also supported when journeys conclude with a sense of returning together.

Returning Together

At the end of the lesson, Paris' story describes coming back together.

> *After we have finished, we join up at the fire circle. I feel happy here. This is my happy place in the forest. It's nice to meet up again after we finish (…). Gathering together again reminds me of playing with my friends because during lockdown I didn't get to see them for quite a while.*
>
> *(Paris)*

Paris' story speaks of the importance of returning to the beginning and joining those who have also finished their journey. The description reveals the significance of gathering and meeting up, which draws the lesson to a close and re-establishes relationships. For Paris, the experience is a reminder of seeing people they have been unable to see because of the Covid-19 restrictions. Now that Paris can be with friends again, there is a sense of celebrating the lived relations they experience. Whilst individual journeys run separately, they are brought together, strengthening the connections navigated throughout the lesson. Just as they began, alongside others, several stories also finish their descriptions with mention of others in their final phrases:

> *…the person gives me the syrup and then I'm back in action.*
>
> *(Alex)*

> *It's like the best dream… going and getting ice cream and having a movie night with everyone.*
>
> *(Sydney)*

It feels really fun to see them again.
(Paris)

These concluding statements highlight the importance of coming together as a single unit. Those who have worked alone, those who have been completing different work and those who have been collaborating within a team all reunite as one. This brings the experience full circle from a beginning of togetherness to an ending of unity. Therefore, teachers must consider the importance of planning endings to lessons where children can connect and reconnect. Whilst children travel on their unique journey, opportunities for coming together are essential, and this implication for pedagogy will be further explored in Chapter Six.

Summary

The central argument from this interpretative process is that lived connections with others are at the heart of the experience of learning mathematics outdoors. Learning mathematics outdoors is experienced through complex and dynamic lived relations with others. Connections to others provide support and security when learning becomes challenging, and the outdoor environment enables these deep connections to be established and maintained. This poiesis has shown that connection between lived others is an essential element of the experience of learning mathematics outdoors. But, of course, this is not an absolute truth but a point towards an emerging horizon that beckons further exploration.

For the participants, lessons are experienced as individually unique journeys that run parallel with others in the class. Individuals in the lesson take their path on the journey, departing and resting before re-joining sometime in the future. The outdoors allows participants to choose to work with others and the self-directedness to work independently. Those who choose to work independently seek comfort in the protection offered by claiming their own learning space. The availability of space outdoors allows individuals to spread out and move away from others

when needed. However, those who choose to work alone still recognise that their experience is ultimately deeply intertwined with others around them.

Furthermore, the participants' stories demonstrate that the outdoor environment allows children to work together more efficiently. There are opportunities for children to leap-ahead of each other, and, whilst this can become burdensome for some, participants engage in delicate negotiations for assistance, motivation and energy, without which they would be unable to make progress. Additionally, Stories reveal that participants are aware of their position within the class. They identify groups of others different from themselves. They are sometimes directed to work with others, forming a single unit working together to achieve success.

Finally, others of the past are encountered through the artefacts they leave behind, which enrich this highly relational experience. Learning in the outdoors transcends the finite time constraints of single lessons and spills into other lessons through the physical traces of learning. The participants feel that they belong through their connections with others. The kindredness experienced is a sense of being together and, even when working alone, knowing others are present.

Poiesis Two – Enthrallment

FIGURE 12 - A DRAWING OF SMILING FIGURES SURROUNDED BY NATURE.

Poiesis Two – Audio Link

This second poiesis demonstrates how enthrallment is essential to the participants' lived experiences. Enthrallment can be defined as a state of being absorbed and engrossed by something fascinating. By dwelling with the data contained within the participants' descriptions of the lived experience, qualities of immersion and awe have emerged, which point towards a state of enthrallment which provides a sense of safety for the children.

When conducting thematization, the term wonder appeared frequently. By this term, I meant "something that causes people to feel great surprise or admiration." (Collins Dictionary, 2022). The participants often described minute details of the natural environment that filled them with curiosity and awe. However, Heidegger deliberated explicitly about the term wonder in his writings (Heidegger, 1994). For Heidegger, wonder (written in German as erstaunen) relates

not to amazement, admiration, astonishment or curiosity but to a fundamental sense of exclusion and how the Greeks understood *Dasein* (Stone, 2006). Therefore, for clarity, I do not use the term wonder in this poiesis but instead, synonyms that more accurately reflect the meanings my analysis has uncovered.

The participants describe their admiration and awe for the natural environment in their accounts, which leads to immersion within the lessons. Wonderment drives the participants' creativity, demonstrated through how they direct themselves using natural resources to support their learning. As Figure 12 illustrates, this poiesis highlights the pleasure and happiness that consumes the participants when immersed in the outdoor environment.

Immersed in the Environment

Amazement begins as the participants move physically and emotionally into a different location.

> *We leave the playground – it's really loud and there's not much space. There aren't as many leaves or trees than in the forest where we're headed. The moving from playground to forest makes me change how I feel.*
>
> *(Paris)*

Paris' account of learning mathematics outdoors begins with a physical movement of leaving the playground and entering the forest. They describe the playground as 'loud' and 'crowded'. In contrast, there is a sense that the forest is the antidote to this. There's more space, it is quieter, and there are leaves and trees. Paris describes how moving from one physical area (the playground) to a natural environment (the forest) changes their feelings. It is the physical movement which has a profound impact on the individual's sense of themselves. How they feel, perceive the world around them and attend to their situations alters. Their sense of themself transitions from one thing to another as their feet move them from one physical location to the next. The cramped concrete and noise of the playground are left behind and

replaced with the space and quietness of the forest. Highlighted here is the importance of transition on how participants feel about themselves. Teachers must be aware that the time between lessons plays a significant role in the children's learning experiences. Chapter Six will further develop this recurring insight concerning pedagogical practices.

Casey's opening paragraph points to excitement in anticipation of what will come in today's lesson.

> *Today's lesson is mathematics, but with a twist; we're working outside! It's something more exciting – a very immersive experience; more immersive than ever imaginable at school. Going outside is like you're almost in the wilderness already.*
>
> *(Casey)*

Casey begins by recalling that this mathematics lesson is mathematics 'but with a twist'. For Casey, learning mathematics outdoors is a different experience from the usual way of experiencing a mathematics lesson. It is something immersive which creates another way of feeling about learning. Casey is refreshed and reinvigorated by the difference this learning experience brings. It recharges Casey and allows them to enter their learning focused and assured. For Casey, being in nature whilst learning also creates a sense of excitement and awakenment not accessible in the classroom environment. Reinforced is the idea that the move towards the wilderness is essential in their experience. For others, the excitement of learning outside alleviates their feelings of sadness.

> *I'm a bit sad right now because I'm losing someone in my family but being outside makes me very happy inside.*
>
> *(Paris)*

Being outdoors changes how Paris feels inside, and they know their position on the outside has caused that change. As Paris is immersed in the natural environment, a sense of pleasure

and happiness is manifested. In addition, Sydney provides insight into how the outdoors can capture the imagination by describing what they can see around them.

> *I quite like this area – not just because it has lots of trees – but there's lots to see. Oh look, there's so many trees. Oh, the trees have different markings. Those ones have the vines up them. You can just see every tree. And it's not just the trees. If you look down, there's so many things on the ground. All the leaves have different patterns and I find them enjoyable to just look at and see all the different coloured ones. It's just a really amazing place.*
>
> *(Sydney)*

Sydney navigates their way through the learning location and travels through a series of awe-inspiring encounters with objects of the natural world that enhance their experience of learning mathematics outdoors. For example, the minor details on the vines climbing a tree are taken in before moving on to be alert to the patterns on a leaf. As each detail is noticed, the individual becomes further immersed within their environment, creating an enthralled feeling as they move from one awe-inspiring moment to the next. Returning to Casey's story, there is a reminder of the difference being outside can make to the participants.

> *It's something new. The something new in school... A new thing that is something different from everything else. A maths outdoor lesson is like getting up in the morning, stretching and getting ready for a new day.*
>
> *(Casey)*

Whilst Casey describes this as a novel way of learning, it is not for them a novelty. All participants have participated in outdoor mathematics lessons for several years, yet every time they venture out into nature, the lesson is experienced as something new and different. Furthermore, the experience lasts not only for the time in which the experience is new and novel but can be experienced repeatedly. One potential implication is that the enthrallment caused by being in nature could distract learning. However, Casey explains how this immersion creates a *'better way of learning maths'*. Therefore, Teachers may need to consider

what opportunities are provided for children to have a moment to become immersed in their surroundings so that they are in a position, or mindset, to engage in their learning actively.

Creativity

The enthrallment experienced through immersion in the outdoor environment leads to the participants engaging creatively in their learning.

> *Outdoor learning is where your creativity comes into play – you can unleash your creativity off the charts.*
>
> *(Casey)*

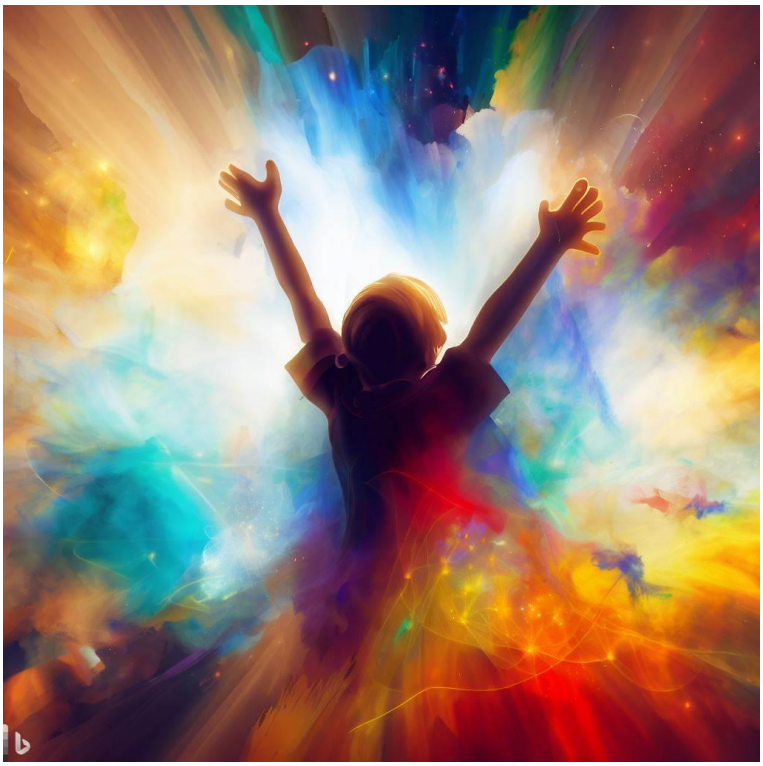

FIGURE 13 - AI-GENERATED ARTWORK OF 'UNLEASH YOUR CREATIVITY"

Casey's words neatly describe that a central element of learning mathematics outdoors is being creative, suggesting that the outdoors provides 'permission' for creativity to be unleashed. Figure 13 illustrates an AI-generated artwork inspired by Casey's words, *'unleash*

your creativity'. The image supported my understanding of the phrase in several ways. Firstly, my interpretation of the image is that creativity (in all its colour) emanates from the child and spreads outward into the environment beyond them. This focused my interpretation on it being the creativity that was always inside the individual, suddenly being released in a rush of energy. Perhaps the creativity has been bubbling up inside Casey, restrained and confined, but being outdoors somehow unlocks the creative power within them.

Secondly, the image depicts a child with their hands outstretched into the air. I interpret this as an expression of freedom of space. It may then be understood that the space and freedom associated with the outdoors (concepts further explored in Poiesis Three) are the key to unlocking the creativity within individual learners. Alex's analogy of being inside a game perhaps offers further insight into why the outdoors is experienced as such a creative environment.

> *It reminds me of being trapped in a wood and trying to find the way out. The maths questions are like a quiz you have to solve to get out. I have to find the pieces of notes. It feels like being in Crash Bandicoot (my favourite game) – an adventure.*
>
> *(Alex)*

For Alex, learning mathematics outdoors is experienced as a game-like journey. The experience of moving forward and solving problems adds to the excitement of the lesson and the sense that it is an adventure. Robin's account also supports the idea that the lesson is experienced as a game.

> *I like moving around and I like space. It makes it feel like it's not a maths lesson – it's like a fun game, whereas it really is a maths lesson.*
>
> *(Robin)*

Robin concludes their lesson description by emphasising that the experience is unlike 'a maths lesson'. This reveals that classroom-based mathematics lessons are experienced very differently. Robin points out that this way of learning is like a fun game but is a mathematics

lesson. Participants can suspend their prior understanding that they are in a mathematics lesson. As such, the participant moves from an externally constructed (the classroom) world into an internally constructed one.

Within the classroom, the teacher arranges the classroom with the resources required for the lesson. Children are sat at desks with displays around the room carefully placed to support the intended learning. From the perspective of the adult in charge, the pupil has everything provided for them within the environment. Alternatively, this poiesis reveals that the outdoors offers a learning environment where children can construct their own landscapes. The environment simultaneously holds the learner and sets them free to create an alternative learning environment that is right for them.

I have found the phrase ‘holds the learner’ particularly useful in inviting an understanding of the studied phenomena. As this is the first mention of the phrase in the thesis, it is important to explain the context in which it is used. The analysis reveals that the outdoor environment plays a significant role in supporting children, firstly through how it allows children to be creative and later through how it removes pressures and instils a sense of freedom in the learners. This shows that the environment is experienced by the participants dynamically as if it were an individual rather than a location. Therefore, interpretation leads to an understanding that the location of outdoor learning holds the learner and the learning.

The outdoors is not simply a place where learning occurs but also an active influence on learning. In this poiesis, through the immersion and enthrallment they experience, they are held by the environment in a creative, game-like activity. The enabling of the children’s creativity is shown particularly in how they interact with the objects of the environment: nature’s equipment.

Nature's Equipment

Analysis of the experiential data demonstrates that the participants interact with the objects of the environment in two distinct ways, first as indicators of location and, secondly, as objects to be used at the will of the children's creativity.

> *I'm on my way to the outdoor classroom – a lovely house where you can just sit down and work. From here I can see that there's a door into the side of the classroom and a tree. The tree defines that we're outdoors. I explore and look at the nature outside.*
> *(Casey)*

Casey explains how the space is clearly defined – the trees signify the presence of nature, and boundaries are marked by artificial objects such as doors. In this description, the door can be seen as the environment's equipment. Casey uses it to travel between locations and also as a signpost. When looking back at the door, Casey is reminded that what lies beyond it is a different environment from what they currently occupy. As Casey makes their way to the outdoor classroom for their lesson, they transition from inside to outside, marked by the landmarks close to them. Casey describes an essential essence of many participants' experiences: the environment is experienced as a collection of equipment.

For Heidegger, nature is part of a greater whole called the world (Heidegger, 2010). As nature is already an entity encountered within the world, an understanding of nature is found through the equipment that it contains. Heidegger considered equipment to be an object in the world with which one has purposeful interactions. Equipment is the stuff in the world which can be utilised. For example, I have pens and pencils in my office, often referred to as equipment. However, for Heidegger, the chair and the desk also become equipment once used for a purpose. I understand that I am in my office through the pieces of equipment that surround me and are ready to be used collectively as fits the definition of an office.

As the lived space is discovered through its resources, then ‘nature’ is thus found in the objects one encounters within the environment. Similarly, participants’ stories reveal that the space in which learning occurs outside is clearly defined by the presence of the objects it consists of. As Figure 12 illustrates, participants identify physical features of the space (trees, birds and a fire pit) to depict the natural environment as a whole. When participants describe the lived space in which their experience occurs, they describe the objects within it.

> *We go along the path towards the fire circle and see the trees. It’s like when you see a riverbank with the trees surrounding you. People are around the trees which have the maths sheets that we put up onto them.*
>
> *(Paris)*

Paris’ description echoes Casey’s described sense of travelling through the environment marked by its constituent parts that make up the whole. The path, fire circle, riverbank and trees combine to create their lived sense of the location where they are learning mathematics. The objects within the space cannot be removed from it. They exist as they are only within and as a part of the environment. Without the fire circle to lead towards, the path would not be ‘the’ path but a different one. Without seeing the trees, the environment would be something else. The trees that make the forest are the forest. Paris’ account provides insights into familiar terrain. Paris knows where the path leads and what is to be seen. It is an everyday experience with an element of predictability.

Paris’ description also illustrates a different creative use of the objects. In Casey’s earlier description, the door and tree can be considered equipment as they mark location boundaries. In this account, the trees also present the sheets on which the work has been written. The trees have taken the place of alternative equipment in the classroom. In the classroom, the equipment is placed for its purpose, but in the natural environment, the equipment is repurposed by the participants to serve the needs of the participants. The equipment is used as tools *ready-to-hand*.

From a phenomenological perspective, *Dasein* lives in the world in an ordinary way and experiences objects as available or *ready-to-hand*. In other words, *Dasein* goes about their day achieving aims and goals without thinking about them. This is possible only because tools are *ready-to-hand*, announcing themselves as part of a field of equipment ready to be utilised. Heidegger uses the analogy of a hammer to describe this process. When looking at a hammer, people do not automatically analyse it and break it down into its constituent parts. Instead, its purpose is automatically understood.

Similarly, people may use a kettle every morning to make a cup of coffee without paying much attention. Only when it stops working is attention drawn to the object itself. Within their accounts, the participants reveal an environment full of tools *ready-to-hand*.

> *We use sticks and things, like leaves, to help with timesing. You can just count what you need. With all of the stuff surrounding us, we can use that for quite a lot of maths – it can really help.*
>
> *(Paris)*

> *Pretending it has numbers.*
>
> *(Robin)*

Paris and Robin experience sticks as tools *ready-to-hand* to be counted as if they were mathematics equipment in the classroom. The participants engage creatively with natural objects and project meaning onto these objects to serve a specific purpose. By assigning a number to a stick, the stick is no longer a stick but a representation of that number. When used by the participant, any physical aspect of the stick is suspended and replaced by an understanding that it represents a number for calculation. Just as a carpenter would use a hammer without necessarily being a subject contemplating the hammer, the participants make use of the stick without attending to it directly.

In the same way as teachers may model substituting values in everyday mathematics (saying that a counter is worth 10), outside Robin attributes number values onto natural objects to access the abstract nature of mathematical concepts and support them in arriving at an answer.

> *You have to explore to find the things you want to use.*
> *(Sydney)*

Sydney's description of searching for the right equipment indicates that not every item within nature fits the desired purpose – not all are *ready-to-hand*. However, choosing the equipment on which to project the function of a tool *ready-to-hand* is common in many of the participants' stories. It illustrates the self-directedness possible when learning mathematics outdoors. Rather than being given a counter with ten on it, participants use natural resources they find and experience a sense of autonomy in their learning, demonstrating that the children can creatively self-direct their learning. Teachers must consider their role in providing children with specific resources and allowing children to use resources imaginatively in outdoor learning.

Summary

The key message of this poiesis is that creativity is nurtured through the enthrallment and immersion experienced by the participant, leading to a feeling of safety, as demonstrated by how the children engage creatively with their learning. What is revealed through this fusion of horizons is not absolute truth but an illumination that points towards further exploration and discussion.

This poiesis has demonstrated that participants become enthralled in outdoor learning as they are immersed in the natural environment. Enthrallment begins with the transition into the outdoors, with participants illustrating how they feel beginning to change. As a result, the

participants develop a sense of pleasure and happiness outdoors, and some are relieved of their sadness and discomfort.

Minor details of the objects in nature fill the participants with a sense of awe as the environment permits them to ‘unleash’ their creativity. This is evident through how they see the experience as game-like and engage with objects through imagination to support their learning. The interpretation that the participants feel happy and can engage in imaginative play-like learning demonstrates that the outdoors provides a safe space for their lessons. The participants are transported from the real world into a different environment that becomes a sanctuary for learning. The environment holds the learner to construct an inner world that best fits their learning purpose.

Poiesis Three – Serenity

FIGURE 14 - A DRAWING OF A SINGLE TREE

Poiesis Three – Audio Link

In this third poiesis, I demonstrate how entering a state of serenity exists within the participants' experiences. The participants' accounts present a feeling of calm, peacefulness and freedom. As previously stated, the poieses are neither hierarchical nor chronological. Therefore, it should not be seen that serenity is to be valued less. On the contrary, as will be explored in this poiesis, serenity may be the underlying factor that gives rise to an environment where connections and enthrallment are possible.

Illustrated here is the sense of serenity that takes the participant away from their normal being-in-the-world and provides a safe learning environment where worries are removed and the outside world is suspended. Through this suspension, participants can focus on active engagement with their learning rather than worrying about external influences. Serenity is the condition of being untroubled that is achieved in the experiences of the participants through

the sights, sounds and spaces in the natural environment. However, as Alex's initial sentences demonstrated, lessons do not always begin this way.

> *It's just a sunny day. Everybody is trying to get the worksheets down from the trees. By the gate people run up the hill to get to the questions. In one part of the playground, it's noisy with children screaming and shouting, trying to get up the hill.*
>
> *(Alex)*

In this extract, Alex is aware of the current busyness of the other children rushing around to answer questions, giving a sense of a fast-paced lesson, driven towards a specific goal and the impression that there is stress at the start of the lesson. However, Alex will soon describe how this stress is relieved through being outdoors and how they experience it as slowing time.

Slowing of Time

Temporality is one way in which participants experience moving from indoors to outdoors. Heidegger distinguishes between two varieties of time (Alawa, 2017). Firstly, there is the scientific concept of time *(Zeit),* which is objective time that passes in defined intervals and measures the passing of events. Secondly, the subjective nature of time is termed temporality *(Zeitlichkeit)* or time as-lived. van Manen (2016b) uses the example of taking a long drive in a car. Whilst the journey's second half is the same length as the first half objectively, subjectively, the second half may drag on. The point here is that time is felt differently depending on many factors.

For Alex, time starts as fast when people are rushing around, and there is much noise. However, the sounds of nature and the outdoor environment impact how they experience the passage of time as it begins to slow down.

> *Where I am, in the middle, is calm and I can hear the screams in the background and leaves getting crunched. I can hear the sound of leaves; leaves crunching and the birds singing. I feel the stress fall away from me and I am calm. The world slows down*

and the breeze in the air makes it feel like I have all the time in the world. The air hits me, and I calm down.

(Alex)

From this account, noise is an indicator of the pace of the environment. One part of the playground is noisy, so time is going quickly. The noise induces a sense of a frantic start to the lesson. However, Alex positions themselves in a quiet space that turns temporality into endless opportunities. In this quiet space, the sounds of nature (leaves, birds) can be heard whilst the screams of children are relegated to the background. The natural sounds slow time for Alex. They are still aware they are moving towards an endpoint, but the new noises allow them time and space to concentrate on their work.

FIGURE 15 - AI-GENERATED ARTWORK OF 'BREEZE SLOWS TIME'

Figure 15 illustrates an AI-generated artwork from the keywords ‘breeze slows time’. This image opened up new possibilities in my thinking and interpretation of Alex’s words. The

closed eyes focus attention on what can be heard and felt. Alex's quote above does not detail what can be seen. For Alex, the slowing of time is not a product of sight but of the sounds that can be heard and the air that can be sensed. In Figure 15, the hair is visibly moved by the wind that swirls in front of the individual before rushing past. Alex's use of the word *'hits'* to describe the wind can be interpreted as emphasising that the breeze is a strong force. The wind is not gentle but a force of strength that still induces a slowing down of lived time. For Alex, the embodiment is also a redirection, being peaceful and allowed to be. There is stillness and peacefulness in Alex's learning, which makes it active in their mind, not their body.

Active can refer to being physically energetic. However, Alex adopts a position on the playground that provides a more passive approach, yet this supports their ability to engage in learning. Therefore, active learning, in this sense, is active engagement in learning. Alex appears unable to engage in learning when it is noisy and busy, but the serenity that the outdoors brings clears the way for Alex to slow down and refocus on their work. To focus, Alex needs to be at peace, which is also seen in the experiences of others.

<u>Peacefulness</u>

Analysis reveals how sound permeating the natural environment greatly affects participants' experiences.

> *Outside it's nice and quiet – it's quiet out here. When it's quiet, it's easier for me to concentrate. It's like the opposite of the classroom. It's not as warm outside – you're not near everybody.*
>
> *(Robin)*

For Robin, the sense of peace has a calming impact on learning mathematics outdoors. Their body is keenly aware of the importance of sound and identifies others (including natural objects) that create those sounds. Quiet does not refer to silence but a state where an individual can focus and concentrate more easily than in a noisy environment. There is a sense

that peace belongs to the natural environment and that by visiting it, Robin can acquire comfort and concentrate more fully without disruption.

> *This place is very peaceful as the trees surround you. Being peaceful and surrounded by my favourite things helps me with the maths. I find that if you're not at peace, or you're upset, your favourite place can help you get happy. Being in your favourite place can help you concentrate on your maths. […] With all of the animals in the background, it's just very peaceful.*
>
> *(Paris)*

Peace does not require silence. The noises of the animals in the background add to Paris' sense of peace rather than detract from it. The environment has its own calmness, which supports children in assisting others. It may be hard to understand how it can be that a place can possess its own tranquillity as it cannot be seen or measured. However, words offered by poet Christina Rossetti (1947) perhaps provide a reminder of the existence of things that cannot be seen in nature:

> Who has seen the wind?
> Neither I nor you:
> But when the leaves hang trembling,
> The wind is passing through.
>
> Who has seen the wind?
> Neither you nor I:
> But when the trees bow down their heads,
> The wind is passing by.

Although the wind cannot be seen, the effect of the breeze is evident from the leaves trembling and the trees bowing. In Paris' account of their experience, peace is not seen but felt because peace belongs to the natural world and is gifted to those within it. As a result of a 'borrowed' sense of peace, individuals can remain level-headed and work effectively to support others.

> *Your partner stands in one place and then you have to try and guess what co-ordinate it is. We're getting to move around – kind of like a game. We're doing it.*
>
> *(Robin)*

For Robin, the quietness of the environment supports their work, but this is not to say that they are not active in their learning. As Robin's words above illustrate, they actively engage in outdoor learning. They interact with their learning kinaesthetically. They are part of the learning, positioned at the centre of the activity – 'we're doing it'. Yet, there is a sense that it is not a loud and boisterous atmosphere as may be expected when describing physically active learning. Casey too explains how stillness and peace are integral to their experience of learning mathematics outdoors. However, this is not mirrored in a lack of actions. Casey uses active phrases such as 'get on', 'get in there' and 'just do it' to describe how they actively engage with the learning in the lesson. Therefore, active learning in this context is about engaging and 'doing' the learning, yet not at odds with being relaxed and occupied by a state of peace. This may cause reconsideration of what active learning can look like – a topic of focus in Chapter Six.

As well as possessing peace, the natural world is seen to provide a calming effect.

> *The noise calms me down. I can hear the birds and the wind. The leaves rattle together. I feel happy and calm as I listen to the birds. It relaxes me. In the quiet I can hear a squirrel climbing up a tree. The maths gets hard again, and I like the noise because it calms me down a bit. It's like listening to an outside version of a lullaby. It makes you feel a little bit sleepy.*
>
> *(Sydney)*

Sydney describes how the environment's sound alleviates an individual's frustration when things get more challenging. Sydney's body senses the environment's calmness through the sounds that can be heard. Natural sounds may include leaves rustling or birds singing. These are listened to through the quietness of the natural environment. By instilling a calm attitude, the individual can refocus on the learning and drive their full attention towards this. Sydney is

engaged in active learning through peace, calm and stillness. Whilst the noises can be distinguished by their individuality, they combine to create something more significant. Sydney describes how the sounds of the natural world are heard simultaneously and create a song-like chorus akin to a natural lullaby, emphasising the calming effect of natural sounds, almost to the point of putting the individual to sleep.

The participants indicate how learning mathematics outdoors removes stresses, worries and concerns from children.

> *I get a breath of fresh air. It feels like you're getting a lot of fresh air and it's just really calm. It's a relieving feeling, breathing in slowly and breathing out. Just like yoga and calming down. […]. It's like you don't have much weight on your shoulders – everything's pretty laid back. I sit down and just forget about everything going wrong and just do maths. Being outside lifts a weight off my shoulders and the bad thoughts are lost in nature.*
>
> *(Casey)*

Analysis shows that concerns are lost in nature – absorbed by the natural environment. The air supports the refreshing nature of the outdoors, allowing the mind to start thinking anew and providing a space for thoughts to be released and weight to be taken off the shoulders of the individual.

FIGURE 16 - AI-GENERATED ARTWORK OF 'BAD THOUGHTS LOST IN NATURE'

Figure 16 illustrates bad thoughts being lost in nature. Initially, I did not attune to this image very well because I felt that the lighter swirl of thoughts should have been darker than the background to represent the negativity of the thoughts. However, after dwelling on the image, I interpreted that the lighter swirl draws attention to the bad thoughts being lifted from the individual's mind and absorbed by the environment. Removing bad thoughts is one way the environment can be seen as holding the learner and the learning. The learner is temporarily relieved of stresses and worries outdoors, allowing them to focus on learning.

Casey describes the calming effect that the fresh air has on them. By comparing the experience to yoga, Casey summons up an image of peacefulness and tranquillity. Casey draws attention to their breathing and is transported into a different way of working.

> *The thing you need to remember with outdoor learning is keep calm, and it will keep you calm.*
>
> *(Casey)*

Casey reminds the reader that the most important thing to remember about outdoor learning is to keep calm; in return, you will remain calm. This is a 'giving into' the calmness of the natural environment.

> *When you're free, you can run around with your friends, which makes me happy. Being free is important to me because sometimes I can get claustrophobic if I'm in a small place or in the same place for quite a long time. The amount of air makes me feel calm, peaceful inside and really free around the forest.*
>
> *(Paris)*

Paris attributes this change to the calmness of the environment and the amount of space. The amount of space (at least as perceived) is also central to the participants' experience of learning mathematics outdoors.

Freedom of Space

Spatiality, or lived space, is essential to human experience (van Manen, 2016b). Therefore, it is unsurprising that many of the participants' stories highlight the importance of the space within which their learning occurred. In phenomenological thinking, spatiality does not refer to physical, mathematical or geographical space but how entities within a person's experience are brought near them (Dahlstrom, 2013). Therefore, spatiality is the orientation of near objects towards an individual and the orientation of the individual towards those objects. Lived space also refers to how space is felt and its impact on individuals as it is lived. In this study, inquiring into how participants experience spatial dimensions of their outdoor mathematics learning provides insights into their connections with nature.

It is essential to recognise that when participants used the terms space, outdoors, environment and nature, they may not have meant these in a phenomenological sense. Space could refer

to a large geographical area, and the terms outdoors and nature could easily have been used synonymously. For Heidegger, nature is part of a greater whole called the world (Heidegger, 2010). As nature is already an entity encountered within the world, an understanding of nature is found through its equipment. As the environment is discovered through its resources, nature is thus found in the encountered. Similarly, participants' stories reveal that the space in which learning occurs outside is clearly defined by the presence of the objects it consists of. As Figure 14 illustrates, children identify physical features of the space (trees, birds and a fire pit) to describe the natural environment as a whole.

How space is perceived within the experience of learning mathematics outdoors is essential. Individuals sense the size of a space they exist within, not through what they can see but what they understand to be there.

> *There aren't as many leaves or trees than in the forest where we're headed. The moving from playground to forest makes me change how I feel. It makes me feel freer because there's so much space. As free as a forest. In the top woodland there's lots of space and it's nice and calm.*
>
> *(Paris)*

Although the playground is an open space, it is seen by Paris as smaller than the expanse of the woodland despite much of the space within the woodland being concealed by vegetation and natural objects. Individuals can see these natural objects as part of the space rather than obstacles blocking it. The impression of the existence of space enables individuals to sense the calmness within the forest. The forest is seen as a living self-other capable of feeling emotion and imparting some of that onto those who reside within it.

> *Just the blue skies and the sun.*
>
> *(Robin)*

Robin here illustrates that the outdoors has almost endless space, only occupied by the sky., indicating that seeing the sky increases the amount of perceived distance. As has been

discussed, space and the environment can provide peace, quiet and calm, but stories also illustrate that space outdoors creates a sense of freedom.

> *Sometimes when you have no space, you feel trapped, and you don't feel like you're doing well in your maths. You feel when you're in a tight space and you're working like there's a lot of pressure on you, and you need to get it done. But when there's a lot of space, you can just sit back and feel no pressures on you in the world and just float free in the air of the outside. Floating free.*
>
> *(Casey)*

Casey ends their description by coming back to a central theme – the freedom that being outside provided. For Casey, the space allows them to feel at ease and, as they put it, 'float free'. Freedom relates to the pressure of the task and the learning. It is not that Casey is no longer attempting to reach the same endpoint, but the sense of freedom within the lived space allows the pressure to be lifted.

Similarly, Robin experiences the freedom associated with being in a larger area as they navigate their way around the environment. Paris identifies early in their recount that freedom is central to their experience. Freedom is felt through their sense of space, and the surroundings' peacefulness has a calming effect. For Paris, this is an essential ingredient for successful learning. It is the calm and sense of freedom that leads the pupils to be able to try again when learning is complex.

Trying Again

Several of the participants discuss the frustration they feel within their mathematics lessons. However, they also describe how being outside helps them to manage this frustration and persist with their learning until they are successful.

> *Being outside helps the frustration, and then suddenly, I get it. I'm really surprised; I want to scream.*
>
> *(Sydney)*

For Sydney, being outside supports them in having another go and not giving up. This links back to other parts of Sydney's story which explain how the environment provides them with calm and peace. This serenity resolves their frustration and allows them to continue.

> *It's not like we're stuck in a classroom. Being outside makes it easier to concentrate and stuff.*
>
> *(Sydney)*

In this extract from Sydney's story, there is one of the few comparisons between being inside the classroom and out. By comparing the two, Sydney explains that being in a classroom creates a sense of being 'stuck'. Being stuck contrasts with the feeling of freedom outdoors, which provides serenity. The participants' accounts point towards the outdoors as a location where children can persist in their learning.

Summary

The key message of this poiesis is (through the feelings of freedom, peace and calm) serenity is found within the outdoor learning environment, which supports the participant's learning and shelters them from troubling external factors. The participants feel safe in this environment. The freedom experienced due to the availability of space and removal of stress gives them the freedom to be wrong, reducing the threat of making mistakes and providing a safe and secure learning environment.

This third poiesis has illustrated that learning mathematics outdoors provides a serene location for participants. The natural environment offers calm, peace, and a sense of freedom, supporting the children's sense of safety. In addition, the environment enables other pressures to be left behind and allows pupils to try again and persist in their learning.

Participants' stories have revealed that the environment leads them to become untroubled by worries and pressures. However, being untroubled does not mean being disengaged or unconcerned about the task. On the contrary, participants are more engaged in their learning due to their untroubledness, which questions the understanding of active learning.

Chapter Summary

The poieses within this chapter have established that connection, enthrallment, and serenity are all essential elements in the participants' experience of outdoor mathematics learning. Poiesis one uncovered how the environment acts as a location where children can engage in complex and dynamic connections with others. Collaboration is possible because of the space afforded to the children in the outdoor environment. Whilst participants maintained their unique journey through the lesson, they did so alongside others. Even those who decided to work independently received constant reminders of the presence of others and engaged in negotiations when needed. When participants worked collaboratively, the lessons allowed them to leap ahead of one another, supporting their peers' learning. The participants were aware of their position in the experience, both physically and socially, within the group.

The second poiesis demonstrated how the participants became enthralled by the natural environment within their experiences. The sights and sounds of the natural landscape provided participants with a sense of awe. As the participants became immersed in the outdoors, they became more creative. This was evident in their imaginatively using natural objects to support their learning. It also demonstrated that learning mathematics outdoors enables children to self-direct their learning, choosing the tools they wish to use to solve problems rather than being provided with equipment in the classroom by the teacher.

The third poiesis points to how the environment is experienced as a place of serenity for the participants. The sounds and sights of the location provide peace and calm. The sensed

availability of space offers freedom for the children. All of these senses combine to create a shelter from harm and worry. There is a feeling of safety within the participants' stories, reinforced by the slowing of time and the renewed ability of the participants to persevere in their learning.

Looking at the insights gleaned from all three poieses, I have established that the natural environment provides a safe location where the participants can connect to others and be creative and calm. Through these elements, the outdoors is understood as a learning environment where the children can be safe and engaged in their mathematics learning. The outdoor environment holds the learner securely while also setting them free from the restraints and pressures of the classroom. In short, I have come to the revealed understanding that belonging, safety and peace afforded to children outdoors provide them with the experience of low-stakes and high-interest mathematics learning.

Chapter Six: Fusing Horizons

"… insights speak not only to our intellectual competence but also to our practical capabilities."

(van Manen, 2016a, p.67)

Exploration of the participants' experiences reveals how the outdoors provides a learning environment that supports the essential essences of connection, enthrallment and serenity. The poieses in the previous chapter aimed to explore these essential essences and uncover insights into the experiences of learning mathematics outdoors through a fusion of the children's crafted stories and my interpretations. As a result of the uncovered insights, in this chapter, I argue that the outdoor environment contains natural objects, peer learners, space and sounds, which provide a sense of belonging, safety, freedom and peace. Figure 17 illustrates how the participants in this study experienced outdoor mathematics learning through **connections** (outer circle), **essences** (inner circle), and resultingly as low-stakes, high-interest learning.

FIGURE 17 - EXPERIENCE OF OUTDOOR MATHEMATICS MODEL

The outer circle of Figure 17 represents children's connections within the outdoor environment. Rather than a passive space, the outdoors is a creative, engaging and empowering learning environment. It is the environment that provides the possibilities and opportunities for learning to occur.

Figure 17 shows children connect with natural objects, sounds, peer learners and the space around them. Children engage with peers through collaborative relationships while managing their autonomy and self-directedness. Natural objects are used as instruments through which children make sense of learning. There is a deep sense of togetherness, kindredness and an understanding that the space is shared. In outdoor mathematics lessons, the teacher does not

provide knowledge through a transmissional exchange. Learning occurs as a result of the children's creative interaction, enabled by the elemental features of the environment, particularly the sounds and space.

The inner circle of Figure 17 illustrates the essences of the experience: safety, belonging, peace and freedom. These essences are what my interpretations of the participant's descriptions have revealed are central to the experience of learning mathematics outdoors. Children feel safe as the environment's security allows them to make errors, reducing the threat of failure. This is influenced by the peace around them, eliminating stress and external worries. The fear of getting things wrong is disrupted by attending to learning without the burden of external concerns. The outdoors is a learning environment which provides a sense of belonging and inclusivity. Children remain aware of their abilities, but outdoors, away from the classroom desks, it is not a matter of concern. Finally, they are afforded the freedom to be self-directed in their learning. Rather than being given knowledge, they are given opportunities to learn.

In the centre of Figure 17 is the child. As a result of the connections of the outer circle and the subsequent essences of the inner circle, children experience low-stakes, high-interest mathematic learning outdoors. Low-stakes should not be considered to mean easy or not worthwhile. Instead, low-stakes refers to children learning without fear. Learning is driven by wanting to do well and having the barriers of fear and anxiety removed. The outdoors and its objects remove the distractions of everydayness and permit the learner to inhabit an internally constructed world suited to their own learning needs. High-interest refers to the active engagement of the participants in their learning. Whereas the extant literature suggests that many learners find mathematics boring, this thesis asserts that outdoor mathematics learning is interesting and engaging, inviting participants' curiosity and creativity.

This chapter enters the uncovered meanings into dialogue with the extant literature and professional agenda, moving my interpretations closer to addressing the overriding research question and eliciting implications for practice and pedagogy. As van Manen (2016a) suggests at the beginning of this chapter, the insights gained from research resonate with daily habits and practical capabilities that inform positive change.

To engage in analytical discussion, I have pulled the revealed meanings into four distinct research insights reflecting different elements of Figure 17.

> **Insight One:** The outdoors instils peace, which reduces stress, enabling children to persist and develop a growth mindset.
>
> **Insight Two:** The outdoors provides safety and freedom which enables children to engage in creative and imaginative learning.
>
> **Insight Three:** The outdoors is a shared space that enables complex connections to be developed between learners, which provides children with a sense of belonging.
>
> **Insight Four:** Outdoors, the focus of learning shifts from what the teacher provides to what is enabled through peers.

These insights represent the study's findings, and each has implications for practice, policy and pedagogy. Accordingly, each insight will be explored further by being entered into dialogue with current thinking, literature and practice. At the end of this chapter, these insights are synthesised into ten key research recommendations.

Insight One

> *The outdoors instils peace, which reduces stress, enabling children to persist and develop a growth mindset.*

In this study, the outdoor environment reduces the stress of learning mathematics and instils a sense of peace and freedom in children. The peacefulness and calm of the outdoors are provided through what is seen, felt and heard. For example, the view of the sky above instils a sense of freedom from the external pressures and concerns that the children have. This is supported by the increased availability of space seen and felt by the learners. In addition, the sounds of the outdoor world are important in the participants' experiences. Whilst the research did not ask directly about what the participants could hear in their lessons, each referred to the soundscape of the outdoors when describing their experience. The sounds ranged from birds singing to leaves rustling and the familiar noises of other people in the distance. Sydney even describes the sounds they can hear as "like listening to an outside version of a lullaby". This adds to the current literature, as sound is often considered a distraction from effective learning in traditional classroom settings.

Distraction vs Engagement

Previous literature, such as Shield and Dockrell's (2008) study, has found that environmental noise can negatively impact the attainment of primary school children. Pratt (2011) also suggests that a possible pitfall of learning mathematics outdoors may be the distractions of the outdoors, which could make it difficult to focus. This is supported by the findings of a study conducted by Jørring, et al. (2020), who found that the surroundings of the outdoors distracted learners from their tasks. On the contrary, for the participants in my study, noises in the outdoor environment are beneficial for learning. Rather than a distraction or a concentration inhibitor, noises were described by the participants as the stimulus for calm and stress reduction, which

enables children to engage in their mathematics learning. Therefore, the noises of the outdoors increase learning engagement by decreasing external worries and concerns.

In this regard, my research aligns more with Neville, Petrass and Ben (2021), who found that quiet outdoor spaces were productive for writing as they contained less noise and distraction. In addition, my study adds to understanding by relating this to mathematics. However, my findings do not suggest that noise reduction is the trigger for focus on learning, but the noises of the outdoors themselves cause positive pupil engagement. However, laboratory-conducted research by Gonzalez and Aiello (2019) suggests that the impact of sound on learning and task completion is more complex. They found that sounds (or music) impacted performance depending on the music, task and the individual conducting it. It should be noted that the participants in this study have a great deal of outdoor learning experience.

Developing a Growth Mindset

One of the key findings of my literature review was that children experience mathematics as a complex, tedious and even scary subject. However, my research finds that this is not the experience when learning mathematics outdoors. Rather than describing anxiety or stress, the participants described enjoyment, peace and freedom. When examining mathematics anxiety, Carey et al. (2019) found symptoms to include stomach ache, feeling sick, experiencing butterflies and becoming tearful. In addition, they found that one cause of mathematics anxiety was the discomfort children felt with mathematical learning and the frustration of getting questions wrong.

In contrast, my research finds that when children learn mathematics outdoors, they experience the freedom to make mistakes in a safe and peaceful environment. To learn, people step outside of their knowing. They feel the discomfort of trying new things and inevitably failing as they learn (Dweck, 2006). My findings identify that the outdoor environment holds the learner

to allow them to go further in their learning, demonstrated through the participants' descriptions of facing adversity in outdoor mathematics lessons.

> *Whenever these types of things happen, I feel like it's a little journey. If you get it wrong, you have to start all the way over, but then you get an upgrade. You learn more, so then you can easily get back up. It reminds me of being trapped in a wood and trying to find the way out.*
>
> *Alex*

Alex describes the 'upgrade' as supporting them in trying again and eventually succeeding. Failing provides a new opportunity to get it right, and each time you fail, you have a better chance of getting it right next time, thanks to the upgrade. For Alex, the sense of adventure and journey that the outdoors provides supports them in developing a growth mindset. A growth mindset, a term coined by Dweck (2006), refers to a learner who sees opportunities for growth and success in failures. By adopting a growth mindset, learners understand that mistakes are a necessary part of learning and do not stop or give up in the face of adversity. Since the introduction of the term by Dweck in 2006, many studies have investigated how growth mindsets can be developed in younger children to encourage them to be successful lifelong learners (Willis, 2019).

My research suggests that the outdoor environment can be used to develop children's growth mindsets in mathematics lessons. I have found that the outdoors is experienced as a safe learning environment that allows children the freedom to be wrong and learn from their mistakes (or 'get an upgrade', as Alex puts it). The outdoors reduces the threat of failure and supports learners in persisting by allowing learners to be actively engaged in their learning whilst inhabiting a state of peace and serenity.

Lesson Transitions

This study also identifies that it is in the movement from the classroom to the outdoors where freedom and peace are first experienced. This is demonstrated through the participants' stories when they described the importance of the landmarks, marking the borders between the school building and the outdoor learning environment. The landmarks signify the moment of transition in the participants' experiences. This means that walking from the classroom onto the playground or into the woods has more meaning than previously identified. Previous literature focuses on the success of lesson transition based on how fast it can be accomplished and to what extent poor behaviour can be reduced during these periods (Shahzad, Seema and Reba, 2020). This is also demonstrated in online blogs where teachers share tips on how to speed up transitions (e.g., Tammy, 2023). This indicates that transition time is often viewed as lost learning time. However, my research suggests that transition time into the outdoors may be much more valuable than previously identified.

> *The moving from playground to forest makes me change how I feel. It makes me feel freer because there's so much space. As free as a forest.*
>
> *Paris*

Paris is so moved by the transition from the playground to the forest that it impacts their emotions. If quick lesson transitions are viewed as effective transitions, the sense of change in feelings and place may be lost. There is an understanding that transition time is vital in developing children's sense of peace and engagement within the learning environment. Instead of measuring the success of a transition by the speed with which it can be accomplished, my research finds that the success of a transition should be measured by how effectively it enables learners to become immersed within the environment. As a result of immersion, peace and freedom can be experienced, and a focus on learning can occur. There seems to be little benefit in rushing to a place of learning when the learner is not ready to learn.

Insight Summary

Insight One has revealed that the outdoors provides a calm and peaceful environment for pupils to learn. The result is that stress and worry are alleviated from learners, leading them to focus on their learning. In addition, the transition to the natural environment and its sounds are essential to the experience. Both invoke a sense of safety that allows learners the freedom to be wrong, the support to try again and an environment that develops their growth mindset.

When children become aware of the sounds of the outdoors, they are relieved of pressure, which supports their focus and helps them to maintain this throughout the lesson. It is through the experience of immersion in the outdoors that children develop a sense of safety and comfort. Participants in this research described the outdoor environment's peace, calm and freedom and how this enabled them to be safe in making mistakes. By removing the fear of failure, the outdoor setting could be a better learning space for children to take risks with their mathematics learning and develop a positive attitude towards the subject.

Insight Two

> *The outdoors provides safety and freedom which enables children to engage in creative and imaginative learning.*

This research reveals that the outdoors is a space where children can engage creatively in their mathematics learning and work in a self-directed manner with greater autonomy and ownership of their learning. As children transition from the classroom's externally constructed adult-centric classroom environment to outdoor spaces, they create their own child-centric, internally built world by suspending everydayness. This is seen through children engaging playfully and imaginatively by using natural resources to support their learning. Whilst the children do not lose touch with reality, the environment holds their learning, so they can temporarily shift to a different mental space. This insight reveals how mathematics can be engaged through creativity and play, which is commonly absent in learners' experiences according to much research literature.

<u>Suspension of Everydayness</u>

This study finds that when children learn mathematics outdoors, they move to a modified experience of the world around them. The natural environment disrupts children's assumptions and offers an alternative world.

> *It reminds me of being trapped in a wood and trying to find the way out. The maths questions are like a quiz you have to solve to get out. I have to find the pieces of notes. It feels like being in Crash Bandicoot (my favourite game) – an adventure.*
>
> *(Alex)*

Alex describes outdoor mathematics lessons as an adventure. Rather than being in a lesson, the experience of being outdoors makes it feel like an exploration or game. Alex's sense of the world shifts from being in a mathematics lesson to solving clues to achieve a goal. The incentive is not to learn mathematics or please a teacher but to accomplish a quest they have

constructed in their reality. However, this does not mean that children are unaware that they are, in fact, in a lesson at school.

An understanding that children can suspend reality when learning outdoors is a finding shared with research by Adams and Beauchamp (2018). They found that when children participated in outdoor music lessons, many participants "believed that they entered a 'different world' during their music-making" (p.60). My research adds to this finding as it suggests that imaginative engagement in learning in the outdoors is not restricted to music but is also possible in mathematics, which is not commonly associated with creativity. Adams and Beauchamp (2018) also found that children's sense of time changed during outdoor learning. This concept appears in my research and supports the idea that children enter a child-centric world.

> *Pretending it has numbers.*
> *(Robin)*

Robin's use of the word 'pretend' indicates that they are conscious that their internally constructed world is a suspension of reality. However, the term 'pretend' also implies that entering into an imaginative world is an active process that requires the individual to participate in the make-believe. Therefore, the outdoor environment can be seen as a learning space that permits children to engage in playful, fantasy learning rather than forcing them to do so.

> *The world slows down and the breeze in the air makes it feel like I have all the time in the world.*
> *(Alex)*

Alex describes how their experience of lived time differs when learning outside. Very closely linked to insight One, a slowing of lived time is demonstrated here, which adds to the sense of peace and calm provided by being outdoors.

Mathematics Manipulatives

Suspension of reality is also demonstrated through how participants in this study interacted creatively with natural resources. For example, participants' stories reveal how they imaginatively use objects in the outdoor environment to support their learning.

> *We use sticks and things, like leaves, to help with timesing. You can just count what you need. With all of the stuff surrounding us, we can use that for quite a lot of maths – it can really help.*
>
> *(Paris)*

Paris describes the ability of the children to use objects around them to support their mathematical development. Using manipulatives (physical apparatus to help the understanding of abstract mathematical concepts) in the primary classroom is a familiar idea. Concrete-Pictorial-Abstract (CPA) (also referred to in the literature as CRA, Concrete-Representational-Abstract or CVA, Concrete-Visual-Abstract) practice is common in primary classrooms. Learners are often directed to use a specific manipulative or guided to solve particular problems. Alternatively, classrooms may be carefully arranged so children can use the equipment as needed. However, in both situations, the resource has been put there by an adult with a specific usage in mind. My research illustrates that children can select natural outdoor resources to support their learning. They do this creatively rather than by following a procedure set by an adult. Outdoors, the children can use whatever they find and whatever they find most useful in the way it works for them. They move from an externally constructed world where an adult places everything, into an internally created world where objects have meanings for the individual. Through these internally constructed meanings, children creatively make sense of the mathematical concepts with which they are engaged.

There are some echoes of this insight with the common practice of Continuous Provision. Continuous Provision refers to the resources and materials a teacher provides for children to explore freely. Continuous Provision as a pedagogy aims to engage learners (predominately

in Early Years Settings – below the age of 6) in imaginative play rather than what may be considered more formal lessons (Bryce-Clegg, 2013). Whilst creative engagement with resources may be regarded as more appropriate for younger children, my research demonstrates the educational benefits this approach can also have with older children aged 10. Although the participants in my study were given specific tasks to complete by a teacher, they used their creativity to engage with natural resources to achieve the objectives. As a result of them being older, they could freely choose natural resources rather than using the apparatus that adults had placed for them.

Insight Summary

As described in earlier chapters of this thesis, mathematics is usually experienced as an unimaginative subject. For example, participants in Pepin's study (2011) called mathematics a "theoretical subject" (p.542), which "does not allow you to be creative" (p.541). In contrast to this, my research finds that, when learning outdoors, mathematics can be experienced as a highly creative and imaginative subject.

The Purpose of Study for Mathematics in England describes mathematics as "a creative and highly inter-connected discipline" (Department for Education, 2013, p.99). This demonstrates the UK government's view that learners should experience mathematics as an innovative and artistic subject rather than static, dull or boring. My research strongly suggests that the outdoor environment can provide children with creative mathematics experiences. Therefore, this research suggests that teachers should adopt an outdoor learning pedagogy to promote mathematics as a subject in which learners can creatively engage.

This insight also demonstrates that, through creativity, children can be self-directed in their learning. Self-directed in this context means that children can use resources and the space in a way that meets their preferences. Research shows that learners often experience

mathematics learning as a subject where routines and processes need to be learned verbatim (Sneck, et al., 2022). This enforces the perception of mathematics as a non-creative discipline with only one way of achieving success. For example, in Russo, Russo and Roche's study (2021), one participant commented that they "enjoyed these much more because we could do things our way instead of getting, like, something, like a math sheet and having to do it this one way" (p.11). This comment reveals the frustration that the learner experiences when having to complete a task in a way dictated to them rather than a way they would prefer or feel more comfortable for the learner.

By taking children outdoors for their mathematics lessons, my research suggests that the learners will be able to find ways to feel more comfortable with answering questions and be creative in their mathematics learning. This gives learners greater autonomy over their strategies to solve problems and achieve success.

Insight Three

> *The outdoors is a shared space that enables complex connections to be developed between learners, which provides children with a sense of belonging.*

My interpretation of the participant data reveals that when learning mathematics outdoors, children connect with their peers and experience the space as a shared learning environment. Compared to the traditional classroom, the increase of space outdoors provides children with greater opportunities to collaborate as they can more freely move around and interact with others. However, the increase in space also allows children to spread apart and work alone whilst constantly being aware that others are readily available to establish cooperative relationships. Co-operation in this context refers to the individual's choice to work with a peer (or within a team) to accomplish a task. Participants describe how they support each other whilst learning mathematics outdoors; this is an essential part of the experience for many.

During outdoor mathematics lessons, children connect with their peers and experience the space as a shared environment. This supports the children's experience of inclusivity where, although not all are equal, all are included. Children in this research clearly understood their position within lessons (usually related to their mathematical ability). Despite knowing they are academically stronger or weaker than others in the lesson, this study reveals that learning outdoors instils a stronger sense of unity within the children.

<u>Managing Connections within Lessons</u>

This study has found that when learning mathematics outdoors, children develop connections with others to provide support and attain the necessary help to achieve goals within lessons. This builds on previous research that has also looked into the relationships of outdoor learners. For example, Coates and Pimlott-Wilson's phenomenological study (2019) looked at the experiences of 33 children in Forest School sessions compared to a traditional classroom

environment. They found that interactions with peers were the most frequently mentioned learning opportunity. However, participants were limited in their interactions within the classroom to only those sitting next to them. In the Forest School sessions, participants identified that they could negotiate with a broader group of learners as they had the freedom to move around the environment and the opportunity for increased interactions. However, my research suggests that the relationships children form within outdoor lessons are more complex than those identified by Coates and Pimlott-Wilson's (2019) study.

My study supports the assertion that the ease with which learners can move around an outdoor environment helps more people to work with each other and, therefore, greater opportunities for cooperative learning. However, my research also finds that control of outdoor space is instrumental in managing these interactions. The participants described the importance of having a space to work in. Some viewed this as a commodity for learning.

> *I manage to get one of the circles to work in. I have my own little sphere – my own little area which I can defend from others if they try to come in or steal ideas.*
>
> *(Alex)*

Alex identifies in this lesson as space, which is theirs to protect. The purpose of protecting the space, for Alex, is being able to control the level of connection they have with others. Only if it suits Alex, are other children permitted to enter this space. This demonstrates how children acquire and control space to manage ongoing relationships throughout the lessons. In a classroom, children generally sit at a desk as directed by the teacher. They usually sit beside another person and work physically close to others even if they do not collaborate on their learning. The availability of space outdoors means that children can interact with more children than the person they sit next to, but it also means that they can spread out further away from others and claim space for themselves.

One participant described the burden they felt from the pressures of working with others. Whilst collaborative and cooperative learning structures as ways of encouraging children to learn more effectively in groups are becoming increasingly common in the UK (Gillies and Ashman, 2003), my research illustrates that not all children feel comfortable with this way of learning. Research by Mouw, et al. (2019) found that learners' perceptions of cooperative learning differed significantly from one individual to the next. As a result, teachers must be aware that, whilst collaborative learning may have many advantages, it is not a teaching strategy that will be comfortable for all learners.

In their book Promoting Independent Learning in the Primary Classroom, Williams (2003) defined two interpretations of independent learning. An *isolationist* view would see independent learners as those who develop the ability to work alone in self-sufficiency. Alternatively, an *interactionist* would view independence as where children are motivated, efficient at solving problems and effective at communicating with others. This suggests that children can be independent in their learning whilst interacting with others – the two positions are not at odds with each other. However, Williams claims, "In a truly effective classroom, there must be a sensitive balance between the two views of independence" (2003, p.11). My study has revealed that both forms of independent learning are possible outdoors, and children are afforded the self-directedness to opt for either.

Coates and Pimlott-Wilson's (2019) study suggests that the ability to work in both forms of independent learning within a traditional classroom setting would be restricted due to the limitation of space and the proximity of others both in terms of having space to work alone and closeness to work with chosen others. In my research, children can opt to work 'alone' but do not take an entirely isolationist position for the entirety of the lesson as they demonstrate an understanding that they need others at specific points. Furthermore, they feel comfort in having periods working with self-sufficiency rather than juggling the conditions required to

maintain constant interaction. Consequently, teachers in outdoor learning environments need to be more aware of the subtleties involved in the interactions between learners to develop teamwork and communication skills while supporting a safe environment where children can choose to work alone for periods of time.

Current literature demonstrates that collaboration is far from typical in students' experiences of everyday mathematics learning. For example, participants in a study by Jensen and Hanghøj (2020) reported that most mathematics learning occurred through independent work. However, when learners were given opportunities to help each other and engage in collaborative mathematics learning, Jensen and Hanghøj (2020) found that this benefited all. My research suggests that the outdoors is a learning environment that supports collaborative learning.

Inclusivity

Inclusivity is demonstrated through how participants describe the unity they feel when learning mathematics outdoors. This is linked closely to the experience of connection to others and aligns with the findings of research by Fägerstam and Grothérus (2018), who found that outdoor learning was experienced as a community of learners. Inclusivity or inclusion is used here to mean 'all in it together' and is shown through the participants' sense of belonging to a larger whole. The participants describe working alongside their peers in a shared experience where nobody is excluded or left out. However, inclusivity does not directly relate to equality. Instead, this research demonstrates that the children have an evident sense of their academic standing within a lesson.

> *Another group are working on something different – a diamond instead of a pyramid. They're greater depth and are very concentrated on what they're doing. Because they're greater depth, they're doing something that's a lot harder than everyone else.*
>
> *(Casey)*

Casey demonstrates an understanding of their academic position within the class and how that relates to the position of others. Homogeneous grouping in primary schools is a topic that has been much discussed in contemporary educational literature (Hallam, Ireson and Davies, 2013). Homogeneous grouping refers to putting children into similar ability groups to work on tasks suitable for their ability alongside learners working at their level. Whilst ability grouping is becoming increasingly common in UK primary schools (Bradbury and Roberts-Holmes, 2017), research shows that pupils' awareness of their standing within a class or cohort creates a self-fulfilling prophecy where learners only perform as well as they are told they can (Tereshchenko, et al., 2019). Boliver and Capsada-Munsech's (2021) quantitative longitudinal study of primary-aged pupils in the UK found that children in lower-ability groups developed increasingly negative views of mathematics than those in higher-ability groups. My research suggests, however, that the experiences of children working in homogenous groupings in the outdoors are more complex.

Whilst the participants reveal their understanding of their academic place within lessons, this grouping is experienced neither as negative nor positive. The participants demonstrated a neutral attitude towards this because the experience of identifying as a greater whole was more important to them. Rather than a concern for their academic ranking, the participants spoke of the significance of belonging to the class. The sense of belonging is reinforced when participants describe the importance of coming together at the end of a lesson.

> *After we have finished, we join up at the fire circle. I feel happy here. This is my happy place in the forest. It's nice to meet up again after we finish.*
>
> *Paris*

Paris emphasises here the importance of returning together. Whilst the children have moved apart to complete their tasks, coming together at the end re-establishes the group's togetherness.

Shared Spaces

In addition to the connections children experience during lessons, my research has uncovered that the outdoors is experienced as a learning environment shared with those beyond the limitations of an individual lesson.

> *I start my first question at what looks like one of the oldest trees. It's surrounded by quite a few dens made by last year's Year 6.*
>
> *(Paris)*

Paris describes the dens made by previous children. This indicates that the children know the location is a shared learning environment. Within traditional primary school settings, individual classes spend most of their time in their classroom. Their room is filled with resources and displays that have been made for these children to support their learning and confirm the identity of the class. A Year 1 classroom would likely contain very different resources and displays than a Year 6 classroom. However, the outdoors acts as a shared learning environment. This calls to my own experience of teaching. At break times, I have often heard children from different year groups explaining their lessons as they inhabit the playground with other children (formerly their learning environment, now their play area). I vividly recall Year 3 children (who had drawn life-size diagrams of the human body and internal organs on the playground floor in chalk) explaining their learning to Year 2 children who had joined them at lunchtime. I have also been teaching lessons where Year 6 children had seen the work of the Year 5s, who had used the woodland early in the day, and who had commented on how they remembered doing that lesson when they were in Year 5. These conversations would not have been likely to occur if the learning had been confined to the classroom.

There is little contemporary research on shared learning spaces in primary schools. My research suggests, however, that by using spaces other learners commonly occupy, connections can be made that contribute to the sense of belonging to a larger learning

community. This insight reveals that participants understand that the outdoor environment is shared. Other learners have been there before them, and others will follow. Teachers should see this as an advantage. The benefit of using a shared learning environment may be incidental learning. For example, research has shown that when children explain their mathematical learning aloud, they improve their understanding (Wong, Lawson, and Keeves, 2002). By using the outdoors for mathematics learning, teachers are opening up the possibility that later they may explain their learning to others who also inhabit the space. Furthermore, children may also remember their previous learning, which is triggered by seeing an artefact, again having the potential to reinforce or consolidate that learning.

Insight Summary

Insight Three has revealed that connections with others play an essential and complex role in outdoor mathematics learning. The greater availability of space allows children to collaborate in learning. Because children can move more freely around the learning environment and work with individuals, teachers should be aware of the benefit of greater space in enabling and developing collaborative learning in mathematics, which often does not feature in the traditional classroom.

In addition to creating opportunities for collaboration, this research also finds that the outdoor space allows children to work independently. Teachers need to consider individual learners' attitudes towards collaborative learning to provide a safe and inclusive learning environment. As this research has demonstrated, some children prefer to work independently from the pressures of group work. For these children, the outdoors provides them with ownership over their learning environment, and they use the space to distance themselves from others, in contrast to most classroom settings where children work close to others.

Insight Three demonstrates that the outdoor environment provides an inclusive learning space where children feel a sense of unity and togetherness. Whilst aware of differences in mathematical ability between their peers, participants describe how the outdoors allows everyone to be included. As expressed by the participants, a critical part of the lesson is at the beginning and the end of lessons when children return together. Returning together supports the impression the children have of togetherness.

Insight Four

> *Outdoors, the focus of learning shifts from what the teacher provides to what is enabled through peers.*

This research has found that, when learning mathematics outdoors, learning shifts from what the teacher provides to how peers can support each other in achieving their goals. Learning in this context means how knowledge, skills and understanding are obtained. Laurillard (2012) suggests six learning types: acquisition, collaboration, discussion, investigation, practice and production. The literature review chapter in this thesis found that most learners experience mathematics learning through acquisition. Acquisition is where learners receive information through reading, watching and listening to materials provided by a teacher. For example, children report that much of mathematics lessons are experienced as "learning from the board." (Sneck, et al., 2022, p.12).

Rather than acquiring information from a teacher, my study demonstrates that learning mathematics outdoors is experienced through collaboration. In Laurillard's terms, collaboration refers to learners working together to build on each other's understanding through joint practice, discussion and feedback. Moving learning from acquisition to collaboration takes the focus away from the role of the teacher and pushes it towards the role of peers within the lesson.

<u>The Role of the Teacher</u>

Participants' descriptions of their outdoor mathematics lessons show that the role of the teacher is not given great significance, demonstrated through the lack of reference to the teacher in the participants' stories. Casey and Robin are the only participants who mention the teacher in their interviews.

*I can see the **teacher** going to help other groups on a maths question, "1+2+3=6". Another **teacher** is helping another person. I'm now the person asking for help since I don't know how to do the question. Maths it's not so easy for some people, but since it's outside, there's more space for **teachers** to help people a little more.*

(Casey)

*We're in partners standing somewhere across the grid, where our **teacher** told us to, pretending it has numbers.*

(Sydney)

Casey mentions the teacher three times, but each time it is to describe how they are helping others. Even when Casey needs help, they do not say the teacher provides them with the necessary support. When Sydney refers once to a teacher, it describes the instruction they have been given. Both examples point to the teacher as one who helps others or provides direction. However, neither instance offers first-hand accounts of the learning resulting from teacher intervention or knowledge being imparted from teacher to student. This is also true for the other participants, where no mention of the teacher is made.

Traditionally, the role of the teacher can be seen as the source of information and factual knowledge to be transferred to the learner (Azer, 2005). This is an instructivist view of education as discussed in Chapter One. However, my research suggests that when learning outdoors, children experience when learning through the connectionist theory. The title of Dunn's (2017) book 'How to be an outstanding primary school teacher' appears to put the teacher first and foremost in the conversations. Rather than a title which puts learning first, the role of the teacher is reflected as most important. Despite this, early in his introduction, Dunn flips this around and informs the reader that it is the learning that is important, not the teaching. Therefore, the omission of the role of the teacher in the children's stories is not to be taken as an indication that the teacher was ineffective or that the teaching was poor. Simply,

it may have been the case that the teacher had facilitated a situation where their direct input for successful learning was not required.

Priede and Vigule's (2016) work 'Teacher – Facilitator of Meaningful Learning in Preschool' highlights the importance of carefully balancing the teacher's role between promoting the child's discoveries and direct knowledge transfer. My research adds to the literature because it suggests that the outdoor environment provides a learning space where the teacher can act as a facilitator and set up mathematical activities and opportunities for learners to engage with minimal input from the teacher.

In his 1954 [1968] book, *What is called thinking?,* Heidegger discusses the role of the teacher in several of his writings and points to the need for the teacher to facilitate learning rather than provide it.

> "Teaching is even more difficult than learning. We know that but we rarely think about it… Teaching is more difficult than learning because what teaching calls for is this: to let learn." (Heidegger, 1968, p.15)

Heidegger calls for teachers to let learners learn. In this research, outdoor learning as a pedagogy for mathematics allows learners to learn through their collaboration with others. Rather than providing education as a transactional arrangement between teacher and student, the outdoors offers a space where learning can occur through interaction, discussion and exploration. Current pedagogies for teaching mathematics situate the teacher as the provider of knowledge where they are in a position to control the learning. Alternatively, this research finds that outdoor learning pedagogy can provide teachers with opportunities for learners to learn. Allowing learners to learn is a critical component of experiential learning pedagogy.

Dewey's experiential learning theory, first described in 1938, describes learning not as a passive act of receiving but as a process that involves action on the learner's part (2015). According to Dewey, the teacher's role is to expose learners to engaging experiences that build on their prior understanding, knowledge and skills. My study finds that learning mathematics outdoors is a way for teachers to provide quality experiences and effective experiential learning. Rather than outdoor learning following a transactional form of education, the outdoor environment provides the learning environment for teachers to arrange learning opportunities for children to engage in and connect with those around them.

The Role of Peers

My research identifies that the role of peers in the experience of outdoor mathematics learning supersedes the teacher's role in constructing the individual's learning. It is through opportunities to leap-ahead that effective learning is achieved. Rather than negotiating a trade-in knowledge or answers (i.e., *leaping-in* for each other and providing the solutions), participants in my study describe how the outdoor environment offers the opportunity for learners to support others in carrying out their own projects. The following extract from Alex's crafted story illustrates the *leaping-ahead*.

> *When I get a question wrong, I am the bee trying to rest, waiting for somebody to come and help. The person gives me the syrup and then I'm back in action.*
>
> *(Alex)*

Alex begins by working alone on a problem. They get a question wrong but understand that others are in the environment to support them. Alex waits for the 'syrup' before getting back to solving the question. In this example, the syrup can be seen as the ingredient needed to move Alex forward. They are not simply given the answer to the question but the necessary support to achieve the solution for themselves. As a result, Alex is drawn closer to realising the answer for themselves through the help of others. In their exploration of children's

experience of learning mathematics, Musa and Maat (2021) found that learners could not support each other as they found the work too challenging and could not provide answers. However, in my research, I have found that children don't need to have the answers for others. Instead of being provided with solutions, Alex is supported to make their own progress towards the answer as a result of their peer being able to leap-ahead of them.

Not being provided with the answer also means that children avoid what Kagan (1994) calls hitchhiking. In educational terms, hitchhiking is where a learner relies heavily on a peer or adult to provide answers. This can take the form of copying or the overreliance on someone else's knowledge, skills and understanding to reach a goal. In Heideggerian terms, this would be *leaping-in* and conducting the individual's project on their behalf. According to Kagan (1994), effective co-operative learning aims to avoid hitchhiking so that the combined efforts of co-operation provide the solution.

This research demonstrates that, at least for the children in this study, outdoor learning provides a platform for the connectionist view of learning. As discussed in Chapter One, connectionism views the primary source of learning as knowledge transfer through relationships between learners (Bates, 2019).

Insight Summary

Insight Four has found that the outdoors provides a learning environment where learning takes place through collaboration, discussion and exploration rather than direct acquisition from a teacher. However, this study does not suggest that the role of the teacher is unimportant. Teachers need to engage children in meaningful learning experiences, and the outdoors provides an environment where this can be achieved.

The role of peers is central to the participants' knowledge acquisition. Therefore, this insight demonstrates that outdoor learning provides a pedagogy that promotes collaboration between learners and supports the development of teamwork and communication skills.

Research Recommendations

Throughout the four identified insights, there are numerous implications for practice and pedagogy. Below are ten key research recommendations that this thesis makes. These have been separated into recommendations for teachers and policymakers to reach the intended audience. However, all ten recommendations have implications for policy and practice.

The term 'teacher' in this thesis refers to an adult in charge of learning opportunities for children. Recommendations for teachers' practice require they actively plan for outdoor learning by **preparing children to learn outdoors**, **being pedagogically attuned**, **promoting collaboration** and **bringing the group back together**.

The term 'policymakers' refers to all adults in a position of power over the decisions made within education. This relates to government, senior school leaders and initial teacher training providers. The two key recommendations for policymakers insist that they use their professional positions and influences to promote the pedagogy of outdoor learning for all by **ensuring access to outdoor learning spaces** and **providing adequate training for teachers**.

Recommendations for Teachers' Practice

This research recommends that teachers need to actively plan for outdoor learning by:

Preparing children to learn outdoors:

1. Teachers must carefully plan the transitions between the classroom and the outdoors. Moving to outdoor learning spaces should not be rushed but should be treated as an important phase in moving physically and emotionally and **preparing to learn**. This can be achieved by taking time to move between locations or asking children what they notice as they move from one place to another. This research demonstrates that

by allowing children to appreciate the move to the outdoors, pupils are immersed in the experience, providing creativity and engagement in learning.

2. Children should be provided with outdoor opportunities to be absorbed by sounds in the natural environment before learning. This research suggests that the sounds of the environment are significant in **focusing children on their learning** and preparing them to learn outside. Therefore, teachers should plan regular time at the beginning of lessons for children to listen to the sounds around them and reflect before engaging in mathematics learning.

Being pedagogically attuned:

3. Teaching of the primary mathematics curriculum must use the benefits of outdoor learning to promote problem solving and mathematics reasoning skills. The participants in this research have shown that outdoor learning **promotes creative thinking,** a critical skill in mathematical problem solving and reasoning. Therefore, teachers ought to actively use the pedagogy of outdoor learning regularly throughout the curriculum to effectively deliver the three aims of the national mathematics curriculum (i.e., fluency, reasoning and problem solving).

4. Teachers need to position themselves as a learning facilitator rather than a transmitter of knowledge when teaching outdoors. Participants describe their outdoor learning as a result of investigation, creativity, curiosity and peer interaction. Whilst the teacher may **play an important role in setting up learning opportunities**, the role of the teacher is not a core component of the participants' learning experience. Therefore, teachers need to adjust from a transmissional style of knowledge acquisition and the traditional role of a classroom teacher. This means that teachers should use

themselves and other adults to support children's learning journeys, scaffolding for the child where necessary rather than leading them down a particular path.

5. Teachers should undertake outdoor learning training to support their professional practice and provide effective learning opportunities for their pupils. This research reveals that children experience outdoor learning differently than may be expected from traditional classroom learning. Children engage creatively with natural objects, interact with the environment's sights and sounds, and demonstrate complex relationships with peers. Therefore, to **engage positively with outdoor learning pedagogy**, teachers will require additional training to change their regular classroom practices when outside.

Promoting collaboration:

6. Facilitating outdoor learning requires planning tasks and activities that allow learners to move between varying degrees of independence and group work. For example, lessons should provide opportunities to work together and apart or allow learners to make these decisions for themselves. This aims to create a safe environment where children can **move between different levels of interactions** with others. Whilst participants describe the outdoors as an effective learning environment for working with peers, this research has demonstrated some children find group work challenging. Therefore, teachers need to be mindful of the potential tensions.

7. Children should be provided with outdoor activities to develop collaborative learning and teamwork skills. This research has demonstrated that the outdoors offers a learning environment where **cooperative learning is more easily achieved**. This results from increased physical space, the environment's calming nature and pupils'

ability to move around. Therefore, teachers should place elements of group work as central to outdoor lesson planning. This could involve working with a partner to solve problems or more sophisticated collaborative learning structures where each child is given a specific role in achieving group success.

Bringing the group back together:

8. Time should be provided at the end of lessons to bring the group back together. A core component of outdoor learning for the participants in this study was the togetherness they felt as a group. This further develops the **inclusivity of the mathematics learning** experience as opposed to it being seen as a subject for some and not all. Therefore, whilst lessons may involve periods of independent or group work, to maintain the inclusive atmosphere of learning mathematics outdoors, time should be reserved at the end of lessons to restore the class as a whole.

<u>Recommendations for Policymakers</u>

This research recommends that policymakers should promote the use of outdoor learning by:

9. Providing access to outdoor learning spaces for all children. This thesis provides evidence that outdoor learning **promotes the purpose of study for mathematics** in England and Wales and provides positive mathematics experiences for pupils. Therefore, creative solutions may be needed for schools with limited access to outdoor learning spaces (such as using nearby locations or repurposing existing outdoor areas). Additionally, new school developments must provide outdoor spaces for regular mathematics learning.

10. Provide outdoor learning training for new and existing teachers. Not only have the participants in this research illustrated the benefits of outdoor learning, but they have

also revealed that the role of the teacher is experienced differently when outdoors. All initial teacher training providers should offer training in outdoor learning pedagogy, which details the **differences in practice between the traditional, transmissional classroom teacher and the outdoor facilitator**. In addition, all experienced teachers should be trained in the pedagogy and theory of outdoor learning to change their practices to benefit all learners.

Chapter Seven: A Closing

"A phenomenology of practice sees new thinking as an invitation to "openness," to be intrigued by the constantly renewing and creative impulses of the search for the experience and the origin of lived meaning, and the meaning of meaning in human life."

(van Manen, 2016a, p.213)

In this final chapter, I detail the pedagogical and methodological contributions to knowledge that this thesis provides. The chapter then illustrates how this thesis demonstrates rigour and trustworthiness through each of the seven criteria described by van Manen (2016a). This chapter also describes the limitations of this study and provides recommendations for future research. The chapter (and the thesis) are concluded with a critical reflection on my doctoral journey and final remarks on the study's success and how it informs pedagogy and practice, moving forward the conversations in mathematics education and outdoor learning.

This research set out to address the question: What are the lived experiences of children learning mathematics outdoors? In doing so, this study has produced ten recommendations in Chapter Six. These recommendations result from my interpretations of the participants' lived experiences as they described them. The findings of this study provide an invitation to openness, as defined by van Manen above. The insights revealed in this research move forward current thinking about how mathematics is taught and how children experience learning outdoors. Therefore, this research contributes to understanding how children experience outdoor mathematics learning and advances the conversation about how mathematics learning can be most effective.

Pedagogical Contributions to Knowledge

In this section, I outline the critical pedagogical contributions to knowledge that this thesis provides.

- Whilst traditional mathematics is often experienced through an instructionist view of learning, children engage in learning more aligned to the connectionist view of education when learning outdoors. Children form complex connections with those around them, which is the primary source of meaning-making and new learning. This means that the role of the teacher is altered to that of the facilitator.

- This research demonstrates that for the participants in this study, outdoor mathematics learning is experienced as calming, peaceful and active. Contemporary research suggests that mathematics learning is often experienced with fear, anxiety and boredom, leading to negative attitudes towards the subject and mathematics anxiety in some students. Therefore, this research suggests that outdoor learning can provide an effective pedagogy to counter negative attitudes and anxiety in mathematics.

- This study reveals that the outdoor environment is an active learning space. Children experience the outdoors as a dynamic environment with possibilities and opportunities. The outdoors supports children to work with others and shifts the focus of learning from acquisition to collaboration. It allows children to engage creatively with their mathematical learning.

- The participants in this study have demonstrated their competency to deeply value their learning environment, and where that learning physically occurs is essential. The participants' descriptions show that children are receptive to nature in a more nuanced way than much of the contemporary literature suggests.

Whilst this research has focussed on the context of mathematics lessons, outcomes of this research may also have implications for other curriculum areas and the pedagogy of outdoor learning as a wider field of enquiry. For example, it is widely recognised that boys are engaged

in writing much less often than girls (Garlid, 2014). This research has shown that participants engaged actively, creatively and cooperatively with mathematics in the outdoors. The same could be found if examining the experiences of children writing outdoors.

Each time an interpretive methodology is enacted, the researcher will inevitably make adaptations, which have implications for future research and the methodology itself. As a result, in addition to pedagogical contributions to knowledge, this thesis has also contributed to the understanding of hermeneutic phenomenology. Therefore, this study also provides methodological contributions to knowledge.

Methodological Contributions to Knowledge

Hermeneutic phenomenology requires researchers to be creative in their approach to research and be led by the phenomenon in question, their reflexivity and the research data. Therefore, how hermeneutic phenomenological research has been conducted will likely be unique to the researcher and the phenomenon. As a result, hermeneutic phenomenological studies often contribute to the research methodology, which I outline here.

- This research has required me to maintain a reflexive attitude. I have used and developed several reflexive techniques to achieve a reflexive approach. At the beginning of the study, I participated in a presuppositional interview with my supervisor. From the interview, I co-authored a paper (Barrett-Rodger, Goldspink and Engward, 2023a), which developed the understanding of the presuppositional interview and provided practicalities of how this can be conducted to support hermeneutic phenomenological research. Later, I identified the need to reflect on my assumptions regarding my recruited participants. Knowing the participants before the study, I needed to find a way to foreground my preconceptions about them and, therefore, developed the penned illustration technique (Barrett-Rodger,

Goldspink and Engward, 2023b). These reflexive practices are published in peer-reviewed journals and represent an original contribution to methodological knowledge.

- How I conducted my interviews to gain rich experiential material drew upon several existing interview methods and put them into a unique combination. When designing my interviews, I carefully selected methods that maintained methodological congruence. The combination of vocative methods and place-based interview techniques offers an effective and original template for future hermeneutic phenomenological research.

- My study has demonstrated the value of using hermeneutic phenomenology in mathematics education research. Most contemporary mathematics educational research is positioned within the positivist paradigm, potentially resulting from mathematically-minded researchers being interested in the effectiveness of mathematics education. Qualitative research within mathematics education often focuses on why learners develop certain attitudes to the subject rather than examining in-depth the experiences of the individual. In a blog for the British Educational Research Association (Barrett-Rodger, in press), I drew attention to the need for researchers to think un-mathematically about researching mathematics education. Only through viewing mathematics education from different perspectives can researchers have a greater understanding of the impact of mathematics learning. By demonstrating that hermeneutic phenomenology can provide valuable insights into the lived experiences of those learning mathematics, I hope that more research is undertaken in mathematics education adopting a phenomenological approach.

- My use of AI-generated artwork to develop reflexivity and phenomenological analysis is original. I produced AI-generated artwork using key phrases and words that took my interpretations beyond my presuppositions and natural attitude. The use of AI-generated imagery is an original methodological contribution that builds on the understanding of how insight cultivators may be used in hermeneutic phenomenological analysis.

- My research demonstrates that children have the capabilities to be effective participants in hermeneutic phenomenological studies. The participants in this study have shown that they have the sophistication to describe their lived experiences and can explain how they experience phenomena. By demonstrating that children can effectively participate in hermeneutic phenomenological studies, I hope that greater research that adopts this methodology focuses on children's experiences.

Rigour and Trustworthiness

Chapter Two described the seven criteria van Manen claims can be used to measure the quality of hermeneutic phenomenological research. In this section, I explain how this thesis achieves each of these criteria to demonstrate a rigorous approach to research and instil the trustworthiness of the findings into the reader.

Heuristic Questioning

Heuristic questioning refers to the study's success in stimulating a sense of questioning attentiveness in the reader and links to Smythe's recommendation that high-quality phenomenological research should show the reader the essences of the experience rather

than tell them (Smythe, et al., 2008). Throughout this thesis, the reader has been guided through the participants' lived experiences and invited to question the data and make their own interpretations. This is demonstrated through how audio recordings have been included at the beginning of each poiesis as an invitation to examine the prereflective experiences of the participants in their own words.

Additionally, this thesis has made a deliberate movement between current practice, pedagogy and extant literature and the words of the participants and my interpretations to allow the reader to question the data and insights for themselves. Throughout the thesis, an effort has been made to foreshadow concepts and insights to guide the reader in their own interpretations. For example, the words of van Manen have been used at the beginning of each chapter to orientate the reader towards the nature of each chapter. Moreover, reflexive commentary has been woven throughout the chapters to illustrate my questioning and invite readers to question for themselves.

Descriptive Richness

Descriptive richness should be examined to assess to what extent the descriptions of the lived experience contain detailed experiential data. Several methods and techniques have been used throughout this thesis to achieve descriptive richness. Firstly, van Manen's use of 'experiential data' refers to a pre-reflexive description of how the experience was for the participants as-lived. Therefore, using vocative methods within interviews was essential in providing descriptive richness. How the interviews were designed, as place-based and integrating arts-based techniques, all demonstrate a drive towards eliciting prereflective experiential data, which has been made clear throughout each chapter.

Secondly, the process of crafting stories for each of the participants has been illustrated transparently. I have detailed each stage of the story construction to demonstrate how the

words of the participants have been used to ensure that detailed experiential data is present within all stages of the analysis. Moreover, the decision to recruit five participants demonstrates an understanding of the vast amount of experiential data that can be obtained from very few individuals. Recruiting more participants would have resulted in less time to dwell on descriptions and shallower descriptive richness in this thesis.

The words of the participants are weaved throughout Chapter Five and Chapter Six. This demonstrates that all interpretations and descriptions are based on highly detailed experiential data. Whenever an insight has been uncovered, transcript data has been used so that the reader can trust how the interpretations have been made.

Interpretive Depth

Interpretative depth calls for moving beyond the *taken-for-grantedness* of everyday life. Chapter Four demonstrates my steps to ensure that my interpretations move beyond my natural attitude. These include, but are not restricted to, my creative use of insight cultivation. Insight cultivation aims to integrate frames of reference within interpretations to go beyond the limitations of the researcher's previous understanding. Using poetry, AI-generated artwork and philosophical notions throughout my interpretations has provided me with techniques for understanding the words of the participants through different lenses and angles.

Additionally, I have used a series of reflexive methods to bring my presuppositions to the fore and move my interpretations beyond my fore-structures of understanding. For example, I took part in a presuppositional interview with one of my supervisors and published a peer-reviewed paper on this process of illuminating positionality and biases (Barrett-Rodger, Goldspink and Engward, 2023a). In Chapter Two, I set out my fore-structures of understanding by illustrating my fore-having, fore-sight and fore-conception. During the recruitment process, I demonstrated creative reflexivity by constructing penned illustrations to understand my

preconceptions of each participant. Again, this process has been approved for publication in a peer-reviewed academic journal (Barrett-Rodger, Goldspink and Engward, 2023b). Moreover, throughout this thesis, I have described my decisions based on my reflexive practices and notes in my reflexive diaries. My reflexivity has contributed to the depth and quality of my interpretations.

Distinctive Rigour

Distinctive rigour is evident in how the research is constantly guided by self-critical questioning. Throughout Chapter Four, I detailed my decisions that influenced a creative and distinctive research design. In selecting innovative data collection methods, such as art-elicitation and place-based interviews and being creative with the combination of methods used for phenomenological analysis, I have demonstrated a distinctive and rigorous approach to this study.

My reflexivity and attentiveness to methodological congruence have greatly influenced my research choices. For example, in Chapter Four, I detail my reasons for not using photo-elicitation, member checking or the concept of saturation. Whilst many phenomenological studies use these approaches, I have clearly stated why they are inappropriate for this study. Rather than opting for a ready-made procedure, I have demonstrated a creative and unique research approach drawing on my philosophical reading, professional practice and reflexive techniques, all of which aim to achieve distinctive rigour.

Addressive Meaning

Addressive meaning signifies the extent to which the experience resonates with the reader. One of the main aims of any phenomenological text is to allow the reader to sense the plausibility of the experience even if they have never had a personal experience of the phenomena described (van Manen, 2016a). One way I have achieved this is by exposing the

phenomenological text to different audiences. If a text is to have addressive meaning, it needs to be accessible to a range of different audiences. Throughout the text, I explain philosophical terms in a way that a wider audience can understand. My research needs to be addressive to teachers and policymakers if it is to have an impact on practice and pedagogy. Through presenting at conferences, such as the Joint Conference of Mathematics Subject Associations at Warwick University in April 2023, I have exposed my research to different audiences and changed how I communicate my research based on feedback.

Additionally, I have attempted to provide addressive meaning through the audio clips and images presented throughout this thesis. By providing different media through which to describe my insights, I have presented my research more effectively in a way that resonates with each reader.

Experiential Awakening

Experiential awakening can be expressed through vocative and presentative language, demonstrating the prereflective nature of the described experience. Throughout this study, I have been clear about my use of the term prereflective and why it is important. This research aimed to break through the rehearsed narratives of participants and move beyond their perception of mathematics to understand how they experience it as-lived. Firstly, I used phenomenological interviews and techniques (such as art-elicitation and vocative methods) to draw out prereflective experiential material in my data collection. Then, at the beginning of the analysis process, I crafted stories for each participant, which removed postreflective noise and presented the experiential data in the first person and present tense. These methods aimed to provide experiential awakening where the experience (as-lived) was drawn forward into the reader's consciousness.

Inceptual Epiphany

Inceptual epiphany addresses the research's contribution to knowledge and considers whether the study offers original insight into the experience as-lived by the participants. This study has contributed considerably to pedagogical knowledge outlined in this chapter. Furthermore, six key research recommendations are made at the end of Chapter Six. These represent a significant new contribution to knowledge and inceptual epiphany.

This thesis has demonstrated evidence for all seven of van Manen's criteria for quality in hermeneutic phenomenological research. Therefore, this research exhibits a rigorous approach to addressing the research question and should be seen as trustworthy by its readers. Beck explains that "based on the findings of phenomenological studies, effective interventions can be designed to yield the greatest impact", yet warns, "there is one caveat: Qualitative researchers must pay meticulous attention to its methodology" (2021, p.2) This thesis demonstrates my careful enacting of hermeneutic phenomenology. Therefore, the recommendations should have the power to have a pedagogical impact on the experiences of mathematics learners. However, all research has limitations.

Research Limitations

Any study must recognise the limits of its findings (Peoples, 2021). However, I use the word limitations cautiously. In this section, I outline the limitations of this study when compared to other methodologies to remain transparent about what this research has set out to achieve. However, each 'limitation' is also a methodological strength, and each is why this approach was chosen, as described in Chapter Two.

This study does not attempt to claim that the insights of this research are 'right' or 'truth' in the empirical sense. Instead, the findings and recommendations represent the fusion of horizons between the participants and my interpretations at a moment in time. Whilst they are not

generalisable, their value is in how they contribute to outdoor mathematics learning discussions and provide a glimpse into the previously unseen lived realities of children learning mathematics outdoors.

This study was conducted with one group of 10-year-olds from one educational setting in an English primary school. Transferability to other settings, ages and countries can be considered, given the universality of mathematics education and experience of the outdoors. This study did not collect quantifiable data or seek to arrive at numerical proof.

The gender of the participants could also be considered a limitation of the study. Throughout the thesis, I have used gender-neutral names and pronouns carefully. As with the number of participants, I believe the gender of the participants is not to be of concern because of the aim of hermeneutic phenomenological research. If hermeneutic phenomenology seeks to understand an individual's experience, then the gender of the individual should not be of concern if not related directly to the experience. For example, Afoakwah's (2016) hermeneutic phenomenological study identified all of their participants as female as they were studying the lived experience of first-time breastfeeding mothers. However, learning mathematics outdoors is not a gender-specific experience. Moreover, revealing the genders of the participants would add a lens through which I (and the reader) would interpret the experiences of the individual. By knowing the gender of the participant, further preconceptions and unconscious assumptions may have influenced the findings.

The researcher's positionality within the research is also a common criticism of practitioner-led hermeneutic phenomenology. However, my positionality has called me to ask the questions this research seeks to answer. Throughout the thesis, I have detailed my reflexive practices to understand my place within the study, foster an openness to the possible, and be aware of my *taken-for-grantedness*. My positionality inevitably influences the findings and recommendations of my research. However, by being transparent about this influence and

foregrounding my presuppositions, I have achieved a phenomenological attitude of openness toward my study and its data.

Future Publication Opportunities

In addition to two journal articles and one blog accepted for publication, there are other outcomes from this research that I intend to detail in future publications. I have identified the following topics which will add to understanding of mathematics education, outdoor learning and hermeneutic phenomenology:

- The experiences of children learning mathematics outdoors.
- The role of the teacher in outdoor learning.
- The use of hermeneutic phenomenology as a practical methodology for mathematics education research.
- How children can be valuable participants in hermeneutic phenomenological studies using lessons learned from this research.
- Ethics of balancing the promotion of the voice of child participants' voices and the central interpretive role of the researcher in hermeneutic phenomenological studies.
- The use of AI-generated imagery as an insight cultivator in phenomenological studies.
- How walking interviews can be used as a data collection method for accessing the pre-reflexive lived experience of participants.

Recommendations for Future Research

Based on the findings and discussions in this thesis, I have identified the following research opportunities:

- Research on children with less outdoor learning experience to understand what role novelty might play.

- Research examining children's experiences of learning other curriculum subjects outdoors to identify commonalities and differences with mathematics.
- Research the effect of using natural sounds in a classroom setting to see if they have the same focusing qualities during mathematics lessons.
- Research that examines how the role of the teacher is experienced within the mathematics classroom.
- Research focussing on younger children to understand how their experiences compared when they are perhaps less able to work in cooperative learning contexts.

Closing Reflections

This final section allows me to critically reflect on the successes of this study and presents a closing of this thesis and, as suggested above, an opening for future research. It allows me to reflect on the process and my development as a practitioner-researcher with reference to the presuppositional interview I participated in at the beginning of the study. I conclude this section with the extent to which this research has met its aim and the impact on pedagogy and practice.

Developing Epistemologically

At the beginning of this thesis, I described my positionality as deeply rooted within a positivist paradigm and situated within my professional practice as a mathematics education specialist. However, throughout this doctoral process, I have developed as a qualitative researcher and now appreciate that both qualitative and quantitative approaches to educational research are important in understanding how pedagogy impacts learning and an individual's experiences of that learning. As a result, I have called for a broader approach to examining mathematics education (Barrett-Rodger, in press). My transition to a phenomenological approach has made me ask: if mathematics learning is always questioned mathematically, what is being missed?

Adopting a phenomenological research approach has been challenging. Like my own experience, Thomson comments that “moving from a quantitative, positivistic epistemology to one that focuses on individual, subjective and emic perspectives was as challenging as it was rewarding” (Crowther and Thomson, 2022, p.3). While gaining insights into the participants’ *lifeworlds* hugely rewarding, I have also faced many challenges. Before beginning my doctoral study, I had never heard of phenomenology, and I was concerned about conducting phenomenological research ethically and effectively as a novice researcher. However, through my extensive reading and writing, I have successfully undertaken a hermeneutic phenomenological study and made published contributions to this complex methodology.

Adopting hermeneutic phenomenology has also required me to attune differently to my professional context and adopt a mood of wonder and openness. This has been difficult at times as I have had to move beyond my *taken-for-grantedness*. Being so situated within my professional context, it has been challenging to acknowledge my preconceptions formed through my experiences and focus on the words of the participants to understand how it is for them. However, through my reflexive techniques, I have confronted my presuppositions and found new meaning in the participants' lived experiences. It is through my development as an empirical phenomenologist that this research has been a success.

Developing Professionally

The EdD not only recognises academic practices but also provides the opportunity to develop professional practices within the workplace (Burnell and Czerniawski, 2020). Therefore, it is vital in this closing to consider how this study (and the doctoral process) has influenced my professional practices. This study has confirmed some of my professional beliefs. For example, my reflexivity prior to the study revealed that I saw the pedagogy of outdoor learning as providing a creative and engaging learning environment, which is borne out in the data. However, some of my *taken-for-grantedness* has been challenged.

In my previous practice, I underestimated the power of collaboration between pupils in mathematics learning. This study illustrates the importance of relationships with others in lessons and demonstrates how outdoor learning provides an effective platform for working cooperatively. However, this study also reflects that working with peers is difficult for some. I now focus much more on the opportunities I provide for learners to work together, which I also share with trainee teachers.

Most mathematics lessons I have taught in the past have followed a routine pattern of demonstration, practice and assessment, a strategy widely used by mathematics teachers in the UK, as revealed in the literature review. However, my new understanding of the role of the teacher in outdoor learning has shaken this practice. This research has shown that it is through relationships with others and the environment that learning is experienced and not through copying a demonstration by a teacher. While I still hold that effective modelling is essential in mathematics education, I now better appreciate what it means to "let learn." (Heidegger, 1968, p.15). My professional temptation has been that it is my role to impart knowledge to my pupils. Whilst this is true in some contexts, my role is also to facilitate learning and offer experiences and connections for pupils to learn from.

Chapter One described my long-held passion for mathematics and mathematics education. I always believed that mathematics to be a beautiful and creative subject. However, I have sometimes struggled to instil this enthusiasm in my pupils and the trainee teachers I have worked with. This research has revealed that the participants engage in creative and imaginative mathematics learning when outdoors, whilst the literature suggests that this is not the typical way of learning within the classroom. As a result, I have increased the amount of outdoor mathematics learning for my pupils and encouraged this with my trainee teachers.

Ethical Achievements

Ethical considerations have been central to the design and implementation of this study. One ethical consideration was how many participants to recruit. It could be claimed that recruiting too many participants in qualitative research is unethical as there is a limitation to the amount of data that a researcher can analyse effectively within a given timeframe. I am pleased that I chose five participants as this allowed me to dwell with the data and reach a deeper understanding of the lived experience. Whilst recruiting five participants may require defence for those more used to a positivist approach to research, five participants have provided this research with rich, detailed experiential data but still allowed me time enough to effectively analyse the lived experiences of the individuals.

A concern discussed in Chapter Two was preserving the participants' voices when using a hermeneutic phenomenological approach. Whilst there is a responsibility for the researcher to privilege participants' voices, particularly in research conducted with children, hermeneutic phenomenology places the role of interpretations with the (adult) researcher. Therefore, throughout the analytic process, there has been tension around preserving the voices of the child. This has been achieved by using constructed stories that only use the participants' words in the context they were originally given.

This thesis includes the original interview transcripts (Appendix F1 to F5) and crafted stories (Appendix G1 to G5) so the reader can see how the participants' words are persevered. However, ultimately, the meaning of the words has been interpreted by me as the research, as this is congruent with the methodological approach. Whilst this could be seen as a research limitation, this research has aimed to illustrate possible experiences. This thesis does not claim to portray the experiences as quantitatively verifiable or reproducible.

The ethical achievement of this thesis has been the balance between the preservation of the words of the participants and my adult-centric interpretations. The participants in this study showed themselves to be powerful narrators of their own experiences. It is the participants' words which have been woven throughout the narrative of the thesis.

Continuing a Conversation

Throughout this chapter, the importance of the insights has been made clear through the distinctive original contributions to knowledge. It is through my interpretations of the lived experiences of the participants that these insights have been illuminated. However, there is an additional horizon to be fused beyond my control: that of the reader. As you have read this chapter (and as you have read previous chapters of this thesis), you will have been making your interpretations of the words and their meanings. Each person who comes to understand the findings of this study will do so through their own experiences and preconceptions. To academics, the writing may resonate with other studies they have read. To teachers, the insights may strike chords with their own experiences of teaching mathematics in the classroom.

Whilst this is the closing of this thesis, I recognise that interpretations are never finished, and this is by no means the end of the conversation. Through the lenses that readers view this work, new meaning may be made, new insights gleaned, and changes to practice enacted. This is both welcomed and encouraged.

Returning to the Research Aim

In this final section of the thesis, I return to the overarching research aim, my professional practice and the broader context of mathematics pedagogy. This thesis began with my professional context of teaching children, many of whom have had negative mathematics experiences. Chapter Three demonstrated that current mathematics pedagogies worldwide

lead many to develop a negative attitude towards mathematics. Many children experience mathematics as a scary, challenging subject that they are either good at or cannot do. The national curriculum in England describes its ambition for children to engage in creative, purposeful and beautiful mathematics learning. However, research suggests that this differs from what current mathematics pedagogy provides for many learners.

This research reveals that children experience outdoor mathematics learning through peace, freedom, belonging, creativity and self-directedness, providing children with the experience of low-stakes, high-interest learning. Therefore, this research makes recommendations that call for teachers and policymakers to consider how outdoor learning can impact current pedagogy to give children a mathematics education more in line with the purpose of study of the national curriculum.

This research demonstrates that outdoor mathematics learning is a suitable pedagogy to provide children with positive mathematical experiences that many do not currently benefit from. The participants' voices have revealed an optimistic view of the potential future of mathematics education. Simply, this research suggests that if more children had access to regular mathematics outdoor learning, more children would benefit from positive mathematics experiences, which could impact society’s anti-maths mindset and the perception that mathematics is only for the few.

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Appendix A: List of papers in scoping review 1

Study	Country	Type of Study	Study Design	Population	Sample
Carey, E., Devine, A., Hill, F., Dowker, A., McLellan, R. and Szucs, D., 2019. *Understanding Mathematics Anxiety. Investigating the experiences of UK primary and secondary school students.* Centre for Neuroscience in Education.	UK	Mixed methods	Two interviews per participant. Monthly diary kept by participant. Thematic analysis.	A group of 9 to 10-year-olds and a group of secondary students. Both groups included children at different scores on the mathematics anxiety scale.	96
Francome, T. and Hewitt, D., 2020. "My math lessons are all about learning from your mistakes": how mixed-attainment mathematics grouping affects the way students experience mathematics. *Educational Review (Birmingham)*, [e-journal] 72 (4), pp.475-494.	UK	Qualitative	Lesson observations, interviews and questionnaires.	Year 7 pupils. One group in mixed ability and one group in set ability classes.	186
Hintz, A., 2011. Understanding Students' Experiences as Listeners During Mathematical Discussion. *Canadian Journal of Science, Mathematics and Technology*, [e-journal] 11 (3), pp.261-272.	US	Qualitative	Observations and interviews.	Elementary students.	7
Howley, A., Pendarvis, E. and Gholson, M., 2005. How Talented Students in a Rural School District Experience School Mathematics. *Journal for the Education of the Gifted*, [e-journal] 29 (2), pp.123-259.	US	Qualitative	Interviews	Mathematically gifted students aged 7 to 14 years old.	16

Study	Country	Type of Study	Study Design	Population	Sample
Jensen, E. O. and Hanghøj, T., 2020. What's the math in Minecraft? A design-based study of students' perspectives and mathematical experiences across game and school domains. *Electronic journal of e-Learning*, [e-journal] 18 (3), pp.261-274.	Denmark	Qualitative	Focus groups	Fifth grade pupils (10-11-year-olds).	12
Musa, N. H. and Maat, S. M., 2021. Mathematics Anxiety: A Case Study of Students' Learning Experience through Cognitive, Environment and Behaviour. *International Journal of Academic Research in Business and Social Sciences,* [e-journal] 11 (3), pp.932-956.	Malaysia	Case Study	Interviews	Form Four students (16 years of age) with high levels of mathematics anxiety.	7
Pepin, B., 2011. Pupils' attitudes towards mathematics: a comparative study of Norwegian and English secondary students. *ZDM Mathematics Education,* [e-journal] 43, pp.535-546.	England & Norway	Comparative Mixed Methods	Questionnaires	Secondary school aged students.	501
Russo, J., Russo, T. and Roche, A., 2021. Using Rich Narratives to Engage Students in Worthwhile Mathematics: Children's Literature, Movies and Short Films. *Education Sciences*, [e-journal] 11 (588), pp.1-19.	Australia	Qualitative	Interviews	Year 5 students (10-11-year-olds).	24

Study	Country	Type of Study	Study Design	Population	Sample
Simpson, A. and Che, M. S., 2016. A Phenomenological Study of Middle Grade Female and Male Students' Single-Sex Mathematical Experiences. *Research in Middle Level Education*, [e-journal] 39 (2), pp.1-13.	US	Descriptive Phenomenological	Interviews	8th Grade students (aged 13-14-years-old) taught in single-sex classrooms.	7
Sneck, S., Järvelä, S., Syväoja, H. and Tammelin, T., 2022. Pupils' experiences and perceptions of engagement during the Moving Maths programme. *Education 3-13*, [e-journal] 50 (3), pp.419-434.	Finland	Qualitative	Focus groups	Nine-year-old pupils participating in the Moving Maths programme.	16

Appendix B: List of papers in scoping review 2

Study	Country	Type of Study	Study Design	Population	Sample
Adams, D. and Beauchamp, G., 2018. Portals between worlds: A study of the experiences of children aged 7-11 years from primary schools in Wales making music outdoors. *Research Studies in Music Education,* [e-journal] 40 (1), pp.50-66.	Wales	Grounded theory	Group interviews using video-stimulated reflective dialogue.	7 to 10-year-olds across 5 primary schools involved in outdoor music lessons.	38
Adams, D. and Beauchamp, G., 2021. A study of the experiences of children aged 7-11 taking part in mindful approaches in local nature reserves. *Journal of Adventure Education and Outdoor Learning,* [e-journal] 21 (2), pp.129-138.	Wales	Grounded theory	Group interviews.	7 to 11-year-olds across 4 primary schools taking part in mindful approached in outdoor environments.	91
Berg, S., Bradford, B., Barrett, J., Robinson, D, B., Camara, F. and Perry, T., 2021. Meaning-making of student experiences during outdoor exploration time. *Journal of Adventure and Outdoor Learning,* [e-journal] 21 (2), pp.172-183.	Canada	Interpretative	Focus group interviews.	Grade 3 students (aged 7-8 years) taking part in outdoor exploration.	63
Coates, J, K. and Pimlott-Wilson, H., 2019. Learning while playing: Children's Forest School experiences in the UK. *British Educational Research Journal,* [e-journal] 45 (1), pp.21-40.	UK	Phenomenological	Interviews.	Primary-aged pupils in across two schools taking part in Forest School.	33

Study	Country	Type of Study	Study Design	Population	Sample
Harwood, D., Huang, M. and Somma, M., 2022. “We’re Trying to Find Cool Things in the Forest” – Exploring Children’s Curiosity and Creativity in the Outdoors. *International Electronic Journal of Elementary Education,* [e-journal] 15 (1), pp.33-42.	Canada	Case Study	Interviews, surveys and observations.	6 to 12-year-olds attending Forest School on a full-time basis.	7
Janik, A., 2022. Outdoor (anti-)play spaces and places: a qualitative study of Polish large city backyards seen from children’s perspective. *Journal of Adventure Education and Outdoor Learning,* [e-journal].	Poland	Ethnographic	Observation, guided-tours and meetings.	3 to 10-year-olds in natural play environments.	23
Jørring, A, H., Bølling, M., Nielsen, G., Stevenson, M. P. and Bentsen, P., 2020. Swings and roundabouts? Pupils’ experiences of social and academic well-being in education outside the classroom. *Education,* [e-journal]. 48 (4), pp.413-428.	Denmark	Case study.	Observation and interview.	One group of high-achieving students and one group of low-achieving students in an 8th grade class involved in Education Outside the Classroom (EOtC).	10
Fägerstam, E. and Grothérus, A., 2018. Secondary School Students’ Experience of Outdoor Learning: A Swedish Case Study. *Education (Chula Vista),* [e-journal] 138 (4), pp.378-392.	Sweden	Case Study	Interviews	Secondary-aged students in one school with experience of being taught outdoors.	14
Fasting, M, L. and Høyem, J., 2022. Freedom, joy and wonder as existential categories of childhood – reflections on experiences and memories of outdoor play. *Journal of Adventure Education and Outdoor Learning,* [e-journal].	Norway	Phenomenology	Walking Interviews	24-year-olds with experience of outdoor learning and play as children at school.	8

Study	Country	Type of Study	Study Design	Population	Sample
Manni, A., Ottander, C. and Sporre, K., 2017. Young students' aesthetic experiences and meaning-making processes in an outdoor environmental school practice. *Journal of Adventure Education and Outdoor Learning,* [e-journal]. 17 (2), pp.108-121.	Sweden	Case Study	Observations, logbook entries, interview, written documents.	Grade 6 students with experience of outdoor activities.	13
Neville, I, A., Petrass, L, A. and Ben, F., 2021. The impact of outdoor learning experiences on the development of English creative writing skills: an action research case study of year 7 and 8 secondary school students in Australia. *Journal of Adventure Education and Outdoor Learning,* [e-journal].	Australia	Case Study	Observations, note-keeping, questionnaires, interviews, written documents.	Year 7 and Year 8 students taking part in an elective English Writers Workshop course.	43
Smith, E, F., Steel, G. and Gidlow, B., 2010. The Temporary Community: Student Experiences of School-Based Outdoor Education Programmes. *Journal of Experiential Learning,* [e-journal]. 33 (2), pp.136-150.	New Zealand	Qualitative	Video-elicitation interviews.	14 to 15-year-olds from two secondary schools taking part in school camp programmes.	32

Appendix C: Ethics approval

24 September 2019

a.r.u. | Anglia Ruskin University

ARU Cambridge
East Road
CB1 1PT
www.aru.ac.uk

Dear Lewis

Re: Application for Ethical Approval

Principal Investigator:	Lewis Rodger
FREP Number:	18/19/039
Project Title:	Experiences of Children Learning Mathematics in the Outdoors

Thank you for supplying revisions to your application for ethical approval, as requested by the Faculty Research Ethics Panel (FREP) following its meeting on 15 July 2019.

I am pleased to inform you that your ethics application has been approved by the Faculty Research Ethics Panel (FREP) under the terms of Anglia Ruskin University's Research Ethics Policy (dated 1 May 2019, Version 1.10).

Ethical approval is given for a period of 3 years from 24 September 2019. If your research will extend beyond this period, it is your responsibility to apply for an extension before your approval expires.

It is your responsibility to ensure that you comply with Anglia Ruskin University's Research Ethics Policy and the Code of Practice for Applying for Ethical Approval at Anglia Ruskin University available at www.anglia.ac.uk/researchethics including the following:

- The procedure for submitting substantial amendments to the committee, should there be any changes to your research. You cannot implement these amendments until you have received approval from the FREP for them.
- The procedure for reporting accidents, adverse events and incidents.
- The General Data Protection Requirement (GDPR) if your research will take place in the European Economic Area (EEA)[1] or involve sending or bringing any personal data[2] into

[1] The EEA includes EU member states and also Iceland, Liechtenstein and Norway.

[2] Personal data means any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.

it. If your research will take place in the UK or involve sending or bringing any personal data into it, you must also comply with the Data Protection Act (2018). Other countries in the EEA may have further data protection legislation you must comply with. If your research will take place outside the EEA, you must comply with any data protection legislation relating to that country or countries.

- Any other legislation relevant to your research. You must also ensure that you are aware of any emerging legislation relating to your research and make any changes to your study (which you will need to obtain ethical approval for) to comply with this.
- Obtaining any further ethical approval required from the organisation or country (if not carrying out research in the UK) where you will be carrying the research out. This includes other Higher Education Institutions if you intend to carry out any research involving their students, staff or premises. Please ensure that you send the FREP copies of this documentation if required, prior to starting your research.
- Any laws of the country where you are carrying the research and obtaining any other approvals or permissions that are required.
- Any professional codes of conduct relating to research or requirements from your funding body (please note that for externally funded research, where the funding has been obtained via Anglia Ruskin University, a Project Risk Assessment must have been carried out prior to starting the research).
- Completing a Risk Assessment (Health and Safety) if required and updating this annually or if any aspects of your study change which affect this.
- Notifying the FREP Secretary when your study has ended.
- Please also note that your research may be subject to monitoring.

Should you have any queries, please do not hesitate to contact me. May I wish you the best of luck with your research.

Yours sincerely,

Dr Sarah Burch
Director of Research
For the Faculty (of Health, Education, Medicine, & Social Care) Research Ethics Panel
T: 0845 196 2560
E: sarah.burch@anglia.ac.uk

Copy to:
Dr Grace Spencer (FREP Sponsor)
Dr Philip Howlett (Supervisor)

Appendix D: Approval for face-to-face research during COVID-19

12 November 2020

Anglia Ruskin University

ARU Cambridge
East Road
CB1 1PT
www.aru.ac.uk

Dear Lewis

Re: Face-to-face research during COVID-19

Principal Investigator:	Lewis Barrett-Rodger
FREP Number:	18/19/039
Project Title:	Experiences of Children Learning Mathematics in the Outdoors

Thank you for your email of 2 November 2020 and for further information regarding your request to resume face-to-face research during COVID-19. This was considered by the Chair of the Faculty (of Health, Education, Medicine and Social Care) Research Ethics Panel (FREP) in advance of the next scheduled meeting in November.

I am pleased to inform you that your request to resume face-to-face research has been approved by the Faculty Research Ethics Panel (FREP) under the terms of Anglia Ruskin University's Research Ethics Policy (dated 24 July 2019, Version 1.11).

Please ensure it is explicit in the PIS that the interviews as well as the observations will take place outside.

Please remember that all research must be conducted in accordance with current ARU guidance in relation to COVID-19.

Ethical approval is given for a period of 3 years from 24 September 2019. If your research will extend beyond this period, it is your responsibility to apply for an extension before your approval expires.

It is your responsibility to ensure that you comply with Anglia Ruskin University's Research Ethics Policy and the Code of Practice for Applying for Ethical Approval at Anglia Ruskin University available at www.anglia.ac.uk/researchethics including the following:

- The procedure for submitting substantial amendments to the committee, should there be any changes to your research. You cannot implement these amendments until you have received approval from the FREP for them.
- The procedure for reporting accidents, adverse events and incidents.

- The General Data Protection Requirement (GDPR) if your research will take place in the European Economic Area (EEA)[1] or involve sending or bringing any personal data[2] into it. If your research will take place in the UK or involve sending or bringing any personal data into it, you must also comply with the Data Protection Act (2018). Other countries in the EEA may have further data protection legislation you must comply with. If your research will take place outside the EEA, you must comply with any data protection legislation relating to that country or countries.

- Any other legislation relevant to your research. You must also ensure that you are aware of any emerging legislation relating to your research and make any changes to your study (which you will need to obtain ethical approval for) to comply with this.

- Obtaining any further ethical approval required from the organisation or country (if not carrying out research in the UK) where you will be carrying the research out. This includes other Higher Education Institutions if you intend to carry out any research involving their students, staff or premises. Please ensure that you send the FREP copies of this documentation if required, prior to starting your research.

- Any laws of the country where you are carrying the research and obtaining any other approvals or permissions that are required.

- Any professional codes of conduct relating to research or requirements from your funding body (please note that for externally funded research, where the funding has been obtained via Anglia Ruskin University, a Project Risk Assessment must have been carried out prior to starting the research).

- Completing a Risk Assessment (Health and Safety) if required and updating this annually or if any aspects of your study change which affect this.

- Notifying the FREP Secretary when your study has ended.

- Please also note that your research may be subject to monitoring.

Should you have any queries, please do not hesitate to contact me. May I wish you the best of luck with your research.

Yours sincerely,

Dr Sarah Burch
Director of Research and Research Students
For the Faculty (of Health, Education, Medicine, & Social Care) Research Ethics Panel
T: 0845 196 2560
E: sarah.burch@aru.ac.uk

[1] The EEA includes EU member states and also Iceland, Liechtenstein and Norway.
[2] Personal data means any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.

Appendix E: Interview Schedule

Aims

This interview schedule aims to develop a framework that integrates the qualitative semi-structured interview with phenomenological philosophy. The aim of any phenomenological interview is to gather in-depth, detailed descriptions about the participants lived experiences – for this study: learning mathematics in the outdoors. The focus of the interview is not only to understand the experience of the interviewee, but more importantly to understand the invariant phenomenological structures of this experience.

Questioning

Phenomenological research seeks to elicit stories from research participants by asking questions such as, “Can you tell me an example of when you…?” or, “What was it like when…?” This way, the researcher pursues and values context equally with the action of the experience. Questioning is deliberately conversational and open-ended. This allows participants to narrate their own experiences which can be followed up with adaptable, supplementary probing questions (or prompting questions if required) to dig deeper into the richness of the experience.

Format

The interview is split into sections to aid the emerging narrative of the experience. Drawing will be utilised to open up discussions about the experiences and provide a platform for verbalisation of the lifeworld. Each section has an identified purpose in enabling the participant to portray their experiences. With the exception of the first and last, sections may be conducted in any order as best suits the needs of the interview.

Location

The interview will be conducted within the environment in which the experience occurs. This aims to enable the children to draw on the environment for recall as well as navigate the interviewer around the physical space of the experience should they wish to.

Section 0: Pre-interview

1. **Remind the participant:**
    a. **of the purpose of the interview using a copy of the PIS (Child version);**
    b. **about the use of the tape recorder and briefly explain how it works;**
    c. **there are no right or wrong answers;**
    d. **they can stop at any time if they wish.**
2. **Tell the participant that it is useful if they can go into as much detail as possible, give examples and expand on their answers where they can.**
3. **Ask if the participant has any questions before the interview begins.**

Section	Purpose	Suggested Questions
First Warm Up	Context Building & Acclimatisation	• Tell me about learning maths at school. • Tell me about being outside.
Drawing	Opening Up Experience	• Can you draw what maths outdoors looks like? • If you could see outdoor maths lessons, what do you think it would look like?
	Experience Definition	• Talk me through what you have drawn.
Description	Establishing Specific Descriptive Detail	• How would you describe outside maths learning to somebody? ○ Are there any specific examples you could tell me about? • How would you describe to somebody what it is like being in an outdoor maths lesson?

Environment		• Can you take me to any place outside to help me understand what it is like to experience learning maths outdoors?
		  ○ Why is this place important?
		  ○ Why have you chosen to bring me here?
		  ○ What can you tell me what this place is like when you're learning maths?

Last Closure	Experience Checking	• [Mention some key points from the interview]. • What would you say to someone who has never experiences learning maths outdoors? • Is there anything we haven't talked about that you would like me to know? • [Thank participant for taking part and sharing their experiences].

<u>Possible Prompting Questions</u>

- Talk me through when you last had maths outside:
  - What did you do?
  - What was the weather like?
  - Who were you with?

<u>Possible Probing Questions</u>

- You mentioned _____. Tell me what that was like for you.
- Can you give me an example of _____?
- When you _____, how is this for you?
- When you don't know _____, what do you know?
- How do you know _____?

Appendix F1: Alex's interview transcript

Interviewer Right, that's recording there, so if you look on there, can you see those lines going up and down? Yeah, that's showing that's picking up my voice. If I stop, it goes down. And then when I start speaking again, it picks it up. So that just shows that it's recording. It's not doing a video or anything. It's just our voices, though. So, because I can't remember everything you say and everything I say in this interview. So, I've got that now so I can listen back to it. OK, so we're doing this because I want to find out what it's like for children at our school who learn particularly maths and outside as well, because there are lots of schools that don't do learning outside the classroom as much as we do. And I want to know what it's like for you. So, there are no right or wrong answers because it's just what you feel and what you think and your experiences.

Alex My personality?

Interviewer Exactly. So, if you say, oh, it's really rubbish, I hate it, that's fine. If you say, oh, I think it's amazing. I love it. That is also fine. Whatever the truth is, is absolutely fine. OK, so some questions I'm going to ask you and we've got a tape recorder there to record what we're saying. And if you want to stop any time, like it said on the information sheet that you signed, that we can if you want to stop, we can stop. It will probably take us about twenty-five minutes or half an hour or so. So, when we're talking about things, it's as useful for me if you can go into as much detail as possible and try and explain things in as many words as possible. The words you use are going to be quite important for me to help me understand what it's like for you to learn outside. If you think of a word, just say it. Don't worry about if it's the right word or the wrong word. Just the words you say are fine. So, have you got any questions before we start.?

Alex Um, no, not really.

Interviewer Good. So, what do you think the word experience means? What is experience?

Alex Like you're good. Like you've done... like you're not like new to it. You've done it a lot. Like you're not like a newb.

Interviewer Yeah, like a newb, like someone who's new to something. So, you're experienced that learning outside the classroom. And I want to learn about what that's like for you. OK, so how that makes you feel and what it's like being in those types of lessons. But first of all, forget about outside. Just tell me, tell me about learning maths at school. What's learning maths like at school?

Alex I enjoy learning maths because it's like – it kind of takes takes a break off writing because with writing you have to go up, down, left, right. But with like letters it's like... no numbers it's like only two and one. And all that. So, it's like e... Like I find it easier and I find it like more interesting how some like English stuff is more interesting. But I feel like maths it's got a special thing in my heart as I feel like it's good to know maths. If you don't know maths and like somebody tries to like rip you off at a store like you're just going to go with it.

Interviewer Yeah. Yeah, that's good. And why do you think why do you think you enjoy maths more? Why do you think you enjoy it?

Alex Probably because I'm like good at it. And that means I just find it easier than writing. And then whenever I do maths, I always enjoy like dice stuff like when you roll the dice and then you hit like kind of like what we did in year five roll dice and then we did like plus and division.

Interviewer Why do you think you enjoy the dice?

Alex Maybe just because it's just the satisfaction of getting six or nine. I just find it so satisfying, especially when you get like a one, two, three.

Interviewer Yeah.

Alex Something like that.

Interviewer So cool patterns that come out. You like those?

Alex Yeah

Interviewer Excellent. OK, so what's it like for you in a normal maths lesson? Don't think about outside at the moment. Just in a math lesson in the classroom. What's it like for you? How would you describe it?

Alex Like it's good. I feel more relaxed than like English, although there is more noise in maths normally, like English I find stressful because you've got to do it. But with maths, I just find it easier, especially with like dice. Like I said, I just find it like soothing, if that makes sense.

Interviewer Yeah, it does make sense. Yeah, absolutely. And what's... So, you said about noise in there, what is it about. You say that maths lessons can be quite noisy inside sometimes. How does the noise affect your experience of it? How, how does it change the way it is for you? The noise.

Alex I feel like it makes me use another skill, like blacking out all the noise in my ears and just concentrating on my work. And normally people would talk more because it doesn't like cost as much like concentration. And it would be like... I just find maths a lot easier than English.

Interviewer OK, great. So now forget about maths for a second. Tell me, what is it like for you being outside?

Alex I enjoy it a lot. I just enjoy looking at like bugs, and like leaves and like... I just like the sound of, like, leaves.

Interviewer [laughter] Acorn on your head.

Alex Leaves like crunching and I like listening to the birds. And the only one thing that I don't like about wildlife is daddy long legs and like big, big spiders. I don't mind little baby spiders, but big ones aren't for me.

Interviewer What is it about spiders that you don't really like?

Alex Just the eight legs and how they crawl, especially daddy long legs. I remember at night that was like a daddy long legs on my roof and it was flying. Really scary.

Interviewer Yeah. Yeah, I know exactly what you mean. So, OK, so there's lots of places where you would be if you were outside of school do you prefer being indoors in your house or do you prefer being outside either in a garden or at the park or walking around?

Alex It depends. If it's cold, I like being indoors, but if it's hot and sunny, I like going round like forests. And like going for walks, maybe like walking like my... Sue's dog.

Interviewer And how does it. So, the weather something so cold. How does it change your experience when it's hot or cold? What's the difference?

Alex When it's cold. It like hurts my hand makes me move slower, but then when it's hot it just... I like the sunlight on my face because it feels nice.

Interviewer Yeah. Good. Excellent. So right now, we're going to put those two things together. So, we're going to think about school and we're going to think about being outside, but also going to think about maths. Now, I asked you to choose one of three locations, either the playground or the outside classroom, which we're close to, or the bottom woodland or the top woodland. Why did you choose where we are? The playground.

Alex Because I couldn't be bothered to get my boots on.

Interviewer Fine, then that's absolutely fine. So, over the last couple of weeks, we've done a couple of different lessons. We've done two outside on the playground. One was with the pyramids, doing the numbers on the pyramids on the chalk on the ground.

Alex Oh, yeah.

Interviewer One was with the millipedes where we had the plastic cards, which we had to write on the multiplications.

Alex Oh, yeah.

Interviewer Then when we were down in the bottom woodland, we did one with maths monsters.

Alex Oh, yeah, that one.

Interviewer And then when we were at the top woodlands, we did the one with the word problems pinned on the trees that you had to go around and solve them.

Alex Oh, yeah, yeah.

Interviewer So, we've done something in each of these three places. And that's why I chose you, asked you to choose one of those three places. So, what I'm going to do now, you can think about one of those or you can think of a different maths lesson or it doesn't have to be any of those maths lessons. It could just be about maths because I'm going to get you to do is... There is some card, paper and there are some resources there, pens, pencils, highlighters, different colours. And I'd like you to draw what maths outside looks like to you, OK? It doesn't have to be a fantastic drawing. I'm not judging your art or marking art. I just want to know what is ‘maths outside’? What does that look like for you? How does that look? Off you go. You have as long as you like. Use all of the colours or just one or whatever you feel.

Alex [LONG SILENCE FOR DRAWING] There.

Interviewer	Ok? Done? Excellent. So, because the tape recorder can't see, could you explain what you have drawn to the tape?
Alex	So basically, it's just a sunny day and then everybody's trying to get like worksheets down on like trees. And then this like huge tree with like platforms on them is like trying to describe that: I feel like whenever these types of like things, I feel like it's like a little like journey. And like, if you get it wrong, you have to start all the way over. But then you get like an upgrade. Knowing like that you're more like, you know the Times tables better so then you can easily get back up. And then this is like the hill up there. And then with like the gate, because I know people run up that hill to get there and then just trees to, like, get them. I always feel like, I just enjoy these types of, like, learning skills.
Interviewer	What types? What particular? You're pointing to the middle part that. Do you mean the whole picture, or do you mean the middle bits?
Alex	Like the whole picture where like these like little like things stuck to like trees.
Interviewer	Yeah.
Alex	That you have to work out and try and find.
Interviewer	Yeah. OK, so this journey is talk about on this tree on the left-hand side, you're on the first branch here. Is that like a branch of a tree? Yeah?
Alex	Yeah.
Interviewer	So, what is it like when you're on that first branch?
Alex	It like it doesn't feel like it feels exciting to get in there, but it doesn't feel good, like on the way trying to get there, and then especially when you fall off the top. It doesn't feel good.
Interviewer	OK.
Alex	But once you keep on trying and then you finally get to the top, it feels amazing.
Interviewer	Fantastic. And do you think this is something you experience more when you're outside or is it something that you can experience inside as well?
Alex	Err, definitely better outside, but maybe like in some type of, like, environment in the inside. Yes.
Interviewer	Why is it better in the outside? Why is the outside help you to have that journey?
Alex	Because it like it just reminds me of like trying to like being trapped in like a woods and you got to try and find your way out and then like doing the math questions would be like a quiz you have to do to get out. And it just...
Interviewer	Brilliant. Now, you said it's a sunny day and the weather is something you spoke about earlier. So, is it important that it's a sunny day?
Alex	Yes.
Interviewer	That makes a difference to the experience does it?

Alex	Yes. If it's cold I also don't mind doing these things in cold. However, I like it more when it's sunny, because when it's cold, it feels a bit more realistic. But the type of realistic that I don't like, so I get cold.
Interviewer	OK, what do you mean realistic? What does the word realistic mean to you?
Alex	Like. So like if it was winter and you got crashed onto a plane like you would be cold and you'd have to try and find stuff. I know I wouldn't enjoy that. Definitely not.
Interviewer	No.
Alex	But well if it was sunny I wouldn't be, I wouldn't like worry on the base straight away. I'll probably get like drinks and food.
Interviewer	OK, so what other what could you use for realistic?
Alex	Like lifelike
Interviewer	OK.
Alex	And like. I don't know.
Interviewer	So, when it's colder, it feels more lifelike, but when it's sunny, it doesn't feel as lifelike, but you like it more when it's...
Alex	Unlifelike.
Interviewer	OK, OK, that makes sense. I can understand that. Now, obviously, we can see it's sunny here, but we can't see what it sounds like here. So, describe for me what this picture sounds like.
Alex	So, it was like over here it would be noisy with them, like screaming and shouting, trying to get up the hill. Like here it would, like in the middle, it would be like calm and all you would hear the screams in the background and like leaves getting crunched.
Interviewer	Mm hmm.
Alex	And then up here you would hear screaming of the guy falling off and then him screaming, yes. When he gets to the top.
Interviewer	And which one are you?
Alex	Probably that one.
Interviewer	The one climbing up the tree? OK, why do you say that?
Alex	Because, for one, he's the shortest.
Interviewer	[Laugh] OK. Yeah.
Alex	And two, that's how that's just how I feel when I do like these types of like outdoor learning where you like find the pieces of notes.
Interviewer	OK, and how is that feeling?

Alex It just feels like Crash Bandicoot because that's my favourite game and it just feels like adventure. I like adventure games and it just feels like I have to find stuff and it's just I just find it really fun.

Interviewer Brilliant. I love Crash Bandicoot as well as a really good game. First came out when I was about your age, I think so the one that's the Insane Trilogy that's out now is like is the modernized version. And so, I played the original really grainy one. Anyway, so that's brilliant. Thank you for that. That was really good. So, if someone has never done an outdoor maths lesson, how would you describe it to them? How would you explain it?

Alex I'd describe it as fun and you should definitely do it because going outside, one, is like better than staying inside. You should get some fresh air and it calms yourself. If you're really mad and you go outside you can just listen to the birds singing, especially when you're doing math, because it's not like English, so it's a bit easier, not like really like stressful and like just you can just breathe in the air and just listen to the trees rustle.

Interviewer And when you're breathing in the air and listening to the trees rustle, how how is that feel? How is it how do you feel at that moment?

Alex It makes me feel really calm, but like a way of anger, if that makes sense, because basically, like it just makes me angry because some like thing like natural things in the world is annoying, such as daddy long legs.

Interviewer Yeah, that's right. Absolutely. And how does that affect your maths? So, if you've got that feeling, how does that affect what you're doing or your maths lesson?

Alex If it's sunny? I feel like I get a lot more done, like a lot more. But then when it's cold, I feel like that gives me a disadvantage because it hurts my hands, makes them slower. So, I feel like when it's sunny, I really do like it because the air like hits me and then it just feels really nice just doing maths while I get in the air and the sun.

Interviewer And what about being calm? How does that change the way you experience the lesson?

Alex It makes me like, not as stressful because in maths where you have to like get done like you start rushing, but when you get like the breeze in the air, it feels like you've got all the time in the world.

Interviewer Yeah. Brilliant. That makes really good sense thank you. So, I want you to think back to one of the lessons where we've had maths. It could be up in the playground cause that's where we are at the moment. It could be the pyramid one, it could be the Millepied one. And sometimes it might help me to understand how it feels or what your experience is like if you were to take me to a place, think of a place, it could be what you did, an activity or where you learn something, or it could be your favourite part of the playground to learn in, particularly in lessons. So, can you think of somewhere in this in what we can get to here without going into the forest that you could take me to show me what it's like?

Alex Alright. Oh, yeah,

Interviewer Let's go. Yeah, we can leave things here. I'll just bring my tape recorder and we'll go. Just take me where you want to take me.

Alex When we had [TEACHER NAME] and we did like, I forgot what it was, but we were sitting on the hill and then we had to... it was coordinates! And then we had to like, go to like if it was like 15 and then 30, we'd have to go to where 15 and 30 was. I found that really fun. And also, like, in year 4. No Year 5 I mean like this place. Like, if you were a group, everybody would always try and get into one of these boxes to make like stuff that we didn't like. Year 5. I forgot what we did.

Interviewer What do you mean in a lesson or do you mean in like break time or lunchtime?

Alex In like a lesson.

Interviewer OK.

Alex Doing like chalks on the ground. Everybody would always try and get to the football pitch to try and like get one of these spheres or circles or squares.

Interviewer Yeah. And how would that and how was that for you when you were doing that? If you can remember back?

Alex I always found it like I had my own little like sphere like I always had my little like area and then if somebody tried to come in, I could always like. [Hissing noise] Angry mode.

Interviewer Yeah.

Alex And if they like tried to steal like ideas.

Interviewer OK, and what about sitting on the hill watching [TEACHER NAME] do her coordinate work, what was that like?

Alex I felt that was like really like nice because I like sitting on hills like at the park or like sit on the hill and just think about life. And it just brang me to then, just sitting on the hill listening to her talk and then it would just feel relaxing, not like inside where it was like really closed in because you could hear the echoes and all the like leaves rustle and the squirrels.

Interviewer OK, and why do you think you prefer sitting on a hill?

Alex I just feel like it's more fun. Because it feels like sloped and slippery. Where on the ground, especially like cobbled it's really like hard but on a hill it's like nicer because if you ever do get uncomfortable it's easier to move than on the ground.

Interviewer Yeah, absolutely right. Let's head back over to the desk. That's really helpful. Thanks. So, there's a couple of things you said over there that I want to ask you more about and ask if you can explain them. So, one of the things you said was having your own space. And so, when we're looking at when you had your semicircle or your sphere and you were working in that space and you could you felt you had your space to work. Is that important for you having space?

Alex Yeah, especially with like at home, like my little sister would like she's really got a problem with her, she'd always like throw stuff at me. So then when I got my own bedroom, it felt so nice because it was just space because like everything else, like [SISTER'S NAME] doesn't take care of her room, and then I couldn't be bothered to take care of her and so I wanted to move. When I moved, well, of course it's messy,

but it's only like cups and plates. I just enjoy having my own space because it feels like I can't like get like crowded and like I can't just get like hurt.

Interviewer So, what's that like inside the classroom?

Alex Inside the classroom like if you had your like own table nobody could go there. I feel like it's good, but maybe not if like there's somebody who don't get along with but like good if there's like a friend on there who could keep you occupied. But and like, just talk to you about life. And like when somebody who don't like is on, they're like, I try to ignore them. And then if they don't, I just try to ignore them again. And I just feel like having your, having, me having my own space is really like, nice because I just can do whatever I want in that space.

Interviewer And do you think learning outside the classroom in your math lessons ... the extra space that you can get from that, do you think that that feels better? Does that help?

Alex Yes, definitely, because it doesn't feel like crowded in like a box. It feels open like space where like if like we use chalk to go I could go like to the other side of the playground where somebody who I don't like is like isn't. I mean. On the other side of where they are, so I don't have to go near them and like, like, like the personal space thing again, I can have like my own space without like them coming and like hurting my feelings basically.

Interviewer And so, what about when we're learning outside the classroom and we're doing group work? Does being outside help you to work as a group better or does it not make any difference or what you think?

Alex Yes, definitely. Because when people start getting stressed out, I feel like the air gets to them and they're like they're easier to calm down than being inside, because inside, when they get stressed, it's like no turning back. But outside you can sort of calm them down with the wind and all the birds squawking.

Interviewer Yeah. So, in a math lesson that would help because you could get the actual work done because people can stay calm?

Alex Yeah, definitely. Because if if one person gets stressed out like the whole team gets stressed out and then it all crumbles.

Interviewer So, going back to your picture on the branches there, there is a person on their own. Are they on their own for a reason, or is it just because you just drew one person, or do you think it's important that they are on their own on that journey?

Alex I think it's important that they're on their own. But then because there's people like here near them, if they ever did need help, they could always come to help them, because you always need people to help you. You can never work alone. But if you don't need any help, I feel like working alone is a lot more, it feels like you have more success than getting help when you don't need it.

Interviewer OK, excellent. So, another thing you said is when you said when I'm at the park, I sometimes sit on the hill and you think about life. And then also later you said something about you said help in life in the lessons and those sorts of things. So, what does being outside what do you mean by thinking about life? How does being in the outside help you to think about life?

Alex Like it doesn't like there's hardly any noise except from the nature and it just helps you think because like the wind just like feels nice on your skin. And then when you're cold, it's a lot more harder though. Although if there's snow, I feel like that helps a lot. But like with the like warmth, I feel like it just makes you feel really nice. Almost like your own holiday.

Interviewer Mm. And what sort of things do you think about when you think about life?

Alex Erm, just think about how twenty-twenty like it's been twenty nineteen then it just went to all of this: lockdown, riots and fires it's just...

Interviewer How does that make you feel?

Alex It just makes me feel upset because like in 2019, used to be all happy, like I can't wait for 2020 it's going to be the best year ever. Then it hits 2020, then we're all like, OK, this just happened. And it was just like it just doesn't feel right. Like something about it.

Interviewer And are you hopeful that in the future, maybe in 2021 things will go back to like they were in 2019?

Alex Maybe not 2019 but like, I don't think everything right now will be cleared up, but maybe near the end of 2021 like it will go good and like better than 2019 because all of the new stuff and like that like maybe like petition like how. Like the government. Like maybe they'll sort out my oil rigs and plastic where they can make a machine that will like grind down plastic into little particles. I feel like 2021 at the start it's still not going to be good. But at the end, I feel like it's going to be worth it. I feel like 2020 it's going to be putting down to history and it's going to be worth it being in history.

Interviewer And you can say I was there when you're an old person and they're looking back in the history books, you can say, I lived through that and I know what it was like. So that's quite cool. That's brilliant. So sometimes it helps us to be able to understand how other people experience things by using similes and metaphors. You know, we've done MAPOS quite a lot recently, haven't we, with metaphors, alliteration, similes, onomatopoeia, and those sorts of things. So, I wonder if you can think about a simile or a metaphor that describes a learning outside maths lesson.

Alex It's almost like being on holiday where you can just feel calm. Like as calm as like a butterfly would when they're resting or a bee when they get like sugar and water or is it salt water? I don't know. But like they drink like the syrup0 and then they go, like, really fast and crazy. It almost feels like that. And then when you get a question wrong, it's like you being the bee and then you're trying to rest. And then once somebody comes to help you, yeah, it like feels like that. Like the person gives you the syrup and then you feel back in action.

Interviewer That's really cool and thank you. That's really helped me. So, what would you say to someone who has never experience learning maths outdoors before, what you say to another child at another school about what it's like?

Alex I would say it's calming, and it is definitely recommended because if you stay indoors the whole time of school, it's definitely I don't feel like you get learn as much because it's like... Learning outside it's a lot more fun than inside. Because when you're inside it, just like not the same moods. When it's outside, you can see all the like bugs and all the like birds. And then when you like, like I said, with the bees like if you do get

something wrong, like don't give up, just like carry on. And if you carry on getting it wrong, maybe go ask somebody for help and then they could help you with it. And then if they're wrong then like I don't know, go ask somebody like their friends and then if they've got it wrong then just go ask your teacher.

Interviewer Yeah. Great. And is there anything else you want to tell me about outdoor maths or anything else you think you haven't mentioned? We haven't spoken about that. You want to tell me?

Alex Oh, yeah. Erm den building in like forest schools and I don't know if this is really on topic, but I really enjoy building like dens and like little bug places and I feel like it helps animals live there. Like if I make a den and then I don't go in it any more like spiders and foxes could sleep there for night to, like, stay warm. So, I feel like going outside is like that is good for you, especially at school. It like helps you just calm down.

Interviewer And I think calm is the word of the of the day. Yeah. That's brilliant. You've really helped me to understand what it's like for you in my maths lessons, because when we're in a math lesson I don't say, "Oh, how's this feel for you?" I never get to do that, do I, because we're always doing the maths. So, it's really good for me as your teacher to be able to hear these things. Thank you. You've really, really helped me. I'm going to finish this now.

Appendix F2: Casey's interview transcript

Interviewer There we go. So, can you see those lines going up and down on there?

Casey Yeah, that's the sound, right?

Interviewer Yeah, that's just the sound waves going into the recorder. OK, so the reason I would like to ask you some questions is because I'm interested in finding out what it's like for children in my class who learn maths in the outdoor environment. OK, I want to gather your experiences, what it's like for you. OK. And the reason is because obviously we are a school that does a lot of outdoor learning and I'm the lead of maths. So, I put those two things together and I thought, oh, I wonder what it's like for children who learn maths in the outdoors so there aren't any right or wrong answers. If you love it, brilliant. If you hate it, brilliant. Really doesn't matter. It's just how it is for you. OK, so that's what I'm trying to get out of you to tell me what it's like for you when you're doing it. And if you want to, we can stop at any time. But you're obviously doing this because you're happy to tell me what you think. But if you want, we want to stop, then you can tell me to stop at any time. That's fine. Now, it's really helpful if you can go into as much detail as possible with your answers. I might ask you the same question lots of times. And that's not a trick. It's just I'm trying to get you to think deeper or get you to give me more detail or more information. So even if you think, "Oh, that sounds like a really silly, funny answer," that's fine. Just tell me what you're thinking at the time. OK? There are no wrong answers. And the reason I'm recording it is because I won't remember everything I say and everything you say in the next half an hour. I want to so I might listen to it back to remind myself. Got it?

Casey Yes.

Interviewer Brill. OK, so first of all, what do we mean by the word experience? What is an experience?

Casey Experience is like when you experience like activity when you... To experience something is to have done it or to like, you just do something like to have a lot of experience in something is... You're professional and you know how to do it if you have a lot of experience.

Interviewer Yeah, that's right. So, you can say after this interview, I've now experienced being interviewed here, it's how it is in the moment, how it feels, what it's like for you at the time, isn't it? That's what we mean by experience. So first of all, forget about outside at the moment. Just talk to me about maths. Tell me about learning maths at school.

Casey So, like, I like maths because it's because I feel like it's probably one of my most... one of the subjects that I'm most familiar and comfortable with, one of the subjects that I'm probably the best at.

Interviewer Hmm. What's it like in a maths lesson?

Casey Like I like, it seems like it's exciting because you get to, like, use like worksheets and answer questions. To be honest, like a lot of the time when I'm doing maths. Like, I get really excited because it's like you can it's a subject that I have a lot of strength in, and I know I'm going to be able to get somewhat far.

Interviewer How does it feel when you're in a maths lesson?

Casey I'm not sure, to be honest, like. So, it's basically like, I'm happy when I'm in a maths class because I know that I'm probably going to do really well in it and there's not much stress because maths lessons are usually short, and I don't really take up most of your day.

Interviewer How do you... Right, now forget about maths for a second. What's it like being outside?

Casey I like being outside because it's a change from being inside and doing, like, worksheets, and you can go outside and, you know, experience what it's like to, you know, experience what it's like to be outside in the Woodlands. Like you were almost in the wilderness already.

Interviewer What... When you're at home, do you prefer being inside or outside?

Casey When I'm at home, I prefer being inside. But a lot of the time I go outside as well. I don't really have a real preference. I like them both pretty much the same. Like I like going outside a lot since you get to like explore and you get to like, look at the nature outside, but also like being inside because I can like code and do other things like that on the computer.

Interviewer How does it feel when you're outside? How does it feel like we're outside now aren't we? So how does it fell? What's the experience of being outside?

Casey It feels like feels like you're getting a lot of fresh air and it's just really calm.

Interviewer Yeah.

Casey So, it's like it, you don't have much weight on your shoulders, and everything's pretty laid back and relax.

Interviewer Great. That's fantastic. So, what I'd like you to do now is sometimes when we're expressing our experiences, we can do that through art. So, this isn't an art lesson. This isn't an art test, but I have some paper here and I also have some resources. There are highlighters, felt tip, pens and pencils, whatever you want to use. So, could you draw for me what maths outdoors looks like? All of them or none of them? Whatever you want.

Casey I think I'll sort of do it from, like, a bird's eye view.

Interviewer Fine.

Casey So, here's the like the apparatus and stuff here. And then here you have people (I'll just draw stickman, because why not?) And then someone holding a chalk, I'll probably colour that in. And then you can do like. You know, those pyramids we did, where we add them up? Just put random things and some others and the, of course, draw the rest of the. I don't know, it's just not really a bird's-eye-view any more. Someone else - I can signify it's a difference person with a blue collar. Let’s say this is someone from another group and their thinking about maths. Let's just put 1+2+3 because, why not? And then we have other people here making their pyramids. And I'll draw them in a

green colour. And then draw their pyramid. So, it's like some of them are going over to check the other pyramids people have made and then some of them are doing their own. And then you'll have someone from this group. [PAUSE] And then we're going to have the teacher, who is going to be in, let's say, a red colour. They're going to be helping this group. I'll draw an arrow, so you can see their talking to that person. "One plus, two plus, three equals 6!" And then there's going to be Another teacher, which I'll colour in green right now. Helping, let's see, this person, who I'll colour in pink. Helping them with their maths question. And then there's going to be, wait, this isn't going to be the apparatus, this is going to be the, this is actually going to be the door into the side of the, into the classroom. And then we're going to have a tree over here to define that it's outdoors. Just shade it in like that. Let's say in yellow colour, we'll have another group working on something different, like one of the diamonds instead of the things. I think we did these in Mathletics. I think this is how they look. So, this is sort of like how outdoor maths works, so I got the teacher helping a person on a maths question, got this person making the pyramid out of the chalk. Then you've got person figuring out the other group's pyramid and then this person drawing that pyramid that they're working on. Then you have a teacher helping someone with a maths question and then you have the people who are like greater depth, I assume, working on this diamond for them.

Interviewer And so, let's take a person this person here in the pink chalk. What is it like for them in the lesson? How are they feeling?

Casey I assume they're like they're excited about drawing the pyramid and their cheering on on this person who's figuring it out. So, they're acting friendly to each other cause, you know, that's a good thing. And then you have this person from this group working on the other person. And this person is probably thinking... Probably cheering the person on to try and solve the maths question. And then this person is probably feeling like relieved because his questions have been like answered, and then these people probably feel like feel very concentrated on what they're doing. Because their greater depth so they're doing something that's a lot harder than everyone else.

Interviewer Yeah, that's excellent. Thank you. So that's really useful because that gives me some insights into maybe what it's like. If there is someone on this picture, who is you, who would it be? Which ones?

Casey Sure. I mean, I am I am in a lot of greater depth groups. But I'm not the best. You know, I'm not the best person in the greater depth groups, like I'm not very concentrated as a person. I don't think I am. So, I'd probably be this person.

Interviewer The one with the question mark on their head.

Casey The person help asking for help since I they don't know how to do the question.

Interviewer So how would they be feeling? How would you be feeling?

Casey So, I'd probably be feeling like just confused because the question would be pretty difficult if I needed help on it.

Interviewer Yeah, brilliant, that’s good. So, see if you can describe to me your experience of being in a lesson outdoors. What is that like?

Casey Um. It's very fun and very relieving and laid back. And like, I enjoy a lot. And I think if we could spend every single day doing, spend every single day doing learning outside the classroom, I'd love it. Like if there was more sort of learning outside the classroom activities that I think would be amazing.

Interviewer Why is that?

Casey Because it's just like. I don't think there's enough of it because of how much fun it is, and enjoyable it is. And a lot of people seem that they think the same way as I do, too. They think that learning outside the classroom is good.

Interviewer So how would you describe an outdoor maths lesson to someone who's never done it before?

Casey I would probably say something along the lines of like. So basically, an outdoor maths lesson is where you... It is maths, but with a twist, you're working outside, so you use a lot of chalk and you know your creativity comes into play. And it's sort of a mix of, like forest school and maths. And it's very fun for everyone who does it and a lot of people enjoy it.

Interviewer Right now, you look come here and there's lots of people working together. Is that an important thing about outdoor maths lessons working together or can you work on your own as well?

Casey I think sometimes you work in groups and sometimes you can work by yourself as well, because I think people should have a chance to work by themselves just if they don't feel, you know, if they just don't feel like they want to work with someone else, like they should always be an option for people if they want to work by themselves because they don't feel it doesn't feel right working in the group for some people.

Interviewer And how does that change their experience, do you think?

Casey I think it makes them you know, it makes them more concentrated and since that person is probably pretty anxious doing things with groups, they're happy and good and like they feel relieved that they can work by themselves without having to use a group or work in a group.

Interviewer And how would you describe to someone what it's like being in an outdoor lesson for maths?

Casey I'd probably say it's very exciting. It's something new. The something new in school, like something that... A new thing that... Something different from everything else, something more exciting and more and very immersive experience.

Interviewer What do you mean by immersive experience? That's a great word. What do you mean by that?

Casey Means you can like you can like work together as a team, and you can sort of just get in there and work like... Like you can it's an easier working environment for some people, but also some people might struggle with it. So that's why some people could

work on their own and some people could get help from teachers like this person, this place, this person.

Interviewer Yeah, great

Interviewer So, we're on the playground at the moment. You had the choice between the playground, the bottom woodland, and the top woodlands, and you chose to do the interview on the playground. Why did you choose the playground?

Casey I chose the playground because I think it would have taken a long time to go to the woodland and get boots on stuff.

Interviewer OK, yeah, that's fair enough. So, on the playground, sometimes it's helpful to think about places when we're thinking about experiences. So, can you think of a place on the playgrounds where you've done some maths learning maybe in a math lesson? Can you think of a place on the playground that you can take me to?

Casey Probably the outdoor classroom or around, like the football pitch.

Interviewer Right, take me to one of them, take me to somewhere that shows... that can help me understand your experience in the outdoor maths. [Movement] OK, so, we're inside the outdoor classroom on the second step. So why did you decide to bring me here?

Casey Because it shows how working outside it can be relaxed you have this lovely, like house, you can just sit down and, you know, sit down and work on your paper just like you do inside school.

Interviewer And you talk about being relaxed or having the weight lifted off or relief of being comfortable a lot in the outside. So, what do you think is about those words? How is how does being outside help that experience of being relieved or relaxing or taking pressure off?

Casey Because you get to just have a breath of the fresh air and instead of being inside, you stay outside and, you know, just sit down, and have a great day and just take a breath of fresh air and work on things in a completely new way.

Interviewer And what is it about taking a breath of fresh air? Because other people have said that to me as well, what is it like breathing fresh air?

Casey It's because it's like when you stay inside for a long time, the air sort of gets like this, you know, it just sort of. Yeah, it's just like it gets sort of bland inside, after a while because you're just staying in the same spot. But when you go inside, you can just. It's like relieving feeling where you just breathe in slowly and then you breathe back out. That's why a lot of times during like yoga or just when people calm down, they breathe in and out, so they get fresh air.

Interviewer And how is it learning in the outdoor classroom?

Casey I think it's fun because it's like, for example, if it was raining or really windy, this would just be like a place where you'd be protected from all the rain and wind. And, you know, it would just be like a shelter. And also, it just feels like it makes people feel at home and like they're. Yeah, it makes people feel comfortable and relaxed that they can sit down and, you know, just forget about everything going wrong and just do maths. Maths, I think, mixes really well with working outside the classroom and outside in the classroom, probably, maybe maths it's not so easy for some people. I know a lot of people struggle, but since it's outside, there's more space for teachers to help people a little more. There's more space for the whole place. But you can get to people faster and so it's easier to multitask, helping people.

Interviewer What it like when you have more space, how does it feel different from when you have less space to when you have more space in the lesson?

Casey Because like sometimes when you have no space, you feel trapped and you don't feel like you're doing like, well in your maths. I don't know if this is really true, but like, you don't feel like... You feel when you're in a tight space and you're working, it feels like there's a lot of pressure on you, and you need to get it done. But what there's a lot of space you can sort of just sit back and feel like no pressures on you in the world and just float three, float free in the air of the outside.

Interviewer Let's go back over to the table now. So, in class, we've been thinking a lot about figurative language with metaphors and similes and those sorts of things. So sometimes when we're describing our feelings or our experiences it's helpful to use those sorts of things to describe. So, is there a metaphor or simile that you can think of that really captures or encapsulates what it's like to be in an outdoor maths lesson?

Casey Floating free.

Interviewer That's fine - good alliteration. So, what could you say, "A maths outdoor maths lesson is like?" Let's use some of your words from earlier, so an outdoor maths lesson is as calm as.

Casey Is as calm as calming as stretching, getting up in the morning, stretching and getting ready for a new day.

Interviewer Nice, I like it. What about being in an outdoor maths lesson you can be as creative as creative as....

Casey You can unleash your creative to. You can unleash your creativity off of the charts. It's as exciting as a [pause] roller-Coaster - I guess?

Interviewer Yeah, yeah, that's nice. So, what would you say to someone who has never experienced learning maths outdoors?

Casey Uh. I'd probably say I'd probably recommend it to them and be like, "You should definitely try it. It lifts a weight off your shoulders and the bad thoughts that you had would be lost in nature."

Interviewer Is there anything you haven't said that you think is important? Tell me about learning maths outside.

Casey I think that some people might actually not think it's that good because some people might be scared to go into a new environment. But I think for the people who are scared, they should just try and get used to learning outside and then just relax, relax and not think about anything bad. Just think about how you're learning in a new environment, which means there's more stuff to do and it's more immersive than ever imaginable at school.

Interviewer That has been so helpful in helping to understand what it's like learning maths outside. Thank you very much. We'll finished the interview there.

Appendix F3: Paris's interview transcript

Interviewer There you go, so can you see on the screen there, you see the little lines popping up? Yes, that means it's picking up both of our voices. OK, so I'm going to use that. So, because I can't remember everything I say and everything you say, so I'll just listen back to it and see. Now, when we're doing this, there are no right or wrong answers. It's just what your experience is. So, what does the word experience mean to you?

Paris So, experience means like maybe like the first time you've done something and the experience of what you've done.

Interviewer Yes. And that's what I want to I want to understand, because we are a school that has lots of learning outside and we come into the forest a lot. And because I'm in charge of maths, I want to know how children at our school, how they experience outdoor maths. And that's what I'm trying to get to understand. So, there are no right or wrong answers. It's just up to you. I'm not going to be angry across or upset or happy about anything you say, because I just want to know what it's like for you. There aren't any right or wrong answers. And if you feel like, oh, you haven't got the words for something, that's OK. Just say whatever comes to your mind. Don't think about it too much. Just say what you. And if you say the same thing over and over again, that's OK as well. Um, so first of all and also if you want to stop at any time, then you can you just tell me you want to stop. Because you haven't got to do this. You're here because you want to do this, so that's fine. So first of all, could you tell me why... You had the choice of either the outdoor classroom, the lower woodland, or the top woodland? So why did you choose to come up here?

Paris Because in the top woodland, there's lots of space and it's nice and calm. Yeah. And like with all the animals in the background, it's just very peaceful.

Interviewer Nice, excellent. Good. So first of all, don't think about outdoors at the moment. Tell me about maths. What is it like to learn maths?

Paris OK, maths. Sometimes it can be a bit hard, but like column addition it when you, if you like, don't know it and the teachers talk through it, you get to know it more. And one of my favourite maths is probably column addition because, like at the start of year five, I didn't really know it. And now all through lockdown that's what my parents have been teaching me, so I've got quite good at it. And maths when like if you're not very good at maths, the teachers will always give you help. They're not going to just leave you to do it and get all of the questions wrong.

Interviewer So how does math make you feel?

Paris Sometimes maths makes me feel a bit upset when I get the questions wrong, because I, I don't have a very good memory sometimes, so I forget things.

Interviewer Mm hmm. OK, so what's it like to experience maths?

Paris It's really good to experience maths because maths hasn't always been my favourite thing and I haven't always been good at it. So, it's good to experience maths lessons.

Interviewer Brilliant. So, now forget about maths. We're not interested in maths for a moment. We'll come back to that. What is it like being outside?

Paris Being outside makes me very happy and it makes me feel really free because like in the forest, it just like there's so much space. And in our school, we're very lucky to have a forest because not many schools have a forest.

Interviewer And what about at home? What's it like? What is it like being outside? You know, when you're at home, you can be inside your house or you can be outside. So, what's it like being outdoors?

Paris So outdoors, like in my garden it's, well, there's not much to do because we have nothing in our garden. But it's just nice to like I see like, little animals and centipedes. And I like to put them in a pot with little like huge holes in the lid so I can like, see what they are and when

Interviewer And what's that when you've got an animal or when you've got a bug or whatever you're collecting. How is what is that like? How does that feel? What is that experience?

Paris So, it makes me feel really happy because I am an animal and like bug lover and I just love seeing what they are and like what they like to eat and things.

Interviewer Brilliant. Really good so far NAME. Thank you very much. So, what is it like learning maths outside?

Paris Learning maths outside, it's better to learn it outside because if you're in the Woodlands and you're doing like timsing, you can use like sticks and things like leaves to times it. So, it's easier and you can just count what you need.

Interviewer And how does it make you feel?

Paris It makes me feel again, happy because it feels it makes me feel really free and the air just makes me feel calm.

Interviewer What do you think that is? Why do you think the air makes you feel calm?

Paris Hmm. Maybe because in the air it just makes me feel calm because... It makes me feel calm because it's just like so much of the air and it just makes me feel really free around in the forest.

Interviewer Nice, good idea. So, this is your piece of card, your paper on this. So, we're going to do some art. You're going do some art. It's not an art lesson. And it doesn't matter if it's a good piece of art or not a good piece of art. But I would like you to draw what maths outside looks like. OK, you can use pencils, pens, whatever you want to, whatever colours you want to take as long as you want. What does maths outside look like? [LONG PAUSE] What one are you looking for?

Paris I got it. [LONG PAUSE] Mr Barrett-Rodger? Like the people that are doing the interviews. Is it just doing it once or is it more than once?

Interviewer Just once to start with

Paris Yeah, OK.

Interviewer I might have to come back to you and ask you questions about it or get you to do another one or something. But at the moment it's just one.

Paris Yeah. OK, done,

Interviewer Brilliant well done, right. So, because the tape recorder can't see, can you explain to me talk me through everything you've drawn and what it shows?

Paris OK, so first of all, what I did was I drew the path that we go up to the fire circle. Then I did draw the fire. So, then I drew some trees with people around them with like the maths sheets that we put up on the trees. And then I just drew some people working out the questions.

Interviewer OK, so you drew the fire circle. Why is the fire circle an important place?

Paris Because the fire circle is where class like in Forest School or just to do maths where we join up after we finished.

Interviewer OK, and what is it like being at the fire circle?

Paris Being at the fire circle makes me happy. It's just like not like we're in class, but it just makes me happy. Like we're in my happy place in the forest and it’s nice like to meet up again after we finish.

Interviewer And why do you think the fire circle was your happy place in the forest?

Paris The fire circle is my happy place in the forest is just surrounded by everything I love. And just again, like meeting up with people.

Interviewer Now, you drew three people. Is there a reason you drew three people on yours?

Paris And maybe because like one person, because, you know, we're allowed to work in a single group or in a group together.

Interviewer And do you what do you normally choose?

Paris I usually stay in a two.

Interviewer So, what's it like working with someone else in the Woodlands?

Paris Working with someone else in the woodland is really good because if you're stuck on a question, they can help you. And if they are, you can help them.

Interviewer OK, excellent. That's really good ideas. So How would you describe outside maths learning to somebody who's never done it before?

Paris Outside maths, learning to someone that's never done it before... if they went to a school before that didn't have a forest, it could be really fun for them, because if they've

like never been in a forest or they've never, like, had a forest in their school, it would be really fun. And it's an experience for them. And working outside in general for a new person, they might have worked outside in like their playground, but it would be a different experience for them to work in their forest.

Interviewer And how do you think it'd be different?

Paris It would be different because maybe in a playground like there isn't as many leaves and trees and just more stuff that you wouldn't see in a playground than what you see in a forest.

Interviewer So how does that change how you experience something if there are leaves and trees around? How does that change how you feel or how you are?

Paris So, the reason it makes like me change how I feel is because in a playground it's really loud and there's like not as much space as there is in the forest. And it just makes me feel more free in a forest than what I do in a playground.

Interviewer So So you talk about being free and this freedom. You said that a couple of times about being free in being the outside. And I think that's something a lot people feel when they are outside as well. So, what is it like for you to be free?

Paris What it feels like to me to be free is because when you're free that you can, like, run around but not in the forest because it's really slippery and but like in the playground as well, I still feel free, but not as much in the forest. And in the playground, it's just like fun to run around with your friends because it makes me happy.

Interviewer And why is freedom important to you?

Paris Freedom is important to me is because sometimes I can get claustrophobic if I'm in the same place for quite a long time or in a small place.

Interviewer Mm hmm. Ok. That's good. Now, the picture you draw looks like the lesson we had yesterday, which was up in this in this area, wasn't it, in the top woodland. So, what I'm going to do now is we're going to move. And I'd like you to take me to a place in the top woodlands somewhere around here, take me to a place that's going to help me to understand what that lesson was like for you and understand. Can you think of a place?

Paris Yeah.

Interviewer Let's go. We'll leave everything here apart from the tape recorder and my sheet.

Paris [MOVE TO LOCATION] Here because this is the first question I did.

Interviewer OK, so what? What. So, for the tape, describe where we are.

Paris OK, we are. So, we're near where one of the last Year Six built their den and what looks like one of the oldest trees. And so, yeah, it's surrounded by quite a few dens. The last year, sixes made.

Interviewer Brilliant. And what can you tell? Can you tell me what this place is like when you're learning maths? What's this place? How does this feel?

Paris This place like feels like very peaceful and like, oh, the trees just surround you.

Interviewer Does that help you with your maths?

Paris Yes. Being peaceful and just being surrounded by my favourite things help me with maths.

Interviewer And why do you think being peaceful and being surrounded by good things, why do you think that helps you with your maths work?

Paris Because if like sometimes if you're not peaceful and you can be upset, maybe your favourite place can help you, like, get happy. And, um, so like with maths, it could help you maybe concentrate more if you're in your favourite place.

Interviewer Brilliant, excellent. That's great. Thank you. So, let's move back to the fire circle now. Do you remember in class we've been looking at MAPOS and we've been looking at metaphors, alliteration, personification, all that sort of stuff? So sometimes using a simile or using a metaphor can help us to understand how each other are feeling or what it's like for someone else. So, is there any metaphors or similes or alliteration you can think of that would help someone to understand outdoor maths?

Paris Maybe alliteration is the... I was thinking... Maybe you could think of the ferocious forest, because sometimes there can be some fish like birds and things and foxes can be very vicious.

Interviewer OK, and is that something you think about when you're in the forest?

Paris Not all the time.

Interviewer OK, that's interesting. That's good. What about a simile, if you could finish the sentence, learning maths outdoors is like...?

Paris So, like, I can compare the forest like maybe when you see, like a riverbank or something with the trees surrounding you still.

Interviewer OK, so let's choose one of the words you used earlier, which is the freedom. So, learning maths outdoors is as free as much as free as.

Paris I was going to say as free as a forest, because, yes, like really being in more space.

Interviewer OK, and what about as fun as something? Learning maths in the outdoors is as fun as...

Interviewer As fun as playing with your friends.

Paris Yeah. And what's it like playing with your friends?

Paris Playing with my friends makes me happy because after lockdown, I didn't get to see them for quite a while. So, it just feels really fun to see them again.

Interviewer And you think that's similar to when you were saying about coming together at the end of a lesson and sitting around the fire circle? Is that… is that something about... What's that about? What's that like?

Paris Just gathering together again.

Interviewer So, it's important to feel like part of a group of part of a class for you?

Paris Yeah.

Interviewer Why do you think that is?

Paris Because sometimes like... Maybe if like, you could be a bit upset and if you like, gather around with lots of people, they can help you become happy again.

Interviewer And do you think learning outside helps people work together?

Paris I think so, because, like, I feel like the forest makes me very peaceful. So maybe it does to other people, and it can just make some really calm and help other people in that group.

Interviewer So, let's use one of those other words for a for a simile like you can either a metaphor, the forest is a calm something or you could say learning maths outside is as calm as something. What would you say?

Paris OK, so learning from learning in the forest is as fun as building a den.

Interviewer And what about as calm as?

Paris It's as calm as... It's as calm as praying.

Interviewer So, what would you say to someone? An alien. Think about an alien. Alien doesn't know maths and doesn't know what the outdoors is. How would you describe what it's like to the alien, what you feel?

Paris So, maths, as I said, maths can be hard sometimes, but when you learn it, it gets a bit easier. So, like with column addition and timsing and dividing, when I first learnt it, I didn't really know it, but now I know it quite a bit. So yeah, when you start to learn, it gets a bit easier.

Interviewer Do you think coming outside is helping you to learn?

Paris Yes.

Interviewer Why?

Paris Because as I said, it just makes me feel very free and with all the air, it makes me feel very peaceful inside.

Interviewer So maybe it's sort of you can forget about other things and concentrate on what you're learning. You feel better in yourself; I suppose.

Paris Some things like, yeah, I can I'm a bit sad right now because I'm losing someone in my family but being outside makes me very happy inside.

Interviewer That's really nice. Lovely. Thank you. So, is there anything that you haven't said that you'd like to tell me about learning maths outdoors?

Paris Yes. With like all the stuff surrounding you, you can use that for quite a lot of maths so it can really help as well. And like with everything in this forest, you could use it all for maths. Like it doesn't matter what is just at least like... Nothing that you pick off something because it will kind of like kill the trees and things surrounding it.

Interviewer And what would be your main message from the interview today? What's the main thing you've said all you think about?

Paris That with outdoor learning, just maybe keep calm and it will keep you calm.

Interviewer Brilliant. That's all my questions [NAME]. Thank you. You've answered them brilliantly. You've really tried hard there; I love that you said lots of really good things. So, thank you very much.

Paris You're welcome.

Appendix F4: Robin's interview transcript

Interviewer There we go, so can you see those lines bouncing up and down?

Robin Yeah.

Interviewer I'm going to go quiet. It always goes back to the middle. Yeah, so that's just recording our voice so that I can listen back to a bit later. So, the reason I've asked you to come out and have a chat with me today [NAME] is to talk about what it's like being outside and particularly learning maths, because at our school we do lots of outdoor learning and it's important for us to understand what it's like for you to learn outside. So, there are no right or wrong answers. If you if you hate it and you really don't like it, that's fine. If you really love it, that's also fine. So, you're not going to get into trouble and there's no right or wrong answer. It's about how it feels for you and what experience you have. So, and if you want to stop at any time, you can just say, can we stop? And that's fine and we can stop. I'm not going to force you to it because you're doing this because you want to do it and because your parents are happy for you to do it. It's not schoolwork. You haven't got to do it if you didn't want to. Do you have any questions before we start? OK, cool. So, what do you think the word experience means?

Robin Does it mean like when you are like trying to find a new job or something you see what it's like?

Interviewer Yeah. So, we call that like work experience. Yeah. So, you go and you get a bit of work experience because you're seeing what something is like and that's what I guess what experience is. We experience things all the time don't we like. Yeah, you could say, I could say, oh how was that me interviewing you earlier. And that could be this is your experience of being interviewed. Is the first time you've been interviewed? There you go then. So, this is your first experience of being interviewed. So, I'm interested in what it's like for you to be in a math lesson when we're in the outside. OK. So, forget about the outdoors to start with. Tell me about maths at school. What's is it like and what do you think about maths?

Robin I like it because we do fun things. Well, it makes it more fun. Like we play games while doing it and it doesn't feel like you're doing maths, but you are because it's fun. That's what I like about that.

Interviewer So, what does it feel like in a maths lesson when you're doing maths? What does it feel like?

Robin It feels like you're just playing a game but when you do it, you have to work out some calculations. That's why it's maths.

Interviewer OK. And do you... Have you always liked maths?

Robin Yeah.

Interviewer Yeah. And how good do you think you are? Maths. What would you give yourself out of ten? Ten being the best zero being don't know what number is. Where would you think you are?

Robin Maybe about eight.

Interviewer OK, that's pretty good then. OK, seven. Seven or eight. OK, that's not bad. Um what do you like about maths lessons?

Robin Um, well when I was younger, I done, I had this book of times tables and I used to do it with my granddad, and it was fun. And I just like doing maths.

Interviewer What do you not like about maths? Is there anything you don't like?

Robin There's some stuff, like I do struggle with division a bit but then I don't. I don't like maths when there's a really, really, really hard question and I can't do it.

Interviewer OK, ok. That's fine, right. Forget about maths for a second. What is it like being outside?

Robin I like it.

Interviewer Why do you like being outside?

Robin It's nice and quiet sometimes. And it's just nice to get air.

Interviewer So, two things there. How does it make you feel when you're in a quiet place?

Robin Calm. Um. Makes me feel like I'm happy, I guess, because, like, it's not really loud and stuff, and I like quiet.

Interviewer When you're at home, do you prefer being inside or outside?

Robin Um. In the summer, I'm outside a lot because the swimming pool's always out. But then in the winter, I kind of just stay indoors and get comfy and just spend time with Mom and like [SISTER NAME] and, yeah, and call my friends.

Interviewer So, you said about the air as well. What's it like when you can... Do you feel the air or hear the air or see the air?

Robin I can just feel it like you come from like kind of hot classroom then you come out here and it's just nice.

Interviewer OK, how does it make you feel when you feel the air?

Robin Makes me kind of happy, I guess. And sometimes the classroom can get really hot because like everyone's moving around and then you come outside and it's just like nice and cool.

Interviewer Mm hmm. OK. Right, when we first came out, I decided to give you the choice. You could either come onto the playground into the low woodland or in the top woodlands. Why did you choose to come onto the playground?

Robin Because I couldn't be bothered to put my wellies on.

Interviewer That's OK. That's a good enough reason. That's not a problem. OK, so. So, we have to wear our wellies when we go to the top woodlands or the bottom woodland. You're right. Yeah. So that's fine. That's OK. So, I would like you to draw a picture for me.

Robin Oh no.

Interviewer It's not an art lesson. Your art is not going to be tested. But sometimes we find it hard to put into words what something is like. And so sometimes it's easier for us to draw what it's like and it might help me to understand it a bit more. So, there are lots of pens, pencils, highlighters, felt tips, whatever you want to use, you can just use one or you can use all of them if you want to. You can have as long as you want to. Can you draw on this paper? What is it like a maths lesson outside? Can you draw what a math lesson outside looks like? Go and then you can explain it to me once you've drawn what you've drawn. Just have a think - what does it look like?

Robin Does it have to be good?

Interviewer No. It has to be what you think outside maths looks like.

Robin What, like in the playground?

Interviewer Wherever. When I say outdoor maths, what's the first picture that comes to your head? Think about what might be in that picture. [Long Pause]

Robin Done.

Interviewer Ok. So, the tape recorder can't see the picture. I can, so, can you describe can you tell me what is in the picture? What can we see?

Robin That's the outdoor classroom. And like, when we go outside, it's like people get along better. I don't know why, but there's like these two people here, like doing some really good maths and they're doing really good team. That's the grass and that's the sun.

Interviewer OK, so what is it like? What is this person feeling? How is it for them in this picture?

Robin Um, happy.

Interviewer Because?

Robin Because he's got on really good with his partner because sometimes you don't have to get along with everyone but like, you just don't.

Interviewer And why did you draw grass?

Robin Because there is grass.

Interviewer That's a really good answer. And what about the sun on this? What is the weather like in this picture?

Robin Nice sunny day.

Interviewer Mm hmm.

Robin Like just the blue skies and the sun. So, basically summer.

Interviewer And how does that make how does that make the characters feel in the lesson?

Robin Hot?

Interviewer OK, and is that is that good?

Robin It's like good because I guess they like the hot weather.

Interviewer OK. Why do you reckon they like the hot weather?

Robin You can go outside, and you can do better stuff up in the summer because you can go to like the beach or you can go abroad and stuff. Summer is just better.

Interviewer Yeah, absolutely. Now there's two people on here. Why have you drawn two people rather than more?

Robin Because they were in partners and they're doing partner work and they were in a thing.

Interviewer OK, and what about what, what can they hear in this picture?

Robin They can hear the tree, the leaves like probably moving around and that. And people stepping on the acorns and leaves.

Interviewer So, it's not really loud outside.

Robin No.

Interviewer Is it different to how it would normally be in the classroom?

Robin Yes, because a lot of people are really noisy in the classroom. I mean, people really silly in the classroom and people make you laugh and it's hard to get on with your work.

Interviewer So how is that different outside?

Robin Because outside (when there's not a whole class out here).

Interviewer Yeah, I know Year 3 are making it very noisy now.

Robin It's nice and quiet and then it's just quiet out here. It's like the opposite of the classroom.

Interviewer Does that make it better for you to learn? Is that easier for you to learn maths then?

Robin Yeah, I find it easier because sometimes I can't always do maths because I kind of struggle on it a bit because it's not my favourite topic, but I like it. And in our classroom, it's hard for me to concentrate. Where when it's quiet, it's easier for me to concentrate.

Interviewer Good. If someone has never done a maths lesson outside, what would you tell them?

Robin I'd tell them it's fun and they should try it.

Interviewer Are there any examples you can give me?

Robin We were doing like bubble thing and we had to do factors. There was a number, say 12, and there were different numbers and if they're a factor of 12 you had written it down on your whiteboard. But like you could, I guess, try, and do that outside, like, get I don't know, like 12 leaves if 12 is a factor of something. It's just fun outside.

Interviewer And how would it change your experience of maths if you were outside? If you did that lesson outside, why would it be better?

Robin It probably would be better because it will be fun trying to find all the things. And again, I think people get on better, get on better outside because it's a bigger place.

Interviewer So, space is important?

Robin Yeah.

Interviewer So, do you prefer being in big spaces or small spaces?

Robin Depends.

Interviewer OK, go on. Give me examples.

Robin Like at home. I like just chilling on my bed and that's quite a small place and then if say [SISTER NAME] wanted to play a game, I like to have a big space we can like play it if it's a game.

Interviewer And what about for a maths lesson, is that better in a small space or a big space?

Robin It depends on what we're doing.

Interviewer OK.

Robin So, if we're doing like, I don't know, something that's messy or something, then we then come outside and do it.

Interviewer And does it help having a bigger space? What does it mean you can do when you're outside? If you have a bigger space?

Robin It's not as like warm and you're not near everybody. When you're in partners, I just feel like it's better. I don't know why; I feel like it is.

Interviewer That's okay, that's fine. Sometimes we don't know why. So how would you describe to someone what it's like being in an outdoor maths lesson?

Robin Um, I would say to them it's fun and they should recommend it to their teacher. They should try and tell me what they think of it.

Interviewer OK, so can you take me... Think about the playground.

Robin Yeah.

Interviewer Can you take me somewhere in the playground that reminds you of a maths lesson somewhere that would help me understand what it is like in that lesson for you? Can you think of a place?

Robin What do you mean?

Interviewer Well, so we've done we do remember the lessons we did out here. We did the Millepied one. We put the millipedes together in the multiplication. We've also done, the pyramids, one out here, we drew chalk pyramids on the ground. And then you had to write the numbers in and add those numbers together to make the one above it. And you also sat on the bank and watched [TEACHER NAME] do the co-ordinate work.

Robin Oh, yeah.

Interviewer That was sort of a geography maths lesson as well. So, can you take me somewhere in the playground where we are that shows me something about the lesson that you did? One of those three lessons. Let's go, let's go, let's go then and you can talk about it.

Robin I like the co-ordinates, it was fun.

Interviewer OK, so where were you when we did when you did that?

Robin Well, [TEACHER NAME] (we were in partners) told us to go stand somewhere across the grid and we pretended it had numbers. So, your partner would stand in one place and then the other person would then have to try and guess what co-ordinate it is?

Interviewer OK.

Robin And that's why I found it fun.

Interviewer And what was it like for you in that lesson?

Robin Fun.

Interviewer And what did you enjoy about it? What was fun about it?

Robin I found it fun that we got to move around, and it was like kind of like a game.

Interviewer OK, so you could have played that game on a piece of paper, couldn't you, in the classroom, on your desk. So, what was different about it when you actually move, because you said about moving around, so...

Robin It's actually better because you're doing it, where if you're in the classroom, you just do it on a piece of paper and it's boring.

Interviewer So, what is it like for you to move around?

Robin I like moving around and I like space.

Interviewer OK, and what is it like for you when you have to stay still?

Robin I don't like it because it's really boring because you're just sitting there with nothing to do, I like moving around.

Interviewer And so, being outside helps us to be able to move around, have more space... [LONG PAUSE] Ok, right, in our English lessons, can you remember we've been doing some MAPOS work? So, metaphor, onomatopoeia, alliterations, similes, that sort of stuff. Sometimes when we're trying to explain how something is for us, like our experience, it can be helpful to use some of those things. So can you think of maybe a metaphor or a simile to describe a maths lesson outside. So, you could say, maths outside is like... And describe it or you can say it's... You've given me words like teamwork or quiet or air or space. So, you could use some of those words so you could say, "learning maths outside is" or fun you've used a lot. So, what about, "Maths learning outside is as fun as..."

Robin As something fun as going to the park.

Interviewer Nice, good. OK. Or what about it's as quiet as

Robin It's as quiet as a mouse walking around your house.

Interviewer OK, so what about it makes me feel like...

Robin It makes me feel like [LONG PAUSE] makes it feel like it's not a maths lesson - it's like a fun game, where it really is a maths lesson?

Interviewer OK, and what about learning outside maths with a partner is like...

Robin I like working with partners. It is like... having a fun time because you get to do some fun stuff when you're in partners.

Interviewer Yeah, really good. So, what would you say to someone who's never done learning outdoor maths?

Robin I tell them they've got to try it.

Interviewer Good. Is there anything that we haven't spoken about that you want to tell me about learning maths outside and what it's like for you?

Robin No.

Interviewer OK, are you happy you've told me everything?

Robin Yeah.

Interviewer Excellent. Thank you. That was really cool. You give me loads of ideas and lots of information about what it's like. So thank you very much.

Appendix F5: Sydney's interview transcript

Interviewer There we go. So, the recorder is now recording, and you can see a little line on there. There we go. It's picking up my voice. That's good. We are doing this so I can learn a bit more about what it's like to be a child Kendall, know what it's like for you to learn outside and also particularly in maths, because I'm the maths person at Kendall and so that's what I want to know more about. So, the tape recorder is recording our voice, and I'm going to listen back to it because I can't remember everything I say or everything you say. That's why I'm doing it. There aren't any right or wrong answers. So, if your experience is really bad or really good, that's OK. It's whatever you want to tell me, you're not going to get told off, you're not going to get in trouble, whatever you think is what is perfect. So, there are no right or wrong answers. If you want to stop any time, you can just say, "Can we stop?" And that's fine as well. So, it's really helpful for me, if you can explain what you're saying, as much as possible. So, if you can try and explain it in longer sentences or paragraphs or sections rather than just saying one word or two words, it's going to help me to understand more about it. So, if you think, "Oh, I haven't really explained that the way I want to," you can say it again. You can repeat your answers and say what I mean by that. And I might say, "Oh, what do you mean by that word or what? How does that feel or how do you experience that?" So, have you got any questions?

Sydney No.

Interviewer Good. Excellent. So, tell me all about just what maths is like. Tell me what you think of maths. What is it like to experience maths?

Sydney I love maths. It's my favourite subject. I don't really have a reason why. I just enjoy it because most teachers make it really fun - not saying any teachers don't. Yeah, I like coming outside for maths. I just think it's like a better way of, like, learning maths. I don't have a favourite part maths, but I do like multiplication.

Interviewer OK, yeah. What do you feel when you when you're doing maths? How do you feel?

Sydney Sometimes it gets like - when it gets hard, I get a little annoyed but it's like when, when, when I get it, it's like I'm actually really surprised (I want to scream) if it's really hard I don't want to scream but yeah I like.

Interviewer OK, that's good. And have you always liked maths?

Sydney Oh no. Um, I didn't like it from like right up to like year three because like I didn't really understand any of it, but then I started understanding it in like Year 4 and so I really enjoy it. So, it's not like I've always enjoyed that, but I have since Year 4.

Interviewer OK, and so now forget about maths for a minute. What is it like to be outside?

Sydney Oh, that's a whole other question. I love being outside. I'm like I love exploring like I love outside. it's just a really amazing place. It's like there's so many things to see and stuff, but it's like I love the woodland because like there's so much stuff to do like I love building dens, especially because it's like you have to like to explore to find like the things you want to use and like and it's like I love exploring outside. It's just fun in general.

Interviewer So how does it feel when you're outside compared to when you're inside it?

Sydney I like being outside more than inside because inside it's like, yeah teachers make it fun, but then outside it's more fun. I don't know why. I just find being outside more fun.

Interviewer And what about when you're at home? Do you do you prefer to be inside, or you prefer to be outside?

Sydney Outside. I like being outside more like - inside the house, like it's fine inside the house, like I do like lots of crafts and stuff. But and being outside, I just love that, like when I'm going on my trampoline and other things like, I love riding my bike and other things outside. It's like, it's just fun.

Interviewer And how does it make you feel? Being outside in general?

Sydney Happy, because I don't know. It makes me feel happy. Just makes me feel happy and like calm because like when I listen to the birds, just like it just relaxes me.

Interviewer Why? Why do you think it relaxes you? What is it about it that makes you feel relaxed?

Sydney I just like it. I'm not really sure why. I think it's just the noise.

Interviewer Good, so I'm going to ask you to do is some art now for me in your interview. So, I brought some pens and pencils and highlighters out. So, they're yours. You can use all of them or none of them or whatever you want, but you have to use something, whatever you want to do. And there is some card as well. So, can you. We've done a lot of lessons in maths outside recently. Can you draw what maths outdoors looks like, whatever you think? So, use all the colours you want to. What does maths outside look like in a picture?

Interviewer [LONG PAUSE FOR DRAWING] Do you want to add any colour? You don't have to. [LONG PAUSE FOR COLOURING]. Brilliant. So can you talk me through it, explain to the tape recorder and to me what you've drawn explain it.

Sydney I've drawn two people outside doing multiplication and the one who’s like trying to work part of it out and saying, "This is fun," and then, like, there's the trees and you can just see a bird. And it's like being like it's being loud. So, it's relaxing as well as doing - it's having fun doing the math.

Interviewer And why did you choose a bird?

Sydney Um, just because I like the noise of when they, like. Like, what do they do? Squark. I like the noise when they do it, like calmly not when do it, like really, really loud. But if they're doing it calmly, I like it.

Interviewer Do you think the noises outside, do they distract you from the maths you're doing, or do they help? Do they help.

Sydney Um, some of the noises distract a little bit, but some of the noises help.

Interviewer What type of noises help?

Sydney Um, the birds and like sometimes the wind, if you can see the trees and then the like, the leaves rattle together.

Interviewer How does that help your learning?

Sydney If it's getting really hard, I like the noise because it like calms me down a bit. So, then I can try and like if I get it wrong, I can try and do it again instead of, like, just giving up.

Interviewer Mm hmm. And how do some of the noises, what are some of the noises that distract you or don't help you outside?

Sydney Some if they're really loud, like some of the louder ones, like, they just distract me.

Interviewer And why is that person having fun?

Sydney Um, because like it's outside, and, like outside, if you're outside, it makes everything funner. And it's like it's a really fun way to make a maths more fun.

Interviewer What other words could you use for fun? What does fun mean to you?

Sydney It's like. Having an enjoyable time.

Interviewer Yeah. How many people have you drawn?

Sydney Two.

Interviewer And why did you decide to draw two people?

Sydney Because I was thinking like they could be partners and one could be motivating the other one and then the one who's drawing, like doing it, has motivation.

Interviewer Yes. And do you think being outside helps that?

Sydney Um, yes.

Interviewer Why's that?

Sydney Um, I think it's just because, like, it's not like we're getting stuck in a classroom and it's like if it's really hot day, it's like it's harder to concentrate. So, it's like just being outside. I think it just makes it easier to concentrate and stuff.

Interviewer Yeah. So, think about a lesson that we've had in maths outside.

Sydney Yeah.

Interviewer Yeah. Got a lesson? So explain, what do you do in that lesson.

Sydney Um, the one from yesterday I like it when we went in the forest and had to like complete different like, like long question and all stuck on the trees. I just like enjoyed that because like my partner really like helped because like if he couldn't do it and then like

I couldn't do, he tried. We both gave ideas to see are we doing this bit right or are we doing this bit wrong?

Interviewer And can you remember what the weather was like in that lesson?

Sydney Um, I, I think it was cloudy. It wasn't quite sunny, but it was cloudy, but it wasn't raining.

Interviewer Does that change how you experience the outside the weather?

Sydney No, I don't think it does. Like I like any weather.

Interviewer Mm hmm. OK, so if somebody. How would you describe somebody who's never done maths learning outside? How would you describe it to somebody?

Sydney Um, I would describe it as enjoyable and like fun and enjoyable and like. For me, it makes me feel happy doing it outside, so I would like to tell them it's like that noises calm you down, it's far more enjoyable, happy and all that stuff, like when it calms you down.

Interviewer When the noise calm you down, what it's not like for you.

Sydney It's like. I don't really know how to explain.

Interviewer It's fine, just try your best. There's no, remember, there's no right or wrong answers. It's just how you feel and what your experience is.

Sydney Well, I, it feels like it's like if you listen to a lullaby, just like an outside version of a lullaby. So, it makes you feel a little bit sleepy, depending on what type of like what type of like animal or thing is making the noise. So, it's like a lullaby just outside version.

Interviewer OK. And are there any examples you can give me of when you've - if you explaining it to someone who's never done learning outside the classroom in maths are there any examples you would give them to explain what it's like.?

Sydney Like I don't really know, like, an example, but I would just say, like, it's fine, it's enjoyable and it's not like you're just stuck doing a question, like just sitting there in the classroom doing like nothing really. But then being outside, it's like it's just more enjoyable.

Interviewer So, imagine you're in an outdoor maths lesson. Think about how you feel. Think about what you can hear. Think about what you can see. Think about what you're doing or learning. Think about what you can maybe taste or smell and all your different senses in that moment. In that lesson. What is it like? What is it? How are you? What is your experience like? How are you feeling there?

Sydney It depends what type of maths. Yeah, but it's like depending on what type of maths, it's like I would find it fun. I don't know what I would smell. What would I sense? But like I would hear, like if it's quite windy it's like um, like the leaves rustling together. And sometimes if it's quiet and it feels like a squirrel, you can kind of hear it climbing up a tree like a bit rare, but I don't know what I would taste or smell.

Interviewer And how would you feel?

Sydney Um, I'm trying to think of another word, because I've said the same words multiple times. Um, I feel, um, I just feel like happy and like. Because if it's like something out finding hard, I get a little bit frustrated, but but like being outside, it just helps frustration, like all the noises and everything.

Interviewer Hmm. So, can you take me somewhere in the top Woodland's? We're going to move now. Can you take me somewhere to help me understand what it's like to experience learning maths outdoors? So, it might be a place that you had a particular in the lesson yesterday. It might be somewhere where you were doing something in another lesson. Think about a maths lesson in the outdoors. Can you take me somewhere that would help me to understand what it's like?

Sydney Um, yeah. I think I've thought of a place. From yesterday's lesson. It was my favourite question. On this tree here.

Interviewer OK, so for the tape recorder playing, we by a tree a little bit further off from the top woodland learn from the fire circle. So, can you explain to me why is this place important?

Sydney Um, I just found this place because it was like this was my favourite question that we answered. And it's not just my favourite question, but it took multiple times to try and work it out, like I had to keep trying with my partner and then.

Interviewer Yeah, OK. And why was it your favourite question?

Sydney I think it because it rattled my brain a bit. It's like I couldn't really think of it first or second try, so I had to keep trying.

Interviewer And can remember what the question was about?

Sydney It was like, um, there's this many older dancers and this many younger dancers and they had to be in a group of like six or something. And then it's like how many were in each group. I think something like that.

Interviewer Right. And what can you tell me about this place in the outside? So, thinking about all the outdoor learning you've done. What about - look around, have a look around you. This particular place here, what is it like being in this place?

Sydney Um, I quite like this area because it's not just because it has lots of trees, but it’s like there's lot to like to see like, oh, look, there's so many trees everywhere, it's like, oh, the trees have like different markings, like those ones have like the vines up them. And like you can just see, like every tree. And it's not just the trees. It's like if you look down there's so many things like on the ground, like all the leaves have different patterns and I find them enjoyable to just look at and see all the different coloured ones and everything.

Interviewer So, how is what is - all those things you've just described to me that you really enjoy looking at or you enjoy seeing or the patterns - what is that like for you then when you are doing learning here? Because we might not be looking at we might not be looking at the patterns or the trees and our lessons and our maths learning, but what's it like being in this place when you're learning.

Sydney I don't know really how to describe it, but I like it in this area particular like I don't really have a reason why I just like.

Interviewer That's good. So, you know, in our lessons, we can walk back what we're talking about this, you know in our lessons and we've been doing about metaphors and similes and alliteration? Sometimes that can help us to describe something that's really difficult to describe. So, is there a metaphor or a simile or some alliteration that you can think of? If I said, "Learning maths in the forest or outdoors", what could you describe it as? Like or as something or.

Sydney It's as fun as being in a dance party.

Interviewer That's fine. So, you could say learning outside is as fun as being in a dance class. So, what other words did you use to describe it? Enjoyable. So, we could say learning outside in maths is as enjoyable as...

Sydney As enjoyable as eating delicious, brownie.

Interviewer Nice. That does sound really enjoyable, actually. So, what would you could you say? Learning outside in maths is like... Someone who's never done it before. It's like what?

Sydney It's like... it's like the best dream, like, going and getting ice cream, getting ice cream, and having a movie night with everyone, and then it's really fun.

Interviewer That is really cool. So, what could be like working with someone outside in the forest is as something as something.

Sydney Working outside with someone in the forest it’s if you're struggling with something, they're there to like motivate you and like help you with it, even if they're not in your group, sometimes you just get help from them. Yeah.

Interviewer Yeah, great. So, is there anything we haven't talked about that you think you'd like me to know or that you think is important? I'm trying to understand what it's like for you to learn maths outside. Anything you haven't said or anything you want to say is the main message?

Sydney It's like really, really enjoyable.

Interviewer That's the word for [PUPIL NAME]. I've asked you some really tricky questions there, and you have done fantastically well to talk about that. Thank you so much for being interviewed.

Appendix G1: Alex's crafted story

It's just a sunny day. Everybody is trying to get the worksheets down from the trees. By the gate people run up the hill to get to the questions. Getting the first question correct is exciting, but it doesn't feel good on the way, trying to get there – especially when you fall from the top. But once you keep on trying, and you finally get to the top, it feels amazing.

Whenever these types of things happen, I feel like it's a little journey. If you get it wrong, you have to start all the way over, but then you get an upgrade. You learn more, so then you can easily get back up. It reminds me of being trapped in a wood and trying to find the way out. The maths questions are like a quiz you have to solve to get out. I have to find the pieces of notes. It feels like being in Crash Bandicoot (my favourite game) – an adventure.

In one part of the playground, it's noisy with children screaming and shouting, trying to get up the hill. But where I am, in the middle, is calm and I can hear the screams in the background and leaves getting crunched. I can hear the sound of leaves; leaves crunching and the birds singing. I fell the stress fall away from me and I am calm. The world slows down and the breeze in the air makes it feel like I have all the time in the world. The air hits me, and I calm down. I become aware that if I get stressed, the whole team will get stressed and then it will all crumble.

I manage to get one of the circles to work in. I have my own little sphere – my own little area which I can defend from others if they try to come in or steal ideas. I enjoy having my own space because it feels like I can't become crowded or hurt. I have my own space, and I can do whatever I want in that space. It doesn't feel crowded in a box. Not like inside where it is

really close in. I can go somewhere else if there is someone I don't like. I don't have to go near them. I have my own space without them coming and hurting my feelings.

Working alone in the lesson feels like I am having more success than getting help when I don't need it. But, because there are people near, if I ever do need help, they can always come and help me. You always need people to help you. You can never work completely alone.

I hear the echoes and all the leaves rustle and the squirrels. There is now hardly any noise except from the nature which helps me think. The wind feels nice on my skin. With the warmth, I feel like I'm on my own holiday. It's almost like being on holiday where you can just feel calm. As calm as a butterfly would when they're resting.

The sun helps me to get a lot more done, like a lot more. The air hits me and then it feels really nice just doing maths while I'm in the air and the sun.

I hear screaming of other children getting the question wrong. Now, soon after, they're screaming, "Yes!" they got it right.

As the questions get harder in the lesson, I feel like a bee when they get sugar and water. They drink the syrup and then they go really fast and crazy. It feels almost like that. When I get a question wrong, I am the bee trying to rest, waiting for somebody to come and help. The person gives me the syrup and then I'm back in action.

Appendix G2: Casey's crafted story

Today's lesson is maths, but with a twist; we're working outside! It's something more exciting – a very immersive experience; more immersive than ever imaginable at school. Going outside is like you're almost in the wilderness already. It's something new. The something new in school... A new thing that is something different from everything else. A maths outdoor lesson is like getting up in the morning, stretching and getting ready for a new day. Outdoor learning is where your creativity comes into play – you can unleash your creativity off the charts.

I'm on my way to the outdoor classroom – a lovely house where you can just sit down and work. From here I can see that there's a door into the side of the classroom, and a tree. The tree defines that we're outdoors. I explore and look at the nature outside.

I get a breath of the fresh air. It feels like you're getting a lot of fresh air and it's just really calm. It's a relieving feeling, breathing in slowly and breathing out. Just like yoga and calming down. I take a breath of fresh air and begin working on things in a completely new way. It's like you don't have much weight on your shoulders – everything's pretty laid back. I sit down and just forget about everything going wrong and just do maths. Being outside lifts a weight off my shoulders and the bad thoughts are lost in nature.

Over there someone is holding a chalk. We get on with drawing pyramids which you have to add up. I just get in there and work. There are other groups thinking about maths and making their pyramids. While some are doing their own and working on their pyramids, some of them are going over to check the other pyramids people have made – figuring out the other group's pyramid.

That person’s working on their own – it doesn’t feel right working in the group for some people. They’re able to be more concentrated since they’re probably pretty anxious doing things with groups. They’re happy and feel relieved that they can work by themselves without having to work in a group. Being outside is an easier working environment which means you can work together as a team, but some people struggle with it.

Another group are working on something different – a diamond instead of a pyramid. They’re greater depth and are very concentrated on what they’re doing. Because they’re greater depth, they’re doing something that’s a lot harder than everyone else.

Everyone’s excited about drawing the pyramid and cheering on the person who’s figuring it out. They’re acting friendly to each other. Someone is feeling relieved because his questions have been answered. I can see the teacher going to help other groups on a maths question, “1+2+3=6”. Another teacher is helping another person. I’m now the person asking for help since I don’t know how to do the question. Maths it's not so easy for some people, but since it's outside, there's more space for teachers to help people a little more. There's more space for the whole place. You can get to people faster and so it's easier to multitask, helping people.

Sometimes when you have no space, you feel trapped, and you don't feel like you're doing well in your maths. You feel when you're in a tight space and you're working like there's a lot of pressure on you, and you need to get it done. But when there's a lot of space, you can just sit back and feel no pressures on you in the world and just float free in the air of the outside. Floating free.

Appendix G3: Paris's crafted story

We leave the playground – it's really loud and there's not much space. There aren't as many leaves or trees than in the forest where we're headed. The moving from playground to forest makes me change how I feel. It makes me feel freer because there's so much space. As free as a forest. In the top woodland there's lots of space and it's nice and calm. With all of the animals in the background, it's just very peaceful. When you're free you can run around with your friends which makes me happy. Being free is important to me because sometimes I can get claustrophobic if I'm in a small place or in the same place for quite a long time. The amount of air makes me feel calm, peaceful inside and really free around the forest.

We go along the path towards the fire circle and see the trees. It's like when you see a riverbank with the trees surrounding you. People are around the trees which have the maths sheets that we put up onto them. People have started working out the questions. I start my first question at what looks like one of the oldest trees. It's surrounded by quite a few dens made by last year's Year 6. This place is very peaceful as the trees surround you. Being peaceful and surrounded by my favourite things helps me with the maths. I find that if you're not at peace, or you're upset, your favourite place can help you get happy. Being in your favourite place can help you concentrate on your maths.

I work in a two. Working with someone else in the woodland is really good because, if you're stuck on a question, they can help you. The same as if they're stuck, you can help them. The calmness of the forest means that people can help other people in their group. Some people chose to work in a single group.

We use sticks and things, like leaves, to help with timesing. You can just count what you need. With all of the stuff surrounding us, we can use that for quite a lot of maths – it can really help. Learning in the forest is as fun as building a den.

After we have finished, we join up at the fire circle. I feel happy here. This is my happy place in the forest. It's nice to meet up again after we finish. The fire circle is surrounded by everything I love and it's a place where I can meet up with people. Gathering together again reminds me of playing with my friends because during lockdown I didn't get to see them for quite a while. I'm a bit sad right now because I'm losing someone in my family but being outside makes me very happy inside. It feels really fun to see them again. The thing you need to remember with outdoor learning is keep calm, and it will keep you calm.

Appendix G4: Robin's crafted story

It's a nice sunny day at the outdoor classroom. Just the blue skies and the sun. Basically summer. I can hear the trees, the leaves moving around, and people stepping on the acorns and leaves. A lot of people are really noisy in the classroom. People are really silly in the classroom and make you laugh – it's hard to get on with your work and it's hard for me to concentrate. Outside it's nice and quiet – it's quiet out here. When it's quiet, it's easier for me to concentrate. It's like the opposite of the classroom. It's not as warm outside – you're not near everybody.

As we go outside people get along better because it's a bigger place. Sometimes you don't have to get along with everyone but because we're in partners and doing partner work, we're in a thing. We're doing some really good maths and we're doing really good team.

Today we're doing co-ordinates. We're in partners standing somewhere across the grid, where our teacher told us to, pretending it has numbers. Your partner stands in one place and then you have to try and guess what co-ordinate it is. We're getting to move around – kind of like a game. We're doing it. If we were in the classroom, we'd just do it on a piece of paper. I like moving around and I like space. It makes it feel like it's not a maths lesson – it's like a fun game, whereas it really is a maths lesson.

Appendix G5: Sydney's crafted story

We're in the forest for maths. Different long questions are all stuck on the trees. My favourite question is on this tree here. It rattles my brain a bit. I can't really think of it on the first or second try, so I keep trying with my partner. They motivate me, so I have motivation. We both give ideas to see if we are doing this bit right or this bit wrong. It gets hard, I get a little annoyed – a bit frustrated. Being outside helps the frustration and then suddenly I get it. I'm really surprised; I want to scream.

I quite like this area – not just because it has lots of trees – but there's lots to see. Oh look, there's so many trees. Oh, the trees have different markings. Those ones have the vines up them. You can just see every tree. And it's not just the trees. If you look down, there's so many things on the ground. All the leaves have different patterns and I find them enjoyable to just look at and see all the different coloured ones. It's just a really amazing place. You have to explore to find the things you want to use. It's not like we're stuck in a classroom. Being outside makes it easier to concentrate and stuff.

The noise calms me down. I can hear the birds and the wind. The leaves rattle together. I feel happy and calm as I listen to the birds. It relaxes me. In the quiet I can hear a squirrel climbing up a tree. The maths gets hard again, and I like the noise because it calms me down a bit. It's like listening to an outside version of a lullaby. It makes you feel a little bit sleepy. I get it wrong, but I can try and do it again instead of just giving up.

It’s like the best dream… going and getting ice cream and having a movie night with everyone. It’s as fun as being in a dance party and as enjoyable as eating delicious brownies. It’s a better way of learning maths.