



An exploration of the relationship between motor development and the emergent handwriting skills of junior infant children

by

Sinéad McCauley Lambe B.Ed., M.Ed.

This thesis is submitted for the award of PhD to the School of
Inclusive & Special Education, Dublin City University, Dublin,
Ireland.

Under the supervision of

Dr. Órla Ní Bhroin & Dr. Marie Flynn

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DECLARATION

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Doctor of Philosophy is entirely my own work, and that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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ID No: 14266351

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ABBREVIATIONS

ASD	Autism Spectrum Disorder
ATNR	Asymmetric Tonic Neck Reflex
BOT-2	Bruininks-Oseretsky Test of Motor Proficiency
CPD	Continuous Professional Development
DCD	Developmental Coordination Disorder
DCU	Dublin City University
DEIS	Delivering Equality of Opportunity in Schools
DES	Department of Education and Skills
DS	Down Syndrome
ECEC	Early Childhood Education and Care
ESAI	Educational Studies Association of Ireland
FN	Field Notes
GAA	Gaelic Athletic Association
GDPR	General Data Protection Regulation
KTK	Körperkoordinations Test für Kinder
LEA	Language Experience Approach
NCCA	National Council for Curriculum Assessment
PE	Physical Education
PLC	Primary Language Curriculum
PPCT	Process-Person-Context-Time
PTR	Pupil Teacher Ratio
SD	Standard Deviation
SEN	Special Educational Needs
SESE	Social Environmental and Scientific Education

SET	Special Educational Teaching Allocation
SPHE	Social Personal and Health Education
SPSS	Statistical Package for the Social Sciences
STNR	Symmetric Tonic Neck Reflex
TA	Thematic Analysis
US	United States
USA	United States of America

Abstract

An exploration of the relationship between motor development and the emergent handwriting skills of junior infant children

Sinéad McCauley Lambe

The focus of this research is on the interplay between motor development and the emergent handwriting skills of children from advantaged and disadvantaged communities, during their first year at primary school. This research looks uniquely at the impact of a sensorimotor handwriting programme in the infant classroom on the emergent handwriting skills of young children attending DEIS and non-DEIS schools, and on the practice, knowledge and perceptions of their teachers in relation to sensorimotor development.

The study incorporated a mixed methods approach with two phases of data collection. The first phase involved assessment of fine and gross motor skills of 178 children from three DEIS schools and three non-DEIS schools using the standardised BOT-2 test (Bruininks & Bruininks, 2005). Assessment results provided the rationale for, and informed the adaptation and implementation of, a sensorimotor handwriting programme across the six participating schools. During phase two, the class teachers participated in a professional development initiative, following which they implemented the sensorimotor handwriting programme with the participating children over a 16-week period. Post-implementation of the programme, children were retested using the BOT-2, and semi-structured interviews were employed to gather information relating to changes in teachers' perceptions, knowledge and practice in relation to sensorimotor development and the sensorimotor handwriting programme.

The key findings of this study revealed that children in the DEIS schools entered junior infants with lower motor proficiency than the children in non-DEIS schools, while post-implementation of the sensorimotor handwriting programme, there was no longer a statistically significant difference. What is clear from the participating teachers' responses is that they gained new knowledge and understanding in relation to sensorimotor development and emergent handwriting skills, and that the sensorimotor handwriting programme was positively received and regarded. The study is significant in attending to the sociocultural aspect of motor development within the development of emergent handwriting skills.

CHAPTER ONE: INTRODUCTION

*But words are things, and a small drop of ink,
Falling like dew upon a thought, produces
That which makes thousands, perhaps millions, think.*

*Tis strange, the shortest letter which man uses
Instead of speech, may form a lasting link
Of ages. To what straits Time reduces
Frail man, when paper, even a rag like this,
Survives himself, his tomb, and all that's his.*

1.1 Context and Research Focus

This study explores the interplay between young children's sensorimotor development and their emergent handwriting skills. In particular, it focuses on how teachers employed a sensorimotor handwriting programme in the junior infant classroom to address the emergent handwriting needs of young children. This research also explores the contextual factors that influence motor development in the early years.

By synthesising Bronfenbrenner's biological model of human development (1979, 1988, 1992, 2005; Bronfenbrenner & Morris, 2006) with theories of cognitive development (Piaget, 1928, 1930, 1956, 1952, 1960, 1974) and motor development (Ayres, 1964, 1972a, 1972b, 1974, 1989), this research aimed to highlight the sociocultural aspect of sensorimotor development and enabled the researcher to view and to understand children's motor development in a wider sociocultural context. The research study was shaped by rapidly developing research, in both an international and an Irish context regarding the decline in children's motor development, (O'Brien, Belton, & Issartel, 2015; Gaul, 2014; Lepes, Halsi, & Josip, 2016; Roth, Ruf, Obinger, Mauer, Ahnert, Schneider, Graf & Hebestreith, 2010) as

well as successive curricular and policy reforms in the area of literacy education, including the Primary Language Curriculum (NCCA, 2019) and the National Strategy to Improve Literacy and Numeracy in Schools (Government of Ireland, 2011).

The National Strategy to Improve Literacy and Numeracy in Schools (Government of Ireland, 2011) emphasises the urgency to develop the literacy skills of all young people in Ireland. It highlights the importance of delivering quality literacy programmes in schools that will enable young people to partake fully in all aspects of life by performing basic daily tasks, including reading and writing an email and writing down a shopping list. Additionally, the Better Outcomes, Brighter Futures: The National Policy Framework for Children and Young People report 2014-2020 (Government of Ireland, 2014) highlights the development of good literacy skills among all children and young people as being fundamental to the life chances of each individual and essential to the quality and equity of society. The report states that improving literacy standards is an urgent national priority. The revised Delivering Equality of Opportunity in Schools (DEIS)¹ plan (Government of Ireland, 2017a) also prioritises the development of literacy skills among young children, highlighting findings from the evaluation of DEIS (Kavanagh, Weir, & Moran, 2017) programme that indicate that while the gap between DEIS and non-DEIS schools is narrowing, overall achievement in reading, remains below that in other schools.

The national prioritisation of literacy development was reflected also by the recent revision and implementation of the Primary Language Curriculum (PLC; NCCA, 2019). The PLC emphasises the key role that communication, including verbal, non-verbal and print-based

¹ The DEIS Plan sets out the department's vision for education to more fully become a proven pathway to better opportunities for those in communities at risk of disadvantage and social inclusion (Government of Ireland, 2017a). 852 Primary Level and Second Level Schools in Ireland are included in the DEIS initiative. 658 of these are Primary Schools and 194 are Secondary Schools.

communication plays in the lives of young children. Proficient literacy skills, including oral language, reading and writing provide opportunities for children “to engage emotionally, socially, cognitively, imaginatively and aesthetically in relationships and cultural experiences” (NCCA, 2019, p.6). For children to be able to acquire skills of thinking, expression, reflection, critique and empathy, and to develop their own identity and to experience full participation in society, they must become literate (NCCA, 2019).

Despite the evidence as outlined above in relation to policy and curricular commitment to improving literacy skills at a national level, research in an Irish context relating to the decline of children’s motor skills (O’Mahony, Dempsey, & Killeen, 2008) indicates that teachers, particularly those in DEIS settings, are faced with a number of challenges in the junior infant classroom. These challenges include the readiness of children to begin literacy development, in particular in the area of emergent handwriting which is dependent on children’s motor proficiency upon entry into school. Findings from a recent research study in Ireland (O’ Brien et al., 2015) indicate that the motor proficiency of young people is in decline, with only 11% of early adolescents assessed achieving mastery or near mastery on nine fundamental movement skills including hopping, kicking and throwing by age six. Anecdotally, many teachers complain of children’s poor motor skill competency and a lack of school readiness in relation to the development of emergent handwriting skills upon entry into school. Research indicates that contributing factors include technological advances and an increased focus on the teaching of numeracy and literacy (reading) skills in the classroom (Suggate, Pufke, & Stoeger, 2016), with less time for the explicit teaching of handwriting skills. For children living in areas of lower socio-economic status, the increase in the use of computers and television, combined with factors from the physical environment, have been noted to contribute to such poor readiness for school (O’Mahony et al., 2008). These factors include high traffic volumes, a lack of open green spaces, limited play opportunities and unsafe home environments.

There is also evidence to suggest that children living in areas of lower socioeconomic status in Ireland do not experience a sensory rich environment or engage in meaningful sensory activities, and have limited access to adequate space for movement within their homes and community places (Barron, 2013; The Heritage Council, 2016). Highlighted in the PLC (NCCA, 2019) is the need to provide playful learning experiences for young children, and the importance of active, interactive and enjoyable learning experiences. The sensorimotor handwriting programme (Keller, 2007) that was adapted for the purpose of this research was informed by the learning outcomes of the Primary Language Curriculum - that literacy instruction in the infant years should follow a child-led, playful and hands-on approach.

1.2 Research Questions

This study is guided by the following research questions:

1. What is the baseline measure of motor proficiency of a sample of junior infant children in DEIS and non-DEIS schools?
2. Is there a significant difference in children's motor proficiency upon entry into schools in DEIS schools and non-DEIS schools?
3. What pedagogical approaches should be included in a sensorimotor handwriting programme for junior infant children?
4. What supports do teachers require to be able to implement a sensorimotor handwriting programme effectively in a junior infant classroom?
5. What are the effects of a sensorimotor handwriting programme on the development of fine and gross motor skills and emergent handwriting skills of junior infant children?

These questions were further elaborated on and led to the development of points of inquiry throughout the study as follows:

1. The perceptions and knowledge of teachers regarding the relationship between motor development and emergent handwriting skills?
2. The effects of a sensorimotor handwriting programme on:
 - a. The fine and gross motor skills of children?
 - b. The emergent handwriting skills of children?
 - c. Children's enjoyment of handwriting lessons?
3. The perceived professional development needs of teachers in relation to the teaching of handwriting and sensorimotor development?

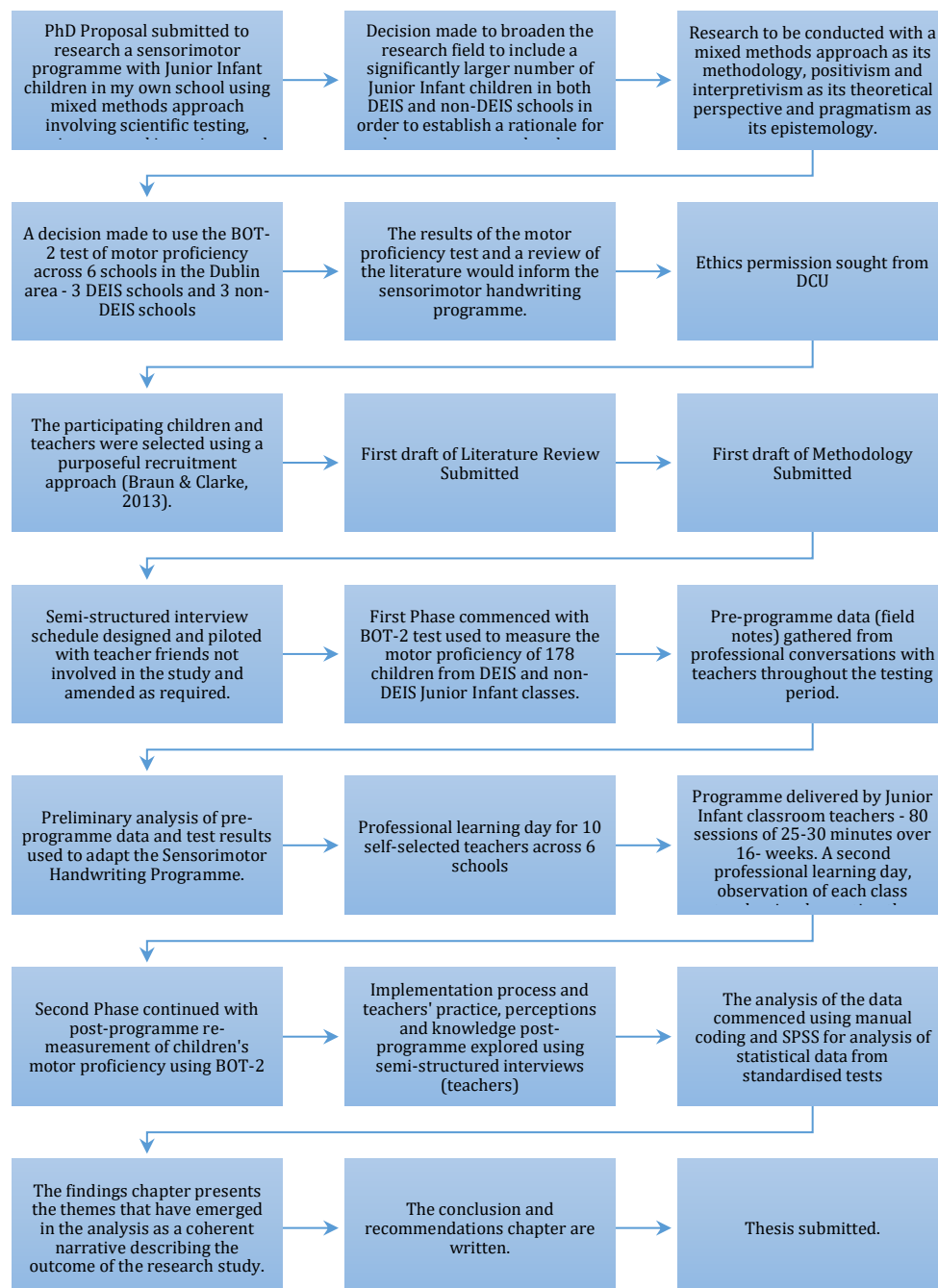
This research study was carried out in two phases over the course of one school year. The initial phase of the study focused on identifying a baseline measure of motor proficiency of 178 children from DEIS and non-DEIS schools in Dublin. This involved administering the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2) (Bruininks & Bruininks, 2005) on an individual basis. At the outset, current practice, knowledge and perceptions of teachers were explored using field notes from conversations that took place during classroom observation days, training days and the testing periods in schools. Results of this phase provided a rationale for conducting a sensorimotor handwriting programme with young children during the second phase of the study, as well as informing the adaptation of that programme.

The second phase of the study involved the implementation of the programme by ten self-selected teachers across six separate schools, three DEIS schools and three non-DEIS schools, all in the Dublin area. Six of the teachers were from DEIS schools and four were from non-DEIS schools. The participating teachers attended two professional learning days led by the researcher, in relation to sensorimotor development and implementation of the sensorimotor handwriting programme during this phase of the research. Observations of the programme

being implemented across all ten classrooms took place over the 16-week rollout period. The motor proficiency of all participating children post-implementation of the programme was re-tested using the BOT-2 test. Semi-structured interviews were conducted with the individual participating teachers at the end of the 16-week period to determine changes to their perceptions, understandings, and practice in relation to sensorimotor development and emergent writing skills of young children and to gather their insights and reflections on the programme illustrates the overall research design process.

Figure 1.1

Overall Research Design Process



1.3 Research Relevance and Rationale

The importance of handwriting as a skill is debated in the literature, with Graham (2018) referring to what he describes as ‘premature’ and ‘overwrought’ inquiries into the demise of handwriting in modern society. Technological advances however, mean that handwriting is no longer “the only means of vital communication among us today” (Nelson, Kiely, & Pedro Correa do Lagi, 2018, p. 27). Stephan Hawking is an example of somebody who has influenced many lives all over the world, without using a pen or pencil for the last decades of his life (Nelson et al., 2018). While this research advocates for children to be provided with every opportunity to become skilled at handwriting, it is important to recognise that each individual child will make use of the tools available to them, dependent on their learning needs.

The importance of handwriting is nonetheless reflected in society, which continues to assign much significance to reading and writing, despite the recent increase in technological advances both in the home and in the classroom (Graham, 2018). Handwriting is “an extremely versatile tool used to accomplish a variety of goals” (Graham, 2018, p. 4), including personal, social and cognitive accomplishments in schools and in a wider societal context (O’Mahony et al., 2008). The importance of handwriting is perhaps more visible than ever in light of the Covid-19 pandemic, when writing became a key mechanism for maintaining connection with family, friends and colleagues. The psychological and physiological benefits from writing have been documented (Smyth, 1998 as cited in Graham, 2018), with writing recognised as a tool to “combat loneliness” (p. 4). Furthermore, and possibly most significantly, handwriting allows for the telling of stories, for the creation of imaged worlds and for experiences to be shared and chronicled. Handwriting is “one of the most visceral means by which human beings leave tracks of their existence” (Nelson et al., 2018, p. 27).

Conversely, poor handwriting competence can lead to a host of difficulties with research by Graham et al (2018) indicating that children who do not learn to write and to read proficiently at primary level are more likely to become early school leavers, be unemployed or be in low skilled jobs and have poorer emotional and physical health.

1.3.1 Contribution of handwriting skills to school success

Problems with the mechanical aspects of handwriting can negatively influence the writing and academic performance of students in a numbers of ways in the classroom. Firstly, poor motor control will affect a child's ability to write legibly and result in incorrect size or placement of letters, inadequate pencil grip and slow handwriting speed (McGlashan et al., 2017). Research indicates that as a consequence of poor legibility, readers may be biased in their evaluation about the ideas and quality of a text (Santangelo & Graham, 2016) and written text may be less accessible to others (Graham, 1999). Good handwriting is still regarded by teachers as a sign of academic prowess (Santangelo & Graham, 2016) and a less legible version of a paper will be scored lower than a more legible one, according to research (Graham, 2018).

Secondly, poor motor skills and handwriting skills may impede children's writing efforts by interfering with other writing processes (Graham et al., 2008). Santangelo and Graham (2016) refer to the *Writer Effect*, which describes how handwriting "consumes an inordinate amount of cognitive resources" (p. 226) until it becomes a fluent and automatic skill. Graham (2018) points out that until children can produce letters with reasonable legibility and speed, their "concentration and effort is consumed with letter production" (p.3). Children experiencing fine motor difficulties are often fatigued by handwritten tasks in school and often take longer to complete their work (May-Benson et al., 2002). This means that they are likely to lose some writing ideas, as their handwriting is often not fast enough for them to record all of their ideas (Graham, 1999).

Finally, the effect of poor fine motor and handwriting skills on academic achievement is highlighted by the significant proportion of the day allocated to fine motor and written tasks in early years' settings (Cameron et al., 2012). Most learning activities in the classroom involve motor as well as cognitive components. Children's self-perception, self-esteem, and motivation are likely to be negatively impacted as a result (Piek et al., 2008; Gaul & Issartel, 2016). Children with strong fine motor skills on the other hand, have been found to demonstrate higher academic achievement, mathematical achievement and earlier development of reading (Van der Fels et al., 2015; Roebbers et al., 2014; Cameron et al., 2012; Grissmer et al., 2010). Research indicates that because handwriting tasks demand integration of the motor and visual processing systems, handwriting fosters children's early literacy skills (Neumann et al., 2012). Children showing competency in handwriting skills have more sophisticated letter knowledge, phonological awareness and spelling competence (Oberer et al., 2018) while children's word writing skills at the end of kindergarten have been used to predict children's literacy skills, including spelling, reading comprehension and oral reading, by the end of first grade (Oberer et al., 2018).

1.3.2 Handwriting in the age of technological advances

A review of literature revealed a number of factors that may have contributed to the current de-emphasis on the development of emergent handwriting skills in the classroom (Donica, Massengill, & Gooden, 2018; Min-Seo, 2018; Culligan, 2009). Noted is the historical absence of formal preschool education during a time when handwriting might have been considered an important subject in the primary school curriculum (Dinehart, 2014). Also highlighted is the focus for educators and researchers on the acquisition of language and reading skills (DES, 2011) and of course, the increasing use of technology (Dinehart, 2014). Graham (2018) documents the introduction of technology into the handwriting sphere with the arrival of the typewriter towards the end of the 19th century, followed by the personal computer

in the late 1970s. This advancement in technology meant that composition moved from writing by hand to typewriter to keyboarding and the 1990s saw “a significant increase in the use of computers and word processing” (Dinehart, 2014, p.104).

However, while digital tools became commonplace in the workplace and in the home, writing in both of these settings still involves the use of paper and pencil and handwriting is a basic tool used for accessing many subjects across the school curriculum (Graham, 2018). Research shows that children in the infant classrooms can spend up to 60% of the school day attending to tasks that involve motor skills, and 80% of their time completing drawing and writing based tasks (McHale & Cermak, 1992). Cutler and Graham (2008) reported that teachers in infant classes used computers less than once a month with preschool teachers reporting even less use of technology. A US survey of kindergarten fifth grade teachers indicated that students spend 24% to 58% of classroom time writing (Zachry et al., 2016). Factors contributing to the scarce use of technology in the classroom include limited access to developmentally appropriate tools (Wartella et al., 2010). Therefore, while technology offers alternative and effective routes for conveying ideas in text form, handwriting with paper and pencil remains the dominant form of written communication in schools.

1.3.3 Socio-economic disadvantage and handwriting skills

The original contribution of this study lies in its focus on the interplay between motor development, emergent handwriting skills of young children, and sociocultural influences. This study is significant because it intends to explore the sociocultural aspect of sensorimotor development and its influence on the development of emergent handwriting skills. A review of the literature indicates that lower socio-economic environments impact negatively on motor development (Lepes et al., 2016; Peterson & Nelson, 2003; Kiernan, Axford, Little, Murphy, Green, & Gormley, 2008). The acquisition of motor skill competence is a critical

developmental task of early childhood and occurs as a continuous, long-term process. Not all children are afforded equal opportunities for motor development in the early years however (Lepes et al., 2016), meaning that some children begin school with educational disadvantages. Lepes et al. (2016) highlight that upon school entry, children may be at differing stages of development and that this “disadvantage gap” (p. 89) cannot be bridged successfully by the school within the first few years. Failure in the first few years of school can lead to poor self-efficacy, low self-esteem and low academic achievement, leaving children at risk of early school leaving (Gonzalez-Rodriguez, Vieira, & Vidal, 2019). Furthermore, Lee-Corbin and Evans (as cited in O’ Mahoney et al., 2008) indicate that there is a link between handwriting and socio-economic status. A study by Peterson and Nelson (2003) on the efficacy of an occupational intervention on the printing of children with economic disadvantages found that an occupational intervention could enhance the printing of children from areas of socio-economic disadvantage. The study highlights a need for further research in relation to the efficacy of playful occupational forms in comparison to rote training.

The aim of this research study was to explore the interplay between young children’s sensorimotor development and their emergent handwriting skills. In particular, it focuses on how teachers employed a sensorimotor handwriting programme in the junior infant classroom to address the emergent handwriting needs of young children from disadvantaged communities. It was anticipated that by establishing links between levels of sensorimotor development of children, sociocultural influences and emergent handwriting skills, findings of this study might be significant for all educators. It was also anticipated that findings might prove to be valuable to teachers in providing opportunities to meet the developmental handwriting needs of young children, particularly those in DEIS schools. Findings may also be of assistance to policy makers in providing appropriate resources in their endeavour to combat a specific aspect of lower literacy levels; particularly to those in priority DEIS areas.

1.4 Positionality

Having graduated from St. Patrick's College of Education, I began my teaching journey in a DEIS junior boys school in north inner city Dublin. For the first 5 years there, I taught junior infants to first class and during this time became aware of the diverse learning and emotional and behavioural needs in a mainstream class setting.

During this period, I taught a first class group within which there were two boys attending a multi-disciplinary team for difficulties related to developmental delay and self-regulation. One of the boys was what the occupational therapist described as 'under-stimulated' and the other boy was described as 'over-stimulated'. The occupational therapist subsequently provided me with strategies to help both boys stay on task and 'alert' in class. What struck me at this time was the diversity of needs in the class and how individual and unique each boy was. While turning the lights down and providing a quiet room with little stimulus was beneficial to the learning of one boy, turning the lights up and having an array of visual and auditory stimulation was helpful to the other.

I subsequently became very interested in the area of sensory integration as I strove to meet those individual needs. Although supported by the Early Intervention team in the local area, I realised that the teacher was key to meeting the needs of each child and that I needed to upskill. I pursued a Master of Education in St. Patrick's College in the area of Educational Disadvantage. The focus of my thesis was on the use of in-class sensory integrative strategies for children with emotional and behavioural difficulties.

Following on from the M.Ed., I began teaching boys with additional learning needs in my school, including those with diagnoses of Developmental Coordination Disorder (DCD), Down Syndrome (DS) and Autism Spectrum Disorder (ASD). Those 6 years, teaching children who do not learn in a 'conventional' way, taught me so much about teaching. In fact, looking

back, I don't think I was 'teaching' at all in the mainstream classroom. I was perhaps delivering a programme, a curriculum.

Teaching children with additional needs provided me with a problem-solving task. The boys I endeavoured to teach did not respond to the methodologies and strategies I had become accustomed to using in the mainstream classroom. They did not respond to the level of verbal praise or reward systems I used in the mainstream classroom nor did they always cope with a typical school physical environment. So I had to think again. I had to devise individual programmes for the individual needs of each learner. When designing the sensorimotor programme for this research, I was cognisant of emphasising to the participating teachers that any programme should be adapted to meet the individual needs of the children, but that rigid adherence or fidelity to the programme was essential in the case of this research.

This new approach to teaching meant that I tried and tested a range of teaching strategies, took advice from experts in the area, for example, occupational therapists, speech and language therapists and psychologists. Some things worked and some things failed. All along, I maintained an interest in the area of sensory integration and motor development, which appeared a central and consistent feature in all of the boys' programmes.

I employed a range of sensorimotor strategies in my daily teaching with the boys, which I believed were effective and engaging. I used sensorimotor strategies to develop the motor skills of those boys who were at a pre-writing stage or who had delayed gross and fine motor development. Recalling the challenges that I faced in the mainstream class to meet individual needs, I observed that these strategies would be equally effective for classroom use to meet the needs of the 'typically developing' children who struggle with a range of curricular tasks, including handwriting.

In talking with teachers informally, I became aware of a limited range of strategies to enable them to manage poor motor skills in the classroom and/or to adapt the environment to meet a range of needs. At times I have noticed a lack of awareness of simple adaptations of tasks/differentiation that would enable children who were struggling with motor tasks such as handwriting in particular.

These observations and desire to assist teachers in delivering a sensorimotor programme to the boys we teach, led me to pursue this research study. I strongly believe in the professional capacity of teachers, in their professional commitment and their professional dedication to meeting the needs of the children they teach. I believe that, with some professional development in this area, they will be enabled to embed sensorimotor strategies into their everyday teaching and, in turn, meet the individual needs of the children.

I was therefore particularly interested in finding out what can be evidenced from a sensorimotor programme, both in terms of the classroom teacher's professional capacity to deliver the programme and perceptions of it and also the impact of the programme on the pre-writing and fine and gross motor skills development of young children, particularly those attending a DEIS school.

1.5 Overview of Chapters

Chapter one provided an introduction to this research and outlined the research questions and the overall design of the study. The significance of the study and the researcher's positionality were also detailed.

Chapter two describes the theoretical framework that informs this research. Bronfenbrenner's ecological and PPCT model are outlined and how they inform the study is explained. Piaget's (1974) sensorimotor theory of cognitive development and Ayres sensory

integration theory of information processing are also considered and how they support Bronfenbrenner's theory and further inform the research is described.

Chapter three is a review of literature relating to the research questions. Motor development in infancy and how motor development and handwriting development are intrinsically linked is explored. Environmental influences on motor development are considered including opportunities for physical play and quality early learning and care settings. The Aistear Framework and the Primary Language Curriculum are discussed in relation to motor development and handwriting, in particular, the time allocated to motor development in the infant classroom.

Chapter four outlines the methodology for this research. This research study employs a mixed-methods approach and the overall paradigm within which the research is conducted is a positivist paradigm, but it is also informed by interpretivism. Addressing the five research questions of the research required the use of a variety of methods which are both positivist and interpretivist in nature: the use of a standardised test of motor proficiency, semi-structured interviews and observation. This chapter also describes the analysis of quantitative and qualitative data.

Chapter five reports the quantitative findings from phase one and phase two study which involved the administration of the BOT-2 test to the 178 child participants across the six participating schools in order to determine: 1) an overall baseline measure of motor proficiency of junior infant children in DEIS and non-DEIS schools; 2) differences in motor proficiency of junior infant children in DEIS and non-DEIS schools.

Chapter six reports the qualitative findings from phase one and phase two study of the study. Semi-structured interviews with the participating teachers, post-implementation of the

programme, form the basis of the qualitative data. Qualitative findings are supported also by the field notes from conversations that took place during classroom observation days, training days and the testing periods in schools. An analysis of the qualitative data aimed to address the following research questions: 1) What pedagogical approaches should be included in a sensorimotor handwriting programme for junior infant children? 2) What supports do teachers require to be able to implement a sensorimotor handwriting programme effectively in a junior infant classroom? and 3) What are the effects of a sensorimotor handwriting programme on the development of fine and gross motor skills and emergent handwriting skills of junior infant children?

Chapter seven presents an integrated discussion of the quantitative and qualitative findings in relation to the five main research questions. Themes that emerged as a result of the qualitative analysis are discussed in light of the quantitative data and in the context of relevant literature in the area.

Chapter eight concludes this thesis by summarising the key findings from this research study. Recommendations for practice and for policy that emerged from an analysis of the data are outlined. The chapter closes with suggestions for future research and concluding comments on the research study.

CHAPTER TWO: THEORETICAL FRAMEWORK

2.1 Introduction

This study explores the interplay between young children's sensorimotor development and their emergent handwriting skills. In particular, it focuses on how teachers employed a sensorimotor handwriting programme in the junior infant classroom to address the emergent handwriting needs of young children from disadvantaged communities. In this way, this research aims to explore motor development and emergent handwriting skills of young children in the actual environment where development happens that is, the classroom, while taking into account a number of contextual factors that might also impact on motor development, including opportunities for physical outdoor play and the quality of early learning and care settings. This chapter will describe the key underpinning theories that inform the theoretical framework for this research, drawing on theories from the fields of child development and sensorimotor development.

The key theory that supports an understanding of these multiple and reciprocal influences on children's motor development is Bronfenbrenner's biological theory (Bronfenbrenner, 1979, 1988, 1992; Bronfenbrenner & Evans, 2000; Bronfenbrenner, 2005; Bronfenbrenner & Morris, 2006), specifically, his Process-Person-Context-Time (PPCT) model. Drawing on Bronfenbrenner's model provides a framework through which to view and to understand children's motor development in that wider sociocultural context and to highlight the sociocultural aspect of sensorimotor development.

Supporting this framework and offering a lens through which children's sensorimotor development could be considered, are Piaget's (1970) cognitivist approach to sensorimotor development and Ayres's (1964, 1972a, 1972b, 1974, 1989) information processing approach. Both these theories consider the interaction between the child and the environment as key to development, as well as the biological features of the child. Along with providing a theoretical

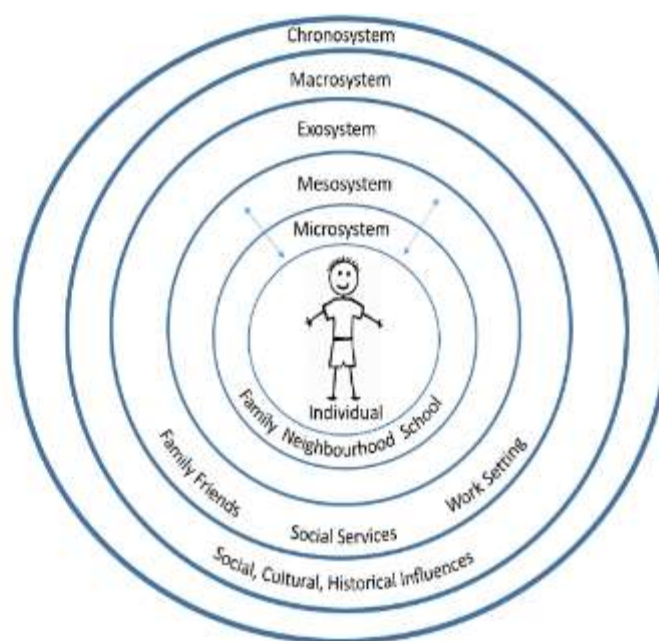
framework to support analysis of the research findings, these concepts offered a lens through which to review and evaluate existing literature.

2.2 Bronfenbrenner's Ecological Model

Bronfenbrenner's ecological systems model (1979, 1988, 1992, 2005; Bronfenbrenner & Morris, 2006) places the child at the centre of a system of reciprocal influences, represented as a set of concentric rings (Figure 2.1). He proposed that the individual, developing child is surrounded by layers of relationships similar to a set of Russian dolls (Leonard, 2011). Bronfenbrenner's theory (1979, 1988, 1992, 2005; Bronfenbrenner & Morris, 2006) hypothesised that it is impossible to fully understand a child's development without considering the environment and the interrelationships among the systems that have the potential to shape the individual. The relevance of this theory to the development of a comprehensive and holistic view of children's motor development is the necessity to consider the multilevel ecological contexts that interact with the changing biological characteristics of the child.

Figure 2.1

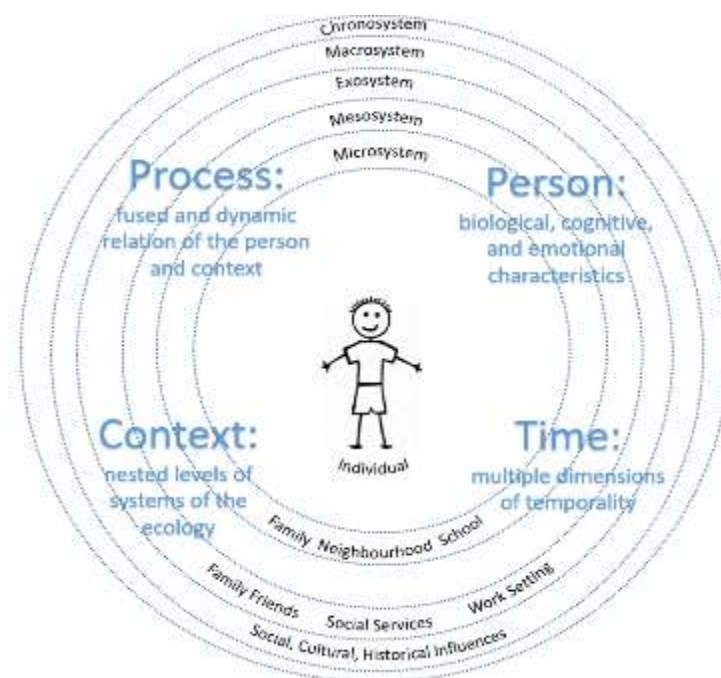
Bronfenbrenner's Ecological Model of Child Development (Bronfenbrenner, 1979)



Early versions of Bronfenbrenner's model (1979, 1988, 1992) did not explicitly focus on the biological aspects of the individual at the core in the same way that the later PPCT model does, although most writings implied that the environment and biology influenced development (Gabbard & Krebs, 2012). The model highlights the range of contexts that an individual may encounter as described by four distinct systems: the microsystem, mesosystem, exosystem, macrosystem. These systems reflect the environmental settings and relationships from the home, the community, and the culture within which an individual exists.

Figure 2.2

Bronfenbrenner's PPCT Model (Bronfenbrenner & Morris, 2006) fused with the Ecological Model of Child Development (Bronfenbrenner, 1979)



Bronfenbrenner proposed the chronosystem in earlier versions of the model (before 1995) to explain past influences of the other systems on the person for example, the longitudinal impact of parenting. Noting that the concept of time was predominantly viewed as being synonymous with chronological age, Bronfenbrenner designed the chronosystem to describe individuals not only according to age, but also with the aim of ordering and explaining

events in their historical sequence and context. This construct was later updated as noted above, and fused with the now popular Process-Person-Context-Time (PPCT) model (Figure 2.2) introduced in 1995 to form the biological model of human development. The PPCT model will be described in further detail later in this section.

The ecological model of human development (Bronfenbrenner 1993, 1994, 1995; Bronfenbrenner & Morris, 1998, 2006) consists of four environmental levels: the microsystem, the mesosystem, the exosystem, and the macrosystem. According to Bronfenbrenner, the microsystem, which represents Level 1, involves the immediate environment with which the child closely interacts such as the classroom, playground, home and neighbourhood. The most immediate and earliest influences are the family, including the specific culture with which the family identifies. In relation to this study, the microsystem relates to opportunities that caregivers provide for movement and the development of motor skills in physical environments. Formally, Bronfenbrenner (1979) defined the microsystem as “a pattern of activities, roles, and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics” (p. 22).

The mesosystem, represented as Level 2, refers to relations among micro-systems such as the relationship between family experiences and school experiences, between school experiences and neighbourhood experiences, and between family experiences and peer experiences. For instance, children who have negative school experiences might withdraw from their parents (family experiences) at home. The mesosystem was defined by Bronfenbrenner (1979) as “the interrelations among two or more settings in which the developing person actively participates (such as, for a child, the relations among home, school, and neighbourhood peer group: For an adult, among family, work, and social life)” (p. 25). In relation to this study, the mesosystem refers to how the school shares information with parents regarding their child’s motor development.

The exosystem then, which represents Level 3, is described as “one or more settings that do not involve the developing person as an active participant, but in which events occur that affect or are affected by, what happens in the setting containing the developing person” (Bronfenbrenner, 1979, p. 25). The exosystem therefore characterises links between a social setting in which the child does not necessarily interact with or have an active role and the child’s immediate context. For example, a child’s experience at home might be influenced by his or her mother or father’s experiences in the workplace or in the larger neighbourhood. In relation to this study, the exosystem relates to parental time and resources, employment status and education and how these factors influence the child’s opportunities for motor development.

Finally, the macrosystem, Level 4, according to Bronfenbrenner (1979), refers to consistencies in the form and content of lower-order systems (micro-, meso-, and exo-) that exist, or could exist, at the level of the subculture or the culture as a whole, along with any belief systems or ideology underlying such inconsistencies. The macro-system therefore, the highest level, involves the larger cultural context (e.g., society, community) surrounding the person. It includes societal belief systems, cultural norms, ideologies and laws that indirectly influence the person. Macro-systems are developed temporally, meaning that they evolve over time (Onwuegbuzie et al., 2017). In relation to this study, the macrosystem refers to differences in perceptions, beliefs and attitudes to motor development between DEIS schools and non-DEIS schools.

While this form of the ecological model of human development quickly became accepted and widely used by psychologists, teachers and sociologists as a framework within which to study development, Bronfenbrenner became aware of what he viewed as a critical flaw in the model. He wrote of “an instance of what might be called ‘the failure of success’” (1992/2005, p.107 as cited in Hayes, O’Toole & Halpenny, 2017). While he had previously strongly advocated taking sufficient account of the context within which development

occurred, Bronfenbrenner now observed “a surfeit of studies on context without development” (1992/2005, p. 108, as cited in Hayes et al., 2017). He warned that developmental psychology was now in danger of failing to recognise the influence of the developing individual, with an overemphasis instead on the specific systems of development.

This revision of his earlier work led Bronfenbrenner to reconsider the title of his model so that the individual would be foregrounded. Thus he defined the ecology of development as “the study of the progressive, mutual accommodation, *throughout the life course*, between an active, growing human being and the changing properties of the immediate settings in which the developing person lives, as this process is affected by the relations between those settings, and by the larger contexts in which the settings are embedded” (1992/2005, p. 107).

2.3 Process-Person-Context-Time Model

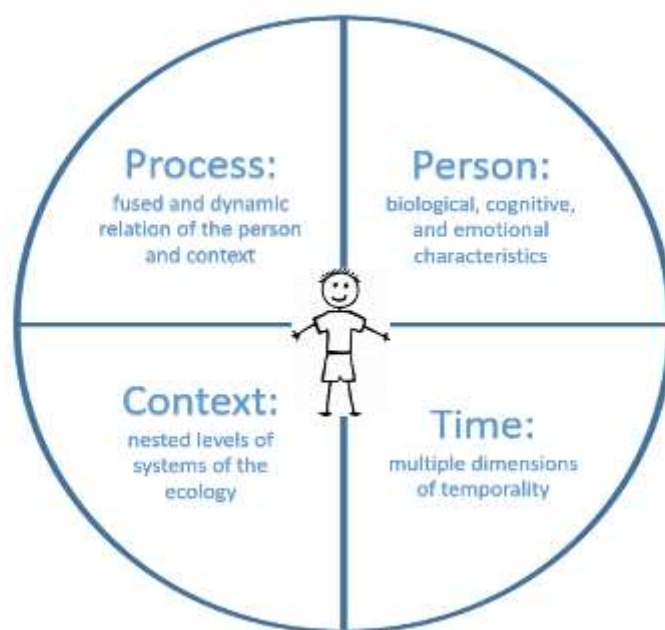
Bronfenbrenner’s biological model of human development (1979, 1988, 1992, 2005; Bronfenbrenner & Morris, 2006) recognised the need for a developmental framework within which to consider psychological theories of learning and of educational practice (Hayes et al., 2017). Such a framework required a level of complexity to include the variety of factors influencing learning while also enabling those factors to be considered and responded to in pedagogical practice, policy and learning. Criticisms of Bronfenbrenner’s early version of the model, the ecological model of human development (1979), included an over emphasis on context and a failure to take sufficient account of the influence of the developing individual.

The Person, Process, Context, Time (PPCT) model (Figure 2.3) which features in the most complete version of the biological model (Bronfenbrenner & Morris, 2006), focuses on the individual child in society. It allows for the analysis of emerging patterns of children’s motor development under the four categories. While the biological model in theory represents broad-based influences on human development and provides an option for studying human development, the PPCT model provides a more feasible research framework to focus on the

individual rather than broad-based influences. Furthermore, it enables the researcher to consider multiple factors that impact on motor development and allows analysis through the lenses provided by other theorists (O'Toole, 2016). The PPCT construct should be understood in terms of each element and in terms of their interaction (Bronfenbrenner & Morris, 2006).

Figure 2.3

Bronfenbrenner's Person, Process, Context, Time Model (2006)



Process: fused and dynamic relation of the person and context (Gabbard & Krebs, 2012).

Process refers to forms of interaction between individuals and the environment, called 'proximal processes', which operate over time and are considered as the primary mechanism producing human development (Gabbard & Krebs, 2012). According to Bronfenbrenner (1995, p. 620), human development occurs through processes of "complex reciprocal interaction between an active, evolving bio-psychological human organism and the persons, objects and symbols in its immediate environment". Within an educational context, process refers to any meaningful interaction that occurs frequently between teacher and child, parent and child or between children during play for example.

Person: biological, cognitive, and emotional characteristics (Gabbard & Krebs, 2012).

Proximal processes, as described above, are not unidirectional. Therefore, regarding interpersonal interaction, there should be ‘reciprocity of exchange’ (Bronfenbrenner & Morris, 1998). According to Bronfenbrenner (1989), the individual child is not viewed as a passive recipient of experiences within processes and contexts. The child is, rather, an active participant in his or her own development. The biological model posits the individual as one who is active in constructing settings through the actions they take within the constraints and opportunities of social and historical contexts. The impact of the bio-psychological characteristics of the person is two-fold. They are both the result of prior developmental processes as well as having a key role in shaping the individual’s future development (Bronfenbrenner, 1995; Bronfenbrenner & Morris, 1998, 2006).

Context: nested levels of systems of the ecology (Gabbard & Krebs, 2012).

While bio-psychological characteristics play a key role in the development of the individual, the environmental conditions that the individual experiences decide ultimately whether that person can achieve his or her full potential. In relation to this research study, this key construct of Bronfenbrenner’s biological model necessitates the investigation of environmental conditions which support or inhibit children’s motor development. This is despite Bronfenbrenner’s (Bronfenbrenner & Morris, 2006) expression of concern regarding the overemphasis on ‘context’ in the model, and his conclusion that one of the key successes of the theory was to move the study of child development towards a framework underpinned by ‘ecological validity’ (Bronfenbrenner, 1979).

Time: multiple dimensions of temporality (Gabbard & Krebs, 2012).

Bronfenbrenner and Morris (2006), refer to ‘time’ in relation to the form, content and direction of ‘proximal processes’ as being impacted by the “social continuities and changes

occurring over time through the life course and the historical period during which the person has lived” (p. 798). Time is featured within each of the levels of the biological model. Micro-time is concerned with the continuity versus the discontinuity of relationships at micro-system level. Meso-time is the duration of these episodes across broader time intervals, including days and weeks. Macro-time refers to societal changes, both within and across generations, as they impact and are impacted by processes and outcomes of human development, over the life course (Bronfenbrenner & Morris, 1998, 2006).

The PPCT model provides a framework within which to understand and study human development in its cross-cultural context and its historical context through analysis of the elements of ‘process’, ‘person’, ‘context’ and ‘time’. Consideration of the four elements as an interrelated system provides a lens through which the researcher can consider the development of the child not in isolation of any of the elements, but rather understanding that actions in any one part of the system influence all of the other parts. The PPCT model provided a framework for this study therefore, to attend to the elements of process, person, context and time. Data generation techniques were chosen and applied with the aim of capturing the dynamics of these interrelated systems and the interactions with the developing child. The following section will describe the two sensorimotor theories that support Bronfenbrenner’s ecological model and further inform the theoretical framework for this study.

2.4 Ayres: An Information Processing Theory of Development

Much of the existing literature on sensory integration theory stems from the original concepts pioneered by A. Jean Ayres (1964, 1972a, 1972b, 1974, 1989). Ayres trained as an occupational therapist and later as an educational psychologist. Her work in these fields therefore allowed her access to clinical observations of children who displayed perceptual, sensory, and motor difficulties. Through hypothesis, Ayres (1964, 1972a, 1972b, 1974, 1989) deduced that because the brain is responsible for learning, learning disorders therefore reflect

some irregularity in neural functions. It was these observations and this hypothesis that prompted Ayres to develop a model of sensory integration, based on principles from neuroscience, biology, psychology and education. The model was designed to illustrate the potential relationships between the neural processes of receiving, modulating, and integrating sensory input and the resulting output: successful adaptive responses (Schaff & Millar, 2005).

Adaptive responses can be defined as accurate and purposeful motor reactions produced from a sensory experience (Ayres, 1964, 1972a, 1972b, 1974, 1989). The body must be able to adapt to changes that occur within the body as well as with the objects with which the infant interacts, for example, an infant taking a drink from a bottle because he/she feels thirsty. It is through adaptive responses that the infant learns and develops. A well-established adaptive response therefore allows the brain to develop and become more organised. Throughout early childhood, adaptive responses are largely motor-orientated. The child receives information from the objects with which he/she interacts and produces motor actions to accommodate these sensations. As the child continues to grow and develop however, cognitive and social responses become more prevalent, replacing many of the sensorimotor processes. It is important to note that the cognitive/social responses only develop as a result of the underlying sensorimotor responses being well established (Crater, 2008).

Sensory integration can be defined as the organisation of senses for use (Ayres, 1964, 1972a, 1972b, 1974, 1989). The senses (auditory, olfactory, visual, tactile, taste, vestibular, proprioceptive) provide the body with information about the surrounding environment. Sensory stimuli are constantly entering the brain at a rapid pace and the brain therefore must be able to organise and discriminate among the various sensations in order to function efficiently. Sensory integration allows the body to be aware of different sensations stemming from the same experience and to experience things as a whole, without much conscious awareness. Sensations are experienced through a series of electrical impulses as well as the

involvement of biochemicals. A stimulus, for example, a sweet smell, is sent to a receptor which in turn sends impulses which retain information received from the stimulus to higher levels of the central nervous system. Here, the impulses combine with the relevant knowledge or experiences in the long-term memory which in turn provides conscious awareness of the original stimuli (Eysenck & Keane, 2006).

Each of the sensory systems (Figure 2.4) has a specific role in sensory processing and often systems are complex and influence other sensory systems. The table below presents a brief summary of five of the major sensory systems, their roles within the body and their impact on other systems. Ayres's sensory integration theory is underpinned by four key principles (Schaff & Millar, 2005) that support Bronfenbrenner's PPCT model and further inform this theoretical framework.

Figure 2.4

Sensory systems and the role they play in the body (Ayres, 1974)

Sensory System	Role – enables the child to:
Proprioceptive 	• Sense the direction and speed of movement • Gauge the amount of effort required to pick up an object • Be aware of the orientation of the body, timing movements, and the amount of force to exert through a writing tool
Tactile 	• Discrimination between pain, temperature and other types of subtle touch such as a tickle and an itch
Vestibular 	• Detect motion, primarily acceleration, deceleration and gravitational pull • Develop body scheme, postural responses
Auditory 	• Process sound waves • Develop language • Differentiate parameters of sound such as direction, frequency, intensity and sequence
Visual 	• Navigate the environment, judge the speed and distance of objects and to recognise people and objects as being familiar

1. Sensorimotor development is an important substrate for learning

Sensory integration theory proposes that adequate processing and integration of sensory information is a vital prerequisite for adaptive behaviour, which subsequently provides the necessary basis for independence and the capacity for individuals to participate in daily activities, play and school tasks. It assumes that higher levels of cognition and motor functions such as language and handwriting develop post sensory integration improvements for the child.

Sensory integration improvements may happen across a range of domains. For example, the integration of the auditory and vestibular senses results in the development of speech and language while the integration of vestibular and proprioceptive senses results in eye movements, posture, balance, muscle tone, and gravitational security. Body perception, coordination of two sides of the body, motor planning, activity level, attention span, and emotional stability result from the integration of vestibular, proprioceptive, and tactile senses. All of the senses together are required for the end products of concentration, organization, self-esteem, self-control, self-confidence, academic learning, abstract thought and reasoning, and specialization of each side of the body and the brain (Ayres, 1964, 1972a, 1972b, 1974, 1989).

Ayres, (1964, 1972a, 1972b, 1974, 1989) describes how, for most children, sensory integration happens naturally and subconsciously, “just as we take our heartbeat and digestion for granted” (p.3). As experiences build up in the long-term memory, children learn how to respond to and cope with various stimuli in their environments. However, sensory integration theory outlines that some children with learning disorders experience difficulty processing and integrating sensory information, which in turn affects behaviour, learning and motor development, thus inhibiting the ability to cope with their environments. Ayres predicted that behaviour and learning problems stemmed partly from defective integration of sensory information and “inability of higher centres to control and regulate lower brain sensorimotor centres” (Ayres, 1964, 1972a, 1972b, 1974, 1989; Schaff & Millar, 2005).

2. The interaction between the individual and the environment shapes brain development

The development of sensory integration is initiated in the womb, as an embryo, when the foetal brain detects the movement of the mother’s body (Ayres, 1964, 1972a, 1972b, 1974, 1989). Throughout the first year of life, a huge amount of sensory integration must occur in order for the child to meet developmental motor milestones such as crawling, standing and walking. Typical early childhood play provides the many sensory experiences that are essential

for the development of sensorimotor integration. Information is taken from the environment and each child is different regarding how well the nervous system processes the information received. Early years' experiences and interaction with the environment are therefore crucial in the development of sensory integration. Sensory integration cannot happen without active engagement and exposure to a vast range of sensory stimuli in the environment. With poor sensory integration, children will experience difficulty in reaching their developmental milestones, such as crawling, walking and standing (Ayres, 1964, 1972a, 1972b, 1974, 1989).

3. The central nervous system is capable of change as a result of its plasticity

Ayres's theory as outlined above, draws not only on principles from education, developmental psychology and occupational therapy, but also from neurobiology. Her theory proposes that sensory integration therapy, which can be understood as the implementation of therapy to modify a response to a stimulus is based on the principle that the central nervous system is capable of change. Ayres further hypothesises that meaningful sensorimotor activity has the potential to act as a mediator of plasticity or change.

While further evidence compounding the complexity of the central nervous system has evolved since Ayres's original hypothesis was formed, many of the principles that Ayres built her theories on are still held in high regard (Schaff & Millar, 2005). Many practitioners, most of whom are occupational therapists, continue to use sensory integration therapy as an intervention. The overall aim of these interventions is to enhance the child's ability to participate in daily activities which are meaningful for that child in their natural environment (Pfeiffer, 2015).

4. Meaningful sensorimotor activity is a powerful mediator of plasticity

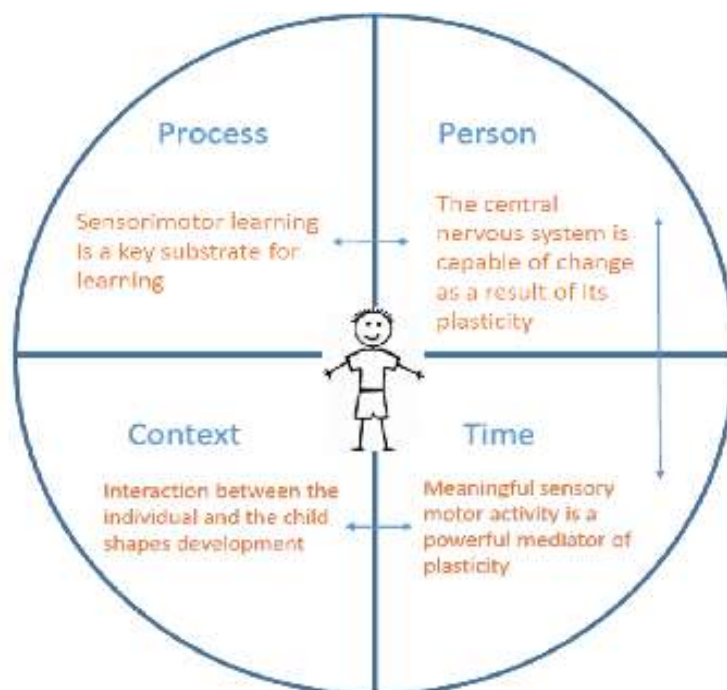
Ayres's theory of sensory integration therapy is widely used by occupational therapists, its main aim being to improve the child's capacity to partake in functional daily tasks. Sensory integration therapy involves repeated exposure to enhanced sensory experiences that can alter

the nervous system so that the sensory system responds in a more organised way. Ayres believes that higher levels of cognitive and motor functioning are dependent on good sensory integration.

Ayres' principles of sensory integration inform the theoretical framework for this study in relation to the pivotal role that the environment plays in the development of the sensory systems. Early learning experiences and the environment, in which they occur for children in the home or in the preschool for example, are recognised as key in developing the sensory systems necessary for learning and development to occur. A rich and stimulating learning environment is critical in the promoting sensory integration which precedes motor development. The environment (home or preschool or school) should be purposefully designed to provide appropriate challenges for development, learning and sensory integration to occur.

Figure 2.5

The interrelationship of the key principles of Ayres's sensory



The following section will describe Piaget's (1928, 1930, 1956, 1952, 1960, 1974) sensorimotor stage of cognitive development and outline how it supports Bronfenbrenner's PPCT model and further informs this theoretical framework.

2.5 Piaget: A Cognitive Approach to Development

Piaget's research (1928, 1930, 1956, 1952, 1960, 1974) divides intellectual development into four major periods (Table 2.1): sensorimotor (birth to 2 years); pre-operational (2 years to 7 years); concrete operational (7 years to 11 years); and formal operational (11 years and over).

Table 2.1

Piaget's Stages of Sensorimotor Development

Typical Age Range	Description of Stage	Development Phenomena
Birth to 2 years	<i>Sensorimotor</i> Experiencing the world through senses and actions (looking, hearing, touching, mouthing, grasping)	• Object permanence • Stranger anxiety
2 years to 7 years	<i>Preoperational</i> Representing things with words and images; using intuitive rather than logical reasoning	• Pretend play • Egocentrism
7 years to 11 years	<i>Concrete operational</i> Thinking logically about concrete events; grasping concrete analogies and performing arithmetical operations	• Conservation • Mathematical transformations
11 years and over	<i>Formal operational</i> Abstract reasoning	• Abstract logic • Potential for mature moral reasoning

This section will focus on the first of these periods in particular, that is the sensorimotor stage, which occurs during infancy. The sensorimotor stage is in turn divided into six substages, which are illustrated in Table 2.2 below.

Table 2.2

Substages of Sensorimotor Development (1952, 1954)

Sensorimotor Substages		Characteristics of Development
Reflexive Schemes		
(0-1 month)		New-born begins to develop reflexes
Primary circular reactions		
(4 months to 8 months)		Infant begins to develop simple motor functions. Infant cannot yet anticipate events.
Secondary circular reactions		
(8 to 12 months)		Infant begins to imitate familiar behaviours. Infant demonstrates repetitive behaviours that create interesting effects.
Tertiary Secondary Reactions		
(12 to 18 months)		Infant's understanding of object permanence matures. Rather than just repeating actions, the infant will appear to explore objects to observe the consequences
Representational thought		
(18 to 24 months)		Infant engages in imaginative play and develops basic problem-solving. Infant demonstrates symbolic thought.

Piaget describes the new-born infant during the sensorimotor stage as one who quickly learns to distinguish among various factors in the environment and to modify his or her behaviour according to the demands of that environment. He outlines the progressive development of sensorimotor schemata and the mechanism of adaption, through assimilation and accommodation, which leads to the first forms of thought and expression.

The first sub-stage of sensorimotor development, Piaget identifies, is the reflex stage (1952). Contrary to common assumption, Piaget describes the new-born as one who is not completely helpless, but who arrives into the world with innate skills and patterns of behaviour displayed immediately after birth, referred to by Piaget as *specific heredity* (1952). Specific heredity can be viewed in terms of inherited physical structures and automatic behavioural reactions or reflexes. Reflexes, described by Piaget (1952) as “the very morphology of the organs with which they are connected” (p. 14), provide anticipatory knowledge of the external environment. The knowledge they provide is instinctive and essential to the later development of intelligence. Innate reflexes occur when environmental stimuli cause the organism to respond with a specific behaviour. The basis for the automatic response is an inherited physical mechanism which the stimulus activates, thus producing the automatic behavioural response.

While observing the behaviour of his own three infants, Piaget first found evidence of the infants’ capacity to organise information through the development of habitual actions (Piaget, 1952). Very soon after birth, each infant sought with its mouth anything which made contact with its lips, and grasped any object which touched the palm of the hand. These reflex behaviours are unconscious; the infant does not need to be taught an elementary sucking response. These well-defined sequences of actions led Piaget to conceptualise a schema: an organised unit of knowledge, which is frequently repeated and which can be easily distinguished from other behaviours.

In describing the sucking response, Piaget outlines how the sucking reflex, among others, is not activated by external stimuli but instead is initiated by the new-born. In addition, he observes that although the child may be equipped with functions such as sucking reflex from birth, life experience and environment play a crucial role in modifying and supplementing the inherited mechanisms. In the case of Laurent, Piaget's son, Piaget observed that the tendency to grasp, an innate schema, soon developed into a habit of clasping and unclasping his hands (Piaget, 1952). Similarly, the inherited reflex to suck may develop into a habit of thumb-sucking, whereby the infant regularly brings his hand to his mouth. While the sucking reflex is inherited, the infant has learned through interaction with his or her environment, the organised pattern of behaviour of sucking the thumb. In this way, the child develops knowledge of his or her environment in relation to actions, objects and theoretical concepts. Inherited mechanisms therefore, that Piaget refers to as *schemas*, have the capacity to grow and evolve through the processes of assimilation and accommodation.

The principle of functional assimilation assumes that when an organism has a basic structure available, there is a tendency to exercise the structure in order to make it function. The sucking reflex, regardless of its automaticity "needs to be used in order to truly adapt itself" with "gradual accommodation to external reality" (Piaget, 1952, p. 29). Piaget's observation of Laurent sucking for non-nutritive purposes represents this tendency for the sucking reflex to practice itself (p. 25-26). Laurent did not suck because he was hungry or because an external stimulus had activated the response, he sucked because there is a tendency for available schemas like sucking to function.

Generalising assimilation describes how the sucking schema tends to extend itself to a variety of objects, for example a finger or a blanket. In conceptualising generalising assimilation, activity on the part of the infant is highlighted. The sucking reflex is not merely automated by an external stimulus, rather the infant, in seeking to exercise the schema, actively

searches out objects which will allow it to function. Thus the two key principles, functional and generalising assimilation, are dynamic. They instigate the new-born's behaviour. New-borns, through their actions, are presented with opportunities to learn about the environment, which in turn, allows for the sucking reflex to become modified or differentiated.

Piaget (1952) describes Laurent (p. 26), in the first month of infancy, as demonstrating what he refers to as *recognitory assimilation*. The observation describes how Laurent adjusts his mouth in search of the nipple after sucking the skin for a moment. Recognitory assimilation is described by Piaget (1952, p.35), as an infant's ability to discriminate or select objects to suck; similar to an adult's ability to 'recognise' objects. He proposes that the infant rather, can *perceive* the difference between the nipple and other things (1952, p.36). Piaget hypothesises that in generalising the sucking schema, the infant will come into contact with a variety of stimuli, some visual, some tactile-kinaesthetic and some postural. In doing so, the infant builds up repetitious experiences through an exploration of his or her environment and perceptual learning subsequently occurs. Schemata that the infant already possesses combine in a new way so that the infant can perceive a solution to a problem by the recall of absent objects.

Piaget's sensorimotor development theory informs this framework in relation to the role that early movement responses and reflexes play in motor development. The environment is again, recognised as having a pivotal role in providing the stimuli for the child to develop and learn. While Bronfenbrenner studied development from an ecological perspective, Piaget's research is grounded in biological and psychological theory. He strove to highlight the dynamic and social nature of development and emphasised the importance of family support and early childhood education. Bronfenbrenner highlighted the influence of urbanisation on children's development and the impact on development for children who spent significant periods of time in care (Hayes et al., 2017). In contrast to Piaget and Ayres, Bronfenbrenner viewed development as the responsibility of the entire society rather than as a result of the synthesis of

biological and psychological theories. By drawing on all three theorists therefore, this research is guided by a theoretical framework that takes into account the biological (physiological) and the psychological (cognitive) features of the child and sociological (ecological) influences on development.

2.6 Conclusion

This chapter set out to explore the suitability and potential of Bronfenbrenner's PPCT model of human development as a framework within which psychological theories of motor development, learning and educational practice can be integrated and considered. Piaget's cognitive approach to development and Ayres' information processing approach supported this framework and provided a lens through which the motor development of children could be considered. Ayres' theory of sensory integration and Piaget's sensorimotor stages of development are described in some detail. The interrelationship of the key principles from all three of those theories was outlined. A theoretical framework therefore was developed that provided the researcher with a lens within which to view, to research and to understand children's motor development in a wider sociocultural context and to highlight the sociocultural aspect of sensorimotor development. The following chapter will present the relevant literature reviewed as part of this research study.

CHAPTER THREE: LITERATURE REVIEW

3.1 Selection and Search Procedure

The literature review is based on a search using the following terms: motor development, motor skills, movement, fine motor skills, gross motor skills, visual processing, visual integration, handwriting development, early childhood education, educational disadvantage, environmental influences, urbanisation, professional development, professional learning communities and cross referencing of the terms curriculum, pedagogy, teaching methods, interventions with handwriting and with motor development. Publications that appeared from 2008 onwards were considered and seminal texts outside of this time frame were also considered. Databases including EBSCO and ERIC were searched for articles published in refereed journals on motor development and handwriting development in early childhood. While not peer-reviewed, the LEARN Journal of the Irish Learning Support Association and the REACH Journal of Special Needs Education in Ireland were searched electronically for articles pertaining to motor development and handwriting development for students in primary education in Ireland. Meta-analyses addressing handwriting development (Santangelo & Graham, 2015) and motor development (Barnett et al., 2016; Pless & Carlsson, 2000) were used to locate primary sources. A number of books (Goodway, Oznum, & Gallahue 2021; Graham et al., 2018), with titles that appeared relevant to this study were used to further signpost research papers in the areas of motor development and handwriting development. Finally, websites of the DES, the INTO, the NCCA, the SESS, the NCSE, the Dublin North East Inner City, the Growing Up in Ireland and Citizens Information were utilised in seeking statistical information, as well as policy documentation.

Articles were included if they fulfilled at least one of the following criteria:

- The articles reported on research investigating educational practices in relation to motor development or handwriting development where research:

1. was conducted with children in the early years (0-6 years);
 2. explored the efficacy of a handwriting intervention or programme that was implemented with young children (0-6 years).
 3. Explored the mechanical or motor aspect of handwriting development
- The articles reported on research exploring the environmental influences on motor development in the early years;
 - The articles related to the professional development of teachers and the development of professional learning communities

Research papers in the resultant collection were categorised into one of four categories 1) motor development 2) handwriting instruction 3) environmental influences on motor development and 4) professional learning communities. Theoretical texts of Bronfenbrenner, Piaget and Ayres were drawn upon to inform the theoretical framework reported in the previous chapter.

3.2 Introduction

This research study grew out of a conviction that arose when teaching infant children in a DEIS school. The hypothesis that underpins this literature review is that children in areas of lower socio-economic status enter school with lower levels of motor proficiency which impacts their ability to access emergent handwriting instruction. The teachers' knowledge and practice in relation to motor development and emergent handwriting and how they implemented a sensorimotor handwriting programme, is also a central feature of this thesis.

This chapter is presented in four parts. First, motor development in infancy and the role of motor proficiency in preparing children to write is considered. Secondly, environmental factors that influence motor development are examined. Next, motor development across the Primary Curriculum is explored. Finally, professional learning communities and how teachers acquire knowledge to change practice is discussed.

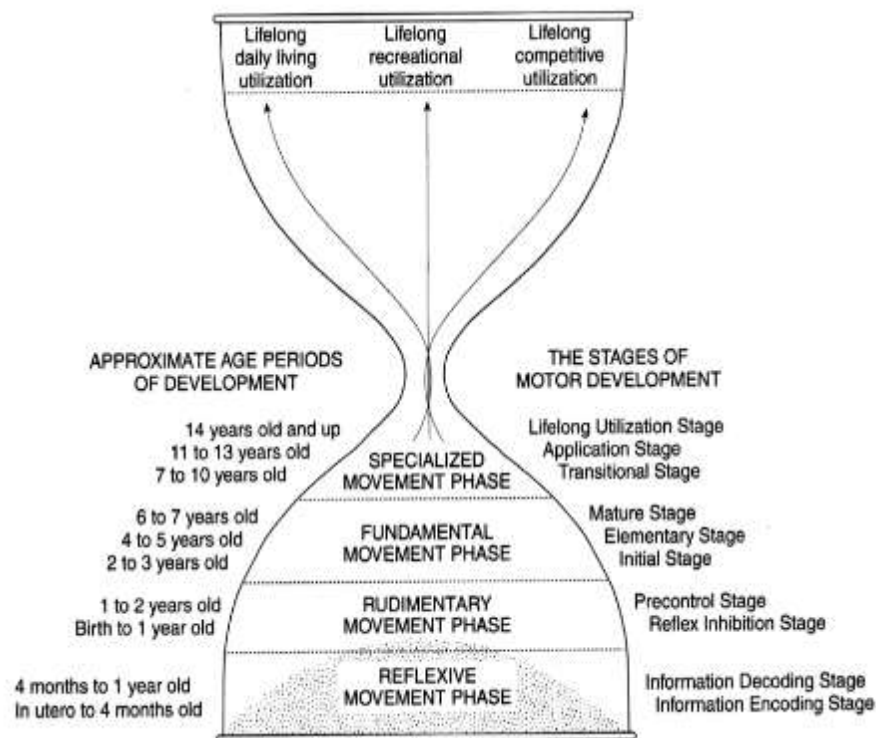
3.3 Preparing for Writing

Handwriting is a complex process and the preparation for handwriting is dependent on a number of components of motor proficiency. The acquisition of motor proficiency is a critical developmental task of early childhood (Lepes et al., 2016). Motor development is a continuous process of modification that involves the interactions of several features. These include neuromuscular maturation, the physical growth and behavioural characteristics of the child, the tempo of physical growth, biological maturation and behavioural development, the residual effects of prior movement experiences and new movement experiences (Gallahue & Ozmun, 2006; Malina, 2003). Motor development occurs in the context of the physical and sociocultural contexts within which a child is reared, and the environmental experiences that interact with the biological features of the child influence motor development and proficiency (Malina, 2003).

Handwriting development in the early years is inextricably linked to children's motor proficiency (Bara et al., 2015; Cameron et al., 2012; Feder & Majnemer, 2007; Gaul & Issartel, 2015; Graham et al., 2008; Grissmer et al., 2010; Lepes et al., 2016; McGlashan et al., 2017; Roebbers et al., 2014; Santangelo & Graham, 2016; Santangelo, 2015; Suggate et al., 2016; Van der Fels et al., 2016). The common performance components (Teodorescu & Addy, 2001; Addy, 1996) of handwriting as in legibility, spacing, letter size, slant, page alignment and formation - depend on early movement responses, spatial orientation and the development of fine and gross motor skills, as well as integration of the various sensorimotor systems as described in Chapter 2 (Ayres 1964, 1972a, 1972b, 1974, 1989; Lamme, 1979; Alston & Taylor, 1987). The following sections will outline how early movement responses, spatial orientation and the development of fine and gross motor skills influence the development of handwriting skills.

Figure 3.1

Phases of Motor Development (Gallahue & Ozmun, 2006)



3.3.1 Early Movement Responses

The motor responses of the new-born infant are extensions of those established during foetal life (Malina, 2003). They exist as reflexes that are either present at birth or appear during infancy. Infant reflexes are commonly categorised as being either primitive (feeding, grasp reflex) or postural (pull-up, tonic neck) (Malina, 2003). Primitive reflexes are well developed between birth and 3 months of age and subsequently begin to reduce in their intensity. They are involuntary movements that are triggered by external stimuli and are characterised by a short reaction time between the stimulus and the response. The role of the primitive reflexes is to protect the infant during the first crucial years of life.

Postural reflexes help to maintain posture in the changing environment after birth. They begin to emerge at about 3 months of age and increase in intensity of response throughout infancy. As a new-born, the infant possesses no means of locomotion. Instead locomotor

reflexes are present (Malina, 2003). Locomotor reflexes are certain responses that resemble later voluntary movements. Included among these locomotor reflexes are responses similar to standing, crawling and stepping. As the central nervous system of the infant matures, inhibitory functions of the cerebral cortex begin to function and reflex movements are gradually inhibited by higher brain centres and are integrated into developing movement patterns as the higher brain centres are differentiated (Feder, 2004). The reflexes of infancy represent the immaturity of the developing nervous system and the retention of certain reflexes can be indicative of neurological disorders (Malina, 2003).

In order for motor proficiency to develop, “most children need to have integrated the early movement responses (primal reflexes) which have supported the body in the womb and during the first months after birth” (McAllen, 2008, p. 93). As children progress through the innate developmental movement phases, they begin to develop coordination and are enabled to exert more control over their movement. The primitive and immature reflexive movements are no longer evident as the child acquires motor control. This occurs as a result of the primary reflexes being “integrated” into the central nervous system (McAllen, 2008, p. 93). For the child for whom this integration does not happen, immature movement patterns are likely to persist. These uncontrolled and uncoordinated movements can impact on the school-aged child and on their ability to develop handwriting skills (McPhilips & Jordan-Black, 2007; McAllen, 2008).

The asymmetric tonic neck reflex (ATNR) and the symmetric tonic neck reflex (STNR) are the primal reflexes that interfere with handwriting development if they are not fully integrated at the appropriate phase of development (McAllen, 2008, p. 94). The ATNR is stimulated by a sideways turning of the head and the response involves extension of the arm and of the leg on one side to which the head turns and bending of the opposing limbs (McPhilips & Sheehy, 2004). McAllen (2008) describes the movement pattern of a child for whom subtle

retention of the ATNR reflex has occurred. The sitting position of the child as he/she writes often shows the child sitting on the left leg or drawing it back to wrap around the leg of the chair, while the left arm is bent on the desk and the head is lowered to the arm as he/she writes. The paper is pushed to the top or to the right of the desk so that the writing hand is pushed out as far as possible. This incorrect sitting position for writing can cause the child to experience fatigue and muscular distortions which impact the movement response to eye-hand coordination (McAllen, 2008).

Children for whom the ATNR persists are likely to encounter fine and gross motor control problems (McPhilips & Sheehy, 2004). The persistence of the ATNR can affect the development of gross motor skills or fundamental movement skills such as rolling, crawling, riding a bike and catching and throwing a ball (Jordan-Black, 2005). As the ATNR becomes inhibited, symmetrical movements become possible (McPhilips & Sheehy, 2004). This means that children can transfer objects across the midline which is a significant and critical motor milestone in terms of handwriting development. The midline is an invisible line down the centre of the body, enabling young children to develop both the left and right sides of their bodies. Young children will pick up an object on the right side of the body with the right hand and an object on the left side with the left hand. The child does not easily cross over the body (McAllen, 2008). While the transference of objects across the midline usually occurs between 6 to 8 months after birth (Holt, 1991 as cited in McPhilips & Sheehy, 2004), the vertical midline barrier is typically not fully integrated until the child is seven years of age (McAllen, 2008). The retention of the midline barrier means that upon entry into school, the child may position his/her paper to the far side of the desk so that it is over to one side of the midline (McAllen, 2008). For the school-age child this might present as poor pencil grip or difficulty in maintaining a flexed elbow when writing or drawing, as a result of the ATNR causing 'extensor tonus' in the arm that the child uses to hold the pencil. The child may have to use more effort

than is typical and experience excessive tension leading to muscular fatigue in the writing arm and poor motor control (McPhilips & Sheehy, 2004). Reading, an essential part of the writing process, may also be impacted by the retention of the midline barrier. Typically, the eyes must cross the midline when reading (McPhilips & Sheehy, 2004). McAllen (2008) describes how the eyes might “jerk” (p.95) when crossing the midline causing the eyes to return to the line below or to return to the start of the same line again.

Children from areas of lower socio-economic status may be more at risk of primary reflex retention (McPhilips & Jordan-Black, 2007). A study in Northern Ireland investigated the effects of social disadvantage on motor development and the persistence of the ATNR in young children attending mainstream primary school (McPhilips & Jordan-Black, 2007). Four primary schools from the Belfast and Lisburn districts were selected using a ranking system, The Northern Ireland Multiple Deprivation Measure. This measure includes a number of indicators of socioeconomic status including levels of family income, employment, education, living environment and health. Areas are ranked from 1 (most deprived) to 582 (least deprived). Two schools were selected from the areas ranked at 503 (80%-90%) and 574 (in the top 10%) and 2 schools from areas ranked 20 and 21 (in the bottom 10%). The study included two year groups - Year 1 and Year 4 in all four schools. Year 1 children were tested individually on standardised tests of motor skills and receptive language. Year 4 children were tested individually on standardised tests of motor skills, receptive language and reading. The children in this group also completed a diagnostic test for the persistence of the primary reflex, the ATNR. The Movement ABC, a standardised, individually administered test battery was used to assess motor skills and is suitable for children as young as 4 years of age. The Schilder Test (Morrison, 1985) was used to assess for persistence of the ATNR in the children in Year 4 as it is only suitable for children ages eight years or over.

Key findings from the study showed that social disadvantage has a powerful negative effect on the emergent motor skills in children aged between 5 years and 8 years of age and that children from socially disadvantaged backgrounds are at particular risk of primary reflex (ATNR) persistence. Acknowledging limitation of sample size, nonetheless, finding indicates that social disadvantage may directly affect the maturation of an early neurological system, which is known to be a fundamental neurological substrate of early motor development (Holt, 1991). These findings are significant in terms of this research study, which explores the motor development of junior infants in DEIS and non-DEIS schools.

3.3.2 *Spatial Orientation and Visual-Motor Integration*

Open space invites the child to move (McAllen, 2008). As soon as a child can walk, “one of his first impulses is to experience his movements in space and to leave his imprint upon it” (McAllen, 2008, p.7). Spatial awareness is a key prerequisite of handwriting development, enabling children to first experience shape and space through their own movement and through their own bodies. Through early mark making and scribbling, children explore a range of movements and shapes, with patterns and dots and zig-zag lines. McAllen (2008) describes a piece of paper for the child as a space to “exercise the sense of his own movement” (p.8). This early stage of mark making is essential in laying the foundations for handwriting development as the child develops a growing awareness of space and his/her place within it.

Another key foundation for handwriting development in young children is the development of visual-perception skills (Taverna, Tremolada, Dozza, Scaretti, Ulrike, Lallo, & Tosetto, 2020; Maldarellie, Kahrs, Hunt, & Lockman, 2015). Visual-perception is the process whereby the brain extracts and organises information, giving meaning to what we see (Ayres, 1964, 1972a, 1972b, 1974, 1989). Visual-perception skills are dependent on sensory processing skills which involve accurate registration, interpretation and response to sensory stimulation in the environment and the child’s own body (Ayres 1964. 1972a, 1972b, 1974,

1989). There are many components of visual processing which work together to assign meaning to what the child sees. These include eye-hand coordination, visual discrimination, form constancy, visual memory and visual-sequential memory (Cornhill & Casesmith, 1996; Chapman & Wedell, 1972). These terms are described further in table 3.1 below.

Table 3.1

The role of visual processing skills in relation to handwriting development

Visual Processing Skill	Role
Visual Discrimination	Visual discrimination is the ability to classify objects or shapes based on visual information such as colour, form, pattern, size or position. In handwriting, children need to be aware of common characteristics as well as subtle differences that distinguish letters and words.
Visual Closure	Visual closure is the ability to process visual information when the object or word is partially hidden. In handwriting, this may affect letter formation and spelling words.
Form Constancy	Form constancy is the ability to identify an object, shape, letter, number or symbol when it is presented in a different way (e.g. larger, smaller, rotated, italics, bold, different font, sideways, upside down, different colour)
Visual Sequential-Memory	Visual sequential-memory refers to the ability to recall a sequence of objects in the correct order.

The coordination of fine motor skills and visual-perception skills (visual-motor integration) is necessary for the production of legible handwriting (Taverna et al., 2020). Visual-motor integration is described as “the degree to which finger-hand movements are well coordinated” (Beery & Beery, 2006, p.12). Visual-motor integration plays a key role in enabling children to perform functional daily tasks as well as education-related activities including handwriting (Lim, Tan, Koh, Guo, Yusoff, See, & Tan, 2014).

Research suggests that visual-motor integration is strongly correlated to handwriting readiness among preschool age children (Lim et al., 2014). The ability to form letters with consistent letter size, proportions and spacing is dependent on visual-motor integration (O’Connor, 2012). The visual component enables children to discriminate letter shape to recognise each letter’s specific characteristics and to identify their orientation. The motor element allows the child to carry out the necessary sequence of movements to form the letter. Studies have found visual-motor integration to be one of the most significant predictors of handwriting performance, with strong correlations documented between visual-motor integration and writing legibility (Pfeiffer et al., 2015). The results of longitudinal studies exploring the relationships between visual-motor skills and academic achievement suggest that academic tasks demand children to be able to process visual cues, perceive spatial relations and integrate visual information with “fine finger movements” (Taverna et al., 2020, p.3) in order to achieve success in school.

A deficiency in visual-motor integration may be evident therefore, when observing poor quality handwriting (Volman, van Schendel, & Jongmans, 2006). A growing number of referrals to optometrists are being made for children who are experiencing difficulties in schools (Barrett, 2009). Children with dyspraxia for example, may experience perceptual problems, particularly in the visual modality, which are associated with difficulties in motor coordination (Barrett, 2009). Research has found that the number of co-occurring disorders

present with DCD, for example reading difficulties or writing difficulties, is linked to the severity of the visual perceptual dysfunction (Barrett, 2009).

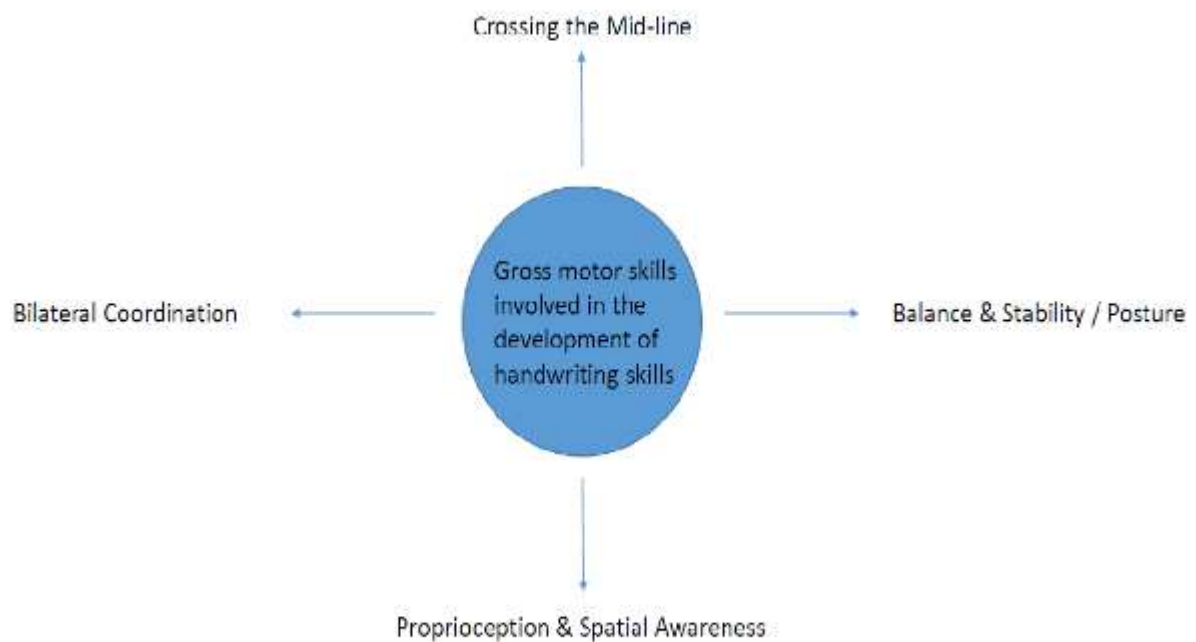
The ability to copy geometric forms is recognised across the literature as an indication of writing readiness in the young child and requires integration of motor skills and visual processing skills (Beery, 1992; Feder, 2007; McAllen, 2008; O'Connor, 2012). The Developmental Test of Visual-Motor Integration was first published in 1989 by Beery & Beery. It is a pencil-and-paper measure that involves 24 geometric forms of increasing complexity that the child being assessed is required to copy. Research in the area suggests therefore that formal handwriting training should be delayed until the child can successfully copy basic geometric shapes, including a vertical line, a horizontal line, a circle, a cross, a right oblique line, a square, a left oblique line, an oblique cross and a triangle (O'Connor, 2012).

3.3.3 The Role of Gross Motor Skills in Handwriting

Motor skills are commonly classified as gross motor or fine motor skills. Gross motor skills involve the body's large muscles and relate to balance and stability, posture, bilateral coordination, crossing the mid-line, and proprioceptive and spatial awareness, all of which are key skills contributing to handwriting development (Ayres 1964, 1972a, 1972b, 1974, 1989; Feder & Majnemer, 2007). As highlighted earlier in this section, the persistence of the ATNR can affect the development of gross motor skills or fundamental movement skills such as rolling, crawling, riding a bike and catching and throwing a ball (McPhilips & Jordan-Black, 2007; McPhilips & Sheehy, 2004).

Figure 3.2

The gross motor skills involved in the development of handwriting skills (Ayres, 1989; Feder & Majnemer, 2007)



Gross motor skills in early childhood generally refer to locomotor skills, object control skills and balance (Gallahue & Ozum, 2006; Draper et al., 2011). Locomotor skills involve the movement of the body through space and include running, jumping, skipping and hopping. Object control skills refer to the manipulation of objects and include throwing, catching, bouncing, striking and rolling (Bardid et al., 2013). Locomotor and object control skills develop proprioception, spatial awareness, bilateral coordination, crossing the mid-line, and balance and stability, all of which are key components in the development of handwriting (Ayres, 1964, 1972a, 1972b, 1974, 1989; Feder & Majnemer, 2007).

Independent walking is one of the most significant locomotor tasks during the first two years after birth. Malina (2003) describes the developmental changes that lead to walking as a series of postural changes through which the child acquires the motor control necessary to firstly assume an upright posture, then to maintain upright posture and finally to walk independently. Control of the head, upper trunk and upper extremities is gradually attained

followed by control of the entire trunk. The infant first masters the sitting posture with support before progressing to sitting independently (Malina, 2003). This is followed by active attempts at locomotion in the form of prone progression, for example, crawling on the stomach. The child will actively attempt upright posture following this stage, first standing with support and then alone. Walking follows a similar sequence. First attempts at walking are made with the assistance of an adult or an object like a table before independent walking develops (Malina, 2003).

Table 3.2

The role of gross motor skills in the development of handwriting skills

Gross Motor Skill	Role
Bilateral Coordination	Using two hands together with one hand leading (e.g. opening a jar with one hand while the other hand helps by stabilising the jar)
Balance & Stability / Posture	Stabilisation of the body in a functional position. Being able to maintain a good sitting position and hold the shoulder in a good stable position. Sitting with poor posture can put stress on the muscles, joints and ligaments.
Proprioception	Proprioception is the sense of knowing where the body is in space and has a direct connection with knowing how much pressure to place through an item
Spatial Awareness	Spatial awareness involves the ability to process information about oneself in relation to their environment in space, orientation and position. It may involve the ability to understand directional language concepts such as up/down, next to, left/right, over/under etc.

Attainment ages vary at each stage of locomotor development and small and inconsistent variance between genders occurs (Malina, 2003). A large percentage of infants

will progress to walking in the following sequence: rolling over, pivoting, crawling on the stomach, crawling on the hands and knees, standing and walking (Malina, 2003). Once the child initiates the skill of walking, proficiency follows quickly. Stride length, speed of walking and cadence increase. Balance is a key skill in the refinement of walking and the development of other motor skills. The infant upon first walking, is supported by a wide base of support with the feet relatively far apart and the toes pointed outward. As the child gains proficiency, the base of support gradually narrows so that the feet are placed within the lateral dimensions of the trunk and the toes point more forward (Malina, 2003). Balance is also a key motor skill in maintaining good posture for handwriting (McAllen, 2008).

The walking pattern may be considered as the foundation upon which other movement patterns and skills develop as it provides the child with a source of independent locomotion. This freedom of movement means that a variety of manipulative experiences are possible and leads to an increase in experimentation with a variety of movements. The experimentation occurs in a variety of contexts, including the home, preschool or play areas in the community (Malina, 2003). The environment therefore, plays a key role in the acquisition of competence in early fundamental movement patterns (Lepes, 2015). These fundamental movements are the basic building blocks for movement and the foundation upon which gross motor skills can be developed and refined (Cohen et al., 2014; Malina, 2004).

While traditionally, children developed gross motor skills through outdoor play and activity, recent studies indicate a significant decline in children's motor development both in Ireland and internationally (O' Brien et al., 2015). A review of the literature in an Irish context found that children are entering adolescence lacking in basic motor skills (O'Brien et al., 2015). Research indicates that children have the developmental potential to master most basic motor skills by 6 years of age during physical education, physical activity and sport (O'Brien et al., 2015). However, studies (O' Brien et al., 2015) show that only 11% of early adolescents

assessed achieved mastery or near mastery on nine fundamental movement skills including hopping, kicking and throwing. International studies examining gender differences in fundamental movement skills in the USA observed that 86% of children demonstrated developmental delays below the 30th percentile for same-age peers (O'Brien et al., 2015). A study of 5-13 year olds in New Zealand found that less than half of the participants demonstrated proficiency in kicking (21%), throwing (31%) and striking (40%) (McGrane et al., 2017).

Gross motor development in the preschool years is critical in terms of developing the motor skills which are prerequisites to a physically active and healthy lifestyle in later life (Cohen et al., 2014; Gaul, 2014; Gaul & Issartel, 2015; O'Brien et al., 2015, Rudd et al., 2017; Stanley et al., 2016). Higher levels of gross motor skills are associated with lower body mass index, better cardiorespiratory fitness and physical activity. Gross motor skill development has been shown to be a consistent correlate of physical activity, allowing children opportunities to be active across a range of settings in the early years (Stanley et al., 2016) and affording them access to a fuller and richer curriculum. As an indicator for school success, children with higher levels of gross motor competence are more likely to benefit from enhanced cognitive development, higher levels of self-esteem and lower levels of anxiety (Barnett et al., 2016).

The current decline in children's gross motor proficiency (O'Brien, 2015; McGrane et al., 2017) not only impacts on their ability to access and enjoy physical activity and sport but also has a direct impact on the development of handwriting skills in the classroom (Ayres 1964, 1972a, 1972b, 1974). In handwriting, difficulties with spatial relationships may affect letter formation and visual discrimination as children have difficulty positioning lines in relation to other parts of a letter. Children may also demonstrate difficulty with writing on a line or judging the appropriate spacing between letters or words. Poor proprioception affects pencil grasp (Ayres, 1964, 1972a, 1972b, 1974). A child who needs a higher amount of proprioceptive input

may not recognize how much pressure to place through their writing instrument. Poor posture, balance, and stability can affect how children function and decrease their ability to complete fine motor tasks, schoolwork and even to listen (O'Connor, 2012). Sitting with good posture for writing increases stability, provides a stable foundation for written output, and can increase attention and focus. Poor core strength is often overlooked when addressing handwriting issues but it has a significant impact on a child's fine motor skills and abilities (Culligan, 2009).

3.3.4 The Role of Fine Motor Skills in Handwriting

Fine motor skills can be defined as “the use of small muscles involved in movements that require the functioning of the extremities to manipulate objects” (Gallahue & Ozmun, 2006). Fine motor skills involve control of the small muscles of the body that enable the child to complete everyday tasks such as writing, drawing, cutting, grasping small objects and fastening clothing (Marr et al., 2003, Van der Linde et al., 2013). Fine motor skills involve coordinating small muscle movements and manual dexterity needed for tasks like drawing, writing and self-care skills such as feeding and dressing (Cameron et al., 2016; Oberer et al., 2016). Children need to develop a range of key fine motor skills before beginning handwriting instruction and the formation of letters (McAllen, 2008; Alston & Taylor, 1987, Lamme, 1979). Those skills include eye-hand coordination, hand and finger strength, hand division (finger and thumb isolation) object (in-hand) manipulation and tactile and proprioceptive awareness (Lamme 1979; Alston & Taylor, 1987).

Table 3.3

The role of fine motor skills in relation to handwriting development (Lamme, 1979; Alston & Taylor, 1987)

Fine Motor Skill	Role
Hand and Finger Strength	Relates to the ability to exert force against resistance using the hands and fingers that allow the necessary muscle power for controlled movement.
Eye-Hand Coordination	The ability to process information received from the eyes to control, guide and direct the hands in the performance of a task such as handwriting.
Hand Division	Using just the thumb, index and middle finger for manipulation, leaving the fourth and little finger tucked into the palm not participating but providing stability for the other 3 fingers.
Tactile and Proprioceptive Awareness	Information that the brain receives from our muscles and joints to make us aware of our body position and body movement, so we can accurately control our movements and know how much pressure to apply to the writing instrument.
Object Manipulation	The ability to skilfully manipulate tools (such as the ability to hold and move pencils and scissors with control) and the controlled use of everyday tools such as a toothbrush, hairbrush, and cutlery.

A review of current literature highlights the key importance of developing fine motor skills before beginning handwriting instruction in the infant classroom (Cameron et al., 2012; Gaul & Issartel, 2015; Graham, 2008; Grissmer et al., 2010; McGlashan et al., 2017; Roebbers et al., 2014; Santangelo & Graham, 2016; Suggate et al., 2016; Van der Fels et al., 2016). Poor fine motor skills and handwriting skills can constrain the beginning writer and the beginning learner in at least four ways.

Firstly, poor motor control will affect a child's ability to write legibly and result in incorrect size or placement of letters, inadequate pencil grip and slow handwriting speed (McGlashan et al., 2017). Research indicates, that as a consequence of poor legibility, readers may be biased in their evaluation about the ideas and quality of a text (Santangelo & Graham, 2016) and written text may be less accessible to others (Graham, 1999).

Secondly, poor motor skills and handwriting skills may impede children's writing efforts by interfering with other writing processes (Graham, 2008). The "Writer Effect" describes how handwriting "consumes an inordinate amount of cognitive resources" (Graham et al., 2016, p. 226) until it becomes a fluent and automatic skill. Poor handwriting fluency causes the child to have to switch attention during composing to think about how to form a particular letter, which subsequently leads to the child forgetting their writing ideas or plans. Fine motor competence therefore has the capacity to place limits on how much text a child can produce and how quickly they can produce it (Berninger, 1999), as well as how much attention children can focus on the meaning-related aspects of writing as opposed to the mechanical aspects (Puranik & Al Otaiba, 2012; Puranik & Apel, 2010).

Thirdly, children experiencing fine motor difficulties are often fatigued by handwritten tasks in school and may take longer to complete their work (May-Benson et al., 2002). This means that they are likely to lose some writing ideas, as their handwriting is often not fast enough for them to record all of their ideas (Graham, 1990). Research reports that difficulties

with handwriting lead children to avoid writing and to develop a self-perception that they cannot write (Berninger, Mizokawa, & Bragg, 1991, as cited in Graham, 2008). Poor handwriting and motor development therefore affects children's self-perception, self-esteem and motivation (Piek et al., 2006; Gaul & Issartel, 2015).

Finally, the effect of poor fine motor and handwriting skills on academic achievement is highlighted by the significant proportion of the day allocated to fine motor and written tasks in early years' settings (Cameron et al., 2012). Most learning activities in the classroom involve motor as well as cognitive components. Research shows that children in the infant classrooms can spend up to 60% of the school day attending to tasks that involve motor skills, and 80% of their time completing drawing and writing based tasks (McHale & Cermak, 1992). A US survey of kindergarten fifth grade teachers indicates that students spend 24% to 58% of classroom time writing ("Handwriting Without Tears", 2013). Children with poor motor skills therefore will likely be exposed to fewer learning experiences in the classroom. Self-perception, self-esteem, and motivation are likely to be negatively impacted also (Piek et al., 2006; Gaul & Issartel, 2015).

Children with strong fine motor skills on the other hand, have been found to demonstrate higher academic achievement, mathematical achievement and earlier development of reading (Van der Fels et al., 2016; Roebbers et al., 2014; Cameron et al., 2012, Grissmer et al., 2010). Research indicates that because handwriting tasks demand integration of the motor and visual processing systems, handwriting fosters children's early literacy skills (Neumann et al., 2012). Children showing competency in handwriting skills have more sophisticated letter knowledge, phonological awareness and spelling competence (Oberer et al., 2016) while children's word writing skills at the end of kindergarten have been used to predict children's literacy skills, including spelling, reading comprehension and oral reading, by the end of first grade (Oberer et al., 2016).

3.3.5 *Grasp Development*

Grasp development is the way in which children grasp or hold a writing instrument. The development of fine motor skills precedes grasp development. Generally, a grasp is labelled according to the nature of the finger or palm contact with the writing instrument and the movement of the writing instrument (Schewellness, 2003). Grasp development is one of the most commonly recognised features associated with handwriting performance (Donica et al., 2018; Shah & Gladson, 2015; Feder & Majnemer, 2007; Graham et al., 2008) and research regarding the developmental progression of grasp appears to vary from researcher to researcher (Tseng, 1998; Schneck & Henderson, 1990; Rosenbloom & Horton, 1971).

Children tend to progress through four predictable stages of development in relation to grasp development (Rosenbloom & Horton, 1971). Stage 1 refers to the supinate grasp, a crude hold that involves the whole hand forming a fist around the writing instrument. This grasp is usually observed in children who have not yet reached school age. Stage 2 sees the development of the pronate grasp. It typically follows the supinate grasp and is characterized as a palm-down position in which the fingers curl around the pencil and the index finger points toward the tip. The simple tripod grasp is observed during stage 3. It involves correct finger positioning but coordinated finger movements are absent. Finally, the dynamic tripod grasp is usually assumed by about 7 years of age. In this mature position, the thumb, index and middle fingers act as a tripod. They support the writing instrument and enable small, highly coordinated finger movements (Figure 3.3).

Figure 3.3

Four stages of grasp development (Rosenbloom & Horton, 1971)

Type of Grasp	Description	Image
The Supinate Grasp or Palmar Supinate Grasp	A crude hold that involves the whole hand forming a fist around the writing implement. This grasp is usually used by children who have not yet reached school age.	 A photograph showing a child's hand holding a pencil in a palmar supinate grasp, where the entire hand is wrapped around the pencil.
The Pronate Grasp or Digital Pronate Grasp	Typically follows the supinate grasps and is characterized as a palm-down position in which the fingers curl around the pencil and the index finger points toward the tip.	 A photograph showing a child's hand holding a pencil in a digital pronate grasp, with the palm facing down and fingers curled around the pencil.
The Simple Tripod	Precedes the dynamic tripod, the correct finger positioning is evident but coordinated finger movements are absent.	 A photograph showing a child's hand holding a pencil in a static tripod grasp, where the thumb, index, and middle fingers support the pencil.
The Dynamic Tripod	Usually assumed by about 7 years of age. In this "mature" position, the thumb, index and middle fingers act as a tripod. They support the writing implement and enable small, highly coordinated finger movements	 A photograph showing a child's hand holding a pencil in a dynamic tripod grasp, which is a more refined version of the static tripod grasp.

Tseng's later (1998) classification system, referred to more commonly in the literature, describes a more detailed progression of grasp development through three stages: from primitive or immature grasps to transitional or static grasps to mature grasps (Donica et al., 2018; Schwellnus, 2012). Primitive grasps occur between the ages of 1 and 3 years and involve the pencil being held in the palm. They include radial cross palmar grasp, palmar supinate grasp, interdigital grasp variation, digital pronate grasp, brush grasp, and grasp with extended fingers (Edwards et al., 2018; Erhardt, 1994; Schneck & Henderson, 1990; Tseng, 1998, as cited in Donica et al., 2018).

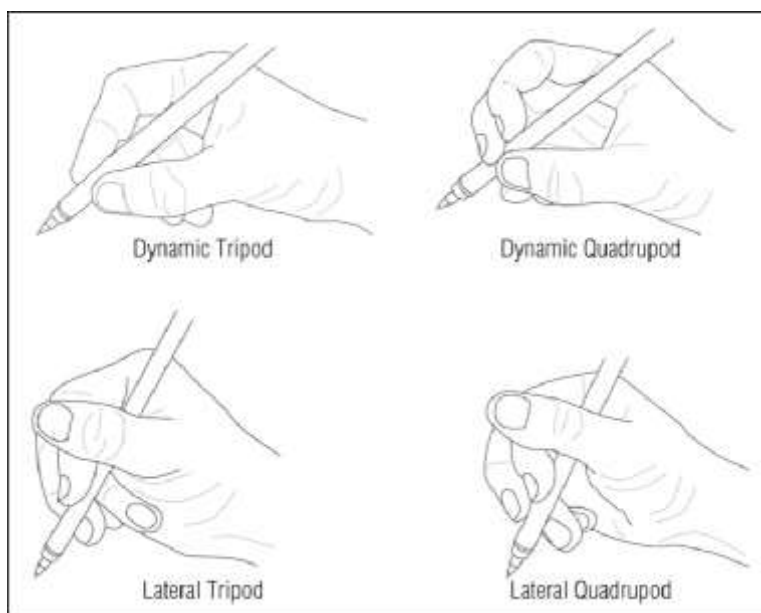
Transitional grasps occur between 3 and 6 years of age typically and involve the wrist directing most of the writing instrument movements. Transitional grasps include lateral quadruped, static tripod, and dynamic quadruped (Almeida, Cruz, Magna, & Ferrigno, 2013;

Edwards et al., 2018; Schneck & Henderson, 1990; Tseng, 1998 as cited in Donica, 2018).

Lastly, the mature stage requires use of both intrinsic and extrinsic muscles of the hand (Almeida et al., 2013; Edwards et al., 2018 as cited in Donica, 2018). Mature grasps (Figure 3.4) include lateral tripod, dynamic tripod, lateral quadrupod and dynamic quadrupod (Dennis & Swinth, 2001; Koziatek & Powell, 2003, as cited in Schwellnus, 2003).

Figure 3.4

Four mature grasp patterns: Dynamic tripod, dynamic quadrupod, lateral tripod, and lateral quadrupod



Research in the area of grasp development provides conflicting evidence regarding the correlation between grasp pattern and legible handwriting (Graham et al., 2008; Schewellness, 2003; Koziatek & Powell, 2003; Dennis & Swinth, 2001). While some evidence supports that mature grasps remain ideal compared to immature grasps, other evidence suggests that no significance is found when relating specific grasps to legibility (Donica et al., 2018). Historically, the dynamic tripod grasp has been considered the superior grasp pattern (Schneck & Henderson, 1990; Tseng, 1998; Tseng & Cermak, 1993, as cited in Donica, 2018). However, approximately 14.3% of 447 right-handed adults demonstrated pencil grasps other than the dynamic tripod grasp (Bergmann, 1990, as cited in Donica, 2018). While this research study

did not address the issue of pencil grasp or legibility specifically, the researcher noted a number of observations (FN, September-October, 2019) in relation to pencil grasp and legibility during the initial testing period. The pencil grasp of children in the three DEIS schools *generally* appeared poorer upon entry into school than children in the three non-DEIS schools and it appeared to impact legibility. This is pictorially evidenced later in the thesis in Chapter 5. In addition, children in the non-DEIS schools *generally* appeared to have some prior experience of practicing the dynamic tripod grasp. While this research supports the finding that a pencil grasp other than the dynamic tripod grasp can still be functional, for a number of children, poor pencil grasp appeared to be linked to poor legibility (further detail on this is Chapter 7: Discussion).

In line with this, poor handwriting is frequently attributed to children's grasp pattern (Graham et al., 2008, Rigby & Schwellnus, 1999, Rosenblum et al., 2006). Children are often referred to school-based occupational therapy services based on teachers' perceptions of poor pencil grasp and its perceived relationship with legibility (Donica et al., 2018). A US national survey conducted by Graham et al (2008) relating to how teachers teach handwriting, revealed that 41% of a sample of 169 teachers recognise use of 'incorrect' pencil grasp as a common indicator of handwriting difficulty. The significance of this in terms of this study is that children presenting with grasp patterns other than the dynamic tripod grasp do not necessarily have 'handwriting difficulties', as functional grasp patterns do exist outside of the dynamic tripod grasp. However, spending time developing the fine motor skills necessary to support a 'correct' pencil grasp can benefit children's handwriting speed, legibility and automaticity and prevent fatigue.

3.4 Environmental Influences on Motor Development

3.4.1 Introduction

The development of motor competence during infancy occurs as a result of the growth and maturation characteristics of the child, interacting with the physical and socio-economic

environment within which the child is reared (Goodway, Ozmun, & Gallahue, 2012; Lepes et al., 2016). Environmental opportunities or limitations for movement interact with the biological substrates of growth and maturation to determine the motor repertoire of the child (Malina, 2004). The influence of Bronfenbrenner's (1979) biological model of development, as outlined in the theoretical framework in Chapter 2, has led researchers to become increasingly aware of the key role that the physical environment plays in shaping children's motor development.

Teachers have reported a decline in children's motor proficiency, perhaps as a result of the environmental constraints that deprive them of the opportunities which would enable them to practice many of the skills that belong to the stages to motor development (McAllen, 2008). A lack of outdoor play spaces for children to engage in challenging physical play experiences for example, may contribute to children's fingers and wrists being less dextrous than they were in the past (McAllen, 2008). The socio-economic context, in which a child is reared, also influences the development of motor competence, with different contexts making different demands on the child's motor behaviour. The influence of socio-economic status on early childhood development has been recognised (Draper et al., 2011) and in particular children from disadvantaged socio-economic backgrounds are more likely to experience developmental delays (Draper et al., 2011).

A review of the literature reveals a number of environmental factors influencing children's motor development (Lepes et al., 2016; Ferguson et al., 2013; Venetsanou & Kambas, 2010; Adolph & Berger, 2007; Adolph & Berger, 2011; Leitschuh & Dunn, 2001; Davis et al., 1998; Reed & Brill, 1996). These factors include family socio-economic status, mothers' educational level, schooling and the existence or absence of siblings. The family in which a child is brought up plays a pivotal role in their motor development. Families that provide a permissive and accepting environment and that provide opportunities for motor experiences aid children in their development of motor competency (Ferguson et al., 2013).

Factors such as whether children sleep on their stomachs or have access to stairs in the home also impact how a child develops his or her motor skills (Ferguson et al., 2013). The following sections outline how the physical environment influences motor development. The environmental factors considered span across all four levels of Bronfenbrenner's ecological systems model: the micro-, meso-, exo-, and macrosystems. They include crowding, urbanisation, housing quality and type, chronic noise exposure, opportunities for physical play and classroom size.

3.4.2 The influence of urbanisation on opportunities for motor development

Physical Activity within an Irish context is defined as “any bodily movement produced by the skeletal muscles which causes energy expenditure greater than at rest and which is health enhancing” (Government of Ireland, 2019). Active play is included in this definition of physical play and is noted as an important part of early childhood in developing children's cognitive and motor skills (Government of Ireland, 2019). Engagement with the natural physical environment tests children's limits and capabilities by providing them with opportunities to take part in challenging activities such as rough play, tumbling and chasing games (Sandseter, 2009, 2012). Among the skills to be developed are key gross motor skills which include running, jumping, climbing and balancing (Government of Ireland, 2019). Relevant to this research is the recognition that the provision of rich play environments is critical for the development of motor skills in the early years.

As part of the National Children's Strategy, launched in November 2000, the Irish Government included a commitment to develop National Play and Recreation Policies. Stemming from this, the National Play Policy was developed in 2004 and since republished in 2019, stating its aim “to ensure that all children have access to at least a minimum standard of play and recreation activities” (Government of Ireland, 2019, p. 8). Among a number of objectives outlined in the Play Policy, the aim to “maximise the range of public play

opportunities available to all children, particularly children who are marginalised, disadvantaged or who have a disability” (Government of Ireland, 2019, p. 9) is of particular significance to this research. The policy acknowledges that children’s physical play has not been given the attention it deserves and states that one objective of the national play policy is to plan for an increase in public play spaces and to provide children with increased play opportunities. A lack of play and recreation spaces is a frequently documented concerns of the children who were consulted as part of this policy (Government of Ireland, 2019). This policy paper highlights the changing nature of play in Ireland as a key issue in planning for increased opportunities and facilities as well as other key issues including standards, funding and quality. The paper also highlights the neglect of play resources at policy level in Ireland. Noted is the shortage of safe, public play spaces, a lack of funding, poorly developed public awareness of the value of play and no national strategy for play.

Outdoor environments provide space for vigorous activity and variety in movement, which in turn promotes improved movement skills, balance and coordination (Sandseter, 2009, 2012). Urbanisation plays a significant role in reducing opportunities for mobility and states that children from low income families, traveller children, children from ethnic minority groups, children living in emergency accommodation, children from refugee families and children living in urban areas are at particular risk of exclusion from accessing outdoor play (Kilkelly, Lynch, & Moore, 2016). A lack of safe space, language barriers, fear of assault, concerns about safety, adult influences and an absence of transport are some of the barriers to outdoor play listed in the Children and the Outdoors report (Kilkelly et al., 2016).

Children living in urban areas are affected by reduced mobility as a result of traffic, growing fear of strangers and a reduction in walking and riding a bike to school. Parents are influenced by a number of issues including health and safety and perceived dangers in children’s use of outdoor spaces (Kilkelly et al., 2016). Appropriate environments are viewed

to be those that are related to low risk for gangs, strangers and road traffic, with parents becoming more hesitant to promote outdoor play for their children due to fears regarding safety (Louv, 2008; Skar & Krogh, 2009; Derr & Lance, 2012). Children living in urban areas therefore, are at an increased risk of reduced mobility and that hyper vigilance regarding children's safety is putting them at risk of becoming "increasingly restricted from experiences and stimuli that are crucial for their normal, overall development" (Kilkelly et al., 2016, p. 32).

A lack of space for physical activity and play in neighbourhoods is much more likely to exist in lower socio economic status neighbourhoods (Hajat et al., 2013; Evans et al., 2012). Children aged between 10-15 years reported that they were aware of the physical quality of their neighbourhood environments, and noted specific aspects of their environments that limited their play opportunities, including high traffic and a lack of open green spaces (Chawla & Driskell, 2008). Children's restricted access to the outdoors and to play spaces in areas of lower-socio economic status is likely therefore to significantly impact on the development of motor skills in the early years.

3.4.3 The influence of housing quality and type on motor development

Children and their families accounted for 63% of Ireland's recorded homeless population in 2018 with 1,739 families, including 3,755 dependent children recorded as homeless (Scanlon & McKenna, 2018). The quality and standard of living conditions has been noted as a key challenge for families accessing homeless accommodation. Within an educational context, poor school attendance, inability to complete homework and higher levels of anxiety in children have been linked to homelessness (Scanlon & McKenna, 2018). Inadequate space to do homework can impact on academic performance (Ferguson et al., 2013) and an adverse relationship between apartment square footage and school performance of children from low-income families living in apartments in Singapore has been reported (Mitchell, 1971 as cited in Ferguson et al., 2013).

Children living in urban areas and in homeless accommodation are also at risk of being deprived of critical opportunities for movement and development (Barron, 2013). A back garden space or play space is a key space for children to develop mobility and to maintain good health (Barron, 2013; Scanlon & McKenna, 2018). In addition to fixed playground equipment such as slides and swings, children describe a back garden as a space where they could practice skills such as skipping and dribbling (Barron, 2013). The absence of a back garden or play space therefore deprives children living in urban areas or homeless accommodation of the same opportunities to engage in movement and play and to develop key motor skills (Scanlon & McKenna, 2018).

In relation to the physical needs of children, overcrowding in homeless accommodation has been reported to impact on health and wellbeing (Scanlon & McKenna, 2018). Infants in more crowded households have been reported as lethargic and drowsy, conditions often associated with delayed development (Rahmanifar, 1993 as cited in Ferguson et al., 2013). Residential crowding has also been linked to delays in psychomotor, but not cognitive, development during their examination of 12-month-old children of Haitian immigrants to the US (Widmayer, 1990 as cited in Ferguson et al., 2013). These associations may be the result of children's limited exploration, play, and engagement with both objects and people in their immediate environments (Ferguson et al., 2013).

Urban children aged between 32 and 64 months, from more crowded homes spent less time engaged in play with objects and more time unoccupied and as onlookers (Liddell & Kruger, 1989, as cited in Ferguson et al., 2013). Residential crowding has been found to have negative effects on parent-child interactions with parents in more crowded homes talking less with their infants and toddlers (Evans et al., 2012). An investigation of the influences of socioeconomic status on South African children's outcomes, (Goduka, Poole, & Aotaki-Phenice, 1992) found that children's physical development and quantitative skills were impacted by

household crowding (Ferguson et al., 2013). The effects of over-crowding on children's cognitive functioning in North America and Western Europe were consistent differences found for standardized achievement scores in grade school children (Evans, 2006).

Chronic noise exposure has been found to elevate psychophysical stress and to impact on perceived quality of life (Evans, Bullinger & Hygge, 1998). The impact of chronic noise exposure on the development of fine and gross motor skills in children is an important consideration. Chronic residential noise exposure from road traffic can interfere with executive functioning among elementary school aged boys (Belojevic, Evans, Paunovic, & Jakovljevic, 2012). Because environmental noise levels for the most part are uncontrollable and unpredictable, repeated exposure to unpredicted events can undermine human motivation, subsequently impacting on persistence and effort required for success in school (Ferguson et al., 2013).

Chronic noise exposure early in childhood has been found to interfere with reading acquisition (Evans, 2006). Children with poorer cognitive skills appear more vulnerable to reading deficits from noise exposure (Dockrell & Shield, 2006; Evans, 2006 as cited in Ferguson et al., 2013). Teachers in high noise impact schools must employ alternative teaching strategies and methods and complain about interruption and fatigue (Ferguson et al., 2013). Noise levels have been found to affect motivation, engagement and attention levels (Ferguson et al., 2013). It would appear therefore, that noise exposure has the potential to impact on the development of motor skills within the home and school environment.

3.4.4 The influence of Early Learning Childcare settings on motor development

An effective and high quality early learning and care experience for young children is described in Ireland as one that ensures that young children are supported in their development by those caring for them (Government of Ireland, 2018). The First 5: A Whole-of-Government Strategy for Babies, Young Children and their Families 2019-2028 (Government of Ireland,

2018) notes that this involves creating environments that support learning and development and making information, resources and supports widely available to the local community. An effective early childhood system should ensure that communities are inclusive and that spaces to play and learn are provided for (Government of Ireland, 2018). Public spaces “shape development” and should be designed with babies and young children in mind, with communities being described as “the backdrop for development throughout the early years” (Government of Ireland, 2018 p. 6). The cross-government Access and Inclusion model (AIM) focuses on children availing of the Early Childhood and Education (ECE) scheme (NCSE, 2020). AIM is a seven-level model that adopts a child-centred approach by identifying and responding to each child’s developmental level, abilities and needs, as opposed to focusing explicitly on formal diagnosis. High quality, play-based early learning environments that promote a strong culture of inclusion that optimise children’s specific learning requirements, are therefore key to motor development of young children in the early years.

The number of children attending childcare settings has increased as a result of lifestyle changes and the increased number of families where both parents are working (Del Bocha, 2015; Horgan et al., 2014; Venetsanou & Kambas, 2009; de Barros et al., 2003). Within an Irish context, 96% of children participate in some form of early learning care provision before starting school (Government of Ireland, 2018). As a result, children are spending more hours of their day in childcare settings which subsequently means that the development of their motor skills is highly dependent on the provision and quality of that childcare (Ferguson et al., 2013). Children from public childcare centres have been reported to have less well developed motor skills than children from private settings (de Barros et al., 2003). Reasons for this include the absence of an appropriate child-centred pedagogy in public childcare centres, where the main function of carers was to meet children’s basic needs, to keep them safe and to feed them. Poor

training in relation to the development of motor skills has also been noted as a contributing factor (de Barros et al., 2003).

While one of the key actions of the National Physical Activity Plan for Ireland (Government of Ireland, 2016) is to develop National Guidelines on Physical Activity for 0-5 year olds, Ireland does not currently have guidelines on physical activity for children from birth to 5 years. However, Aistear, the curriculum framework for preschools in Ireland does highlight the key role of motor development and physical activity in the early years (NCCA, 2009). Wellbeing is one of four themes that underpins the curriculum and refers to psychological wellbeing as well as physical wellbeing. The Wellbeing theme aims to help children to develop a growing sense of awareness of their bodies and to develop skills of coordination, fine and gross motor skills (NCCA, 2009). The twelve principles of Aistear emphasise that this development should occur in a rich learning environment and as a result of meaningful, playful and hands-on experiences for the child. Outdoor play is highlighted within the Aistear framework (NCCA, 2009) as being a key element of physical wellbeing. Children should be afforded ease of access to the outdoors in Early Learning and Care (ECE) settings and appropriate materials and clothing should be provided (NCCA, 2009).

The importance of outdoor play for motor, cognitive and social and emotional development of children is highlighted by The Early Childhood Education and Care (ECEC) policy in Scandinavia. The ECEC forms part of the wider educational system in all three Scandinavian countries and focuses its work on six major themes that the Danish curriculum uses: children's diverse personal development, social competence, language, body and movement, nature and nature phenomenon and cultural expressions (Maynard & Waters, 2014). While the Swedish curriculum does not outline curricular areas in the same way, the aims of ECEC provision are described by focusing on norms which include: democracy and solidarity, development (social, motor, literacy, mathematic, aesthetic and cultural) and

children's participation. Underlying all practice is the fundamental belief that the professional approach to children's learning in ECEC should be through play.

A key value in the Scandinavian ECEC is the importance of outdoor play as a central part of children's lives. Underpinning this value are two key concepts that exist in Scandinavian societies: the concept of *friluftsliv* and the *Gibsonian approach* (Maynard & Waters, 2014). The concept of *friluftsliv* is described as development as a result of meeting and overcoming challenges as opposed to development as a result of maturing with age. The Gibsonian theory emphasises direct engagement with the environment so that an individual can learn about what the environment offers (Maynard & Waters, 2014). The approach promotes opportunities for exploration, and views the transference of knowledge through verbal or pictorial methods as inadequate. Maynard and Waters (2014) cite research from Sandseter et al (2012) that shows that the Gibsonian theory results in greater emphasis being placed on the physical environment and a direct relationship between the environment and learning

The ECEC system in Scandinavia provides children with opportunities to access the outdoor environment to create play activities based on their own interests and motivations. Maynard and Waters (2015) describe children's *independent mobility licence* and the ability to move freely as being central to their learning and their relationship with the environment. They (2015) note a Norwegian study by Fjortoft (2000) of children's play in natural environments versus playgrounds that found that gross motor activities and fundamental movement skills such as running, jumping, crawling, rolling, swinging and sliding were used frequently when children played in nature compared with more traditional standardised preschool playgrounds.

Outdoor play affords children opportunities to practice and develop motor and physical skills and to improve and develop muscle strength and endurance (Byers & Walker, 1995; Fjortoft, 2004; Fjortoft & Sageie, 2000; Pellgrini & Smith, 1998). Perceptual awareness such

as depth, form, shape and size and general spatial awareness, which are key to graphic tasks such as drawing and writing, are developed through exploration and play in nature.

3.4.5 The influence of classroom size on motor development

Class size refers to the number of children in the class (Cheung & Zhang, 2020). Smaller class sizes for young children improve learning attainment, particularly for children in DEIS schools in the early years (Kelleher & Weir, 2017). Smaller class sizes allow for children to be the focus of a teacher's attention and for increased engagement in active learning (Blatchford & Russell, 2020). The frequency of children being 'off task' is increased when class size is larger (Blatchford & Russell, 2020).

Within an Irish context, DEIS Band 1 schools have a recommended pupil teacher ratio (PTR) ratio of 20:1 (Government of Ireland, 2017). As part of the DEIS scheme, a Governmental commitment was made to have maximum junior class sizes of 20 and maximum senior class sizes of 24 in urban / town primary schools with the highest concentrations of disadvantage. A review (Government of Ireland, 2021) of class size in DEIS urban Band 1 primary schools revealed that overall, an increase in academic achievement is linked to reduced class sizes, in particular in junior classes. Children from disadvantaged and minority backgrounds have been found to benefit from smaller class sizes more than other groups (Government of Ireland, 2021). Smaller class size was reported by 26 principals in DEIS schools as the number one key determinant of increases in academic attainment both in reading and in mathematics (Kavanagh, Weir, & Moran, 2017). Teachers in DEIS schools further emphasised the importance of smaller class sizes, indicating that they are an essential in facilitating the successful implementation of literacy initiatives (Kavanagh, Weir, & Moran, 2017).

In relation to this research study, it is significant that class size has been found to impact on children's motor development in the early years. The development of fundamental

movement skills among preschool children was found to be improved by smaller class sizes (Cheung & Zhang, 2020). Smaller class size means that the ratio of child to playground space is more favourable, providing more open space for children to move and to play and for the use of play equipment.

3.5 Motor Development and the Primary Curriculum

The following section will review how motor development is addressed across the Primary Curriculum. The time allocated to motor development will be considered. Both the 1999 Primary Curriculum and the new Primary Language Curriculum, as well as the Aistear Framework, will be included in this review. All of the participating teachers in this research study received their pre-service teacher training education using the 1999 Primary Curriculum. However, all of the participating teachers had since received ongoing professional developmental training on the new Primary Language Curriculum and the Aistear Framework at the time that this research took place.

3.5.1 Motor development across the Primary Curriculum and the Aistear Framework

Motor development features both implicitly (Visual Arts, Mathematics, SESE) and explicitly across a number of subject areas in the Primary Curriculum (NCCA, 1999). Motor development is explicitly addressed in the Physical Education (PE) curriculum and in Language (writing) as part of the new Primary Language Curriculum. The PE curriculum lists a number of aims relating to the promotion of the physical development of the child and the acquisition of an appropriate range of movement skills in a variety of contexts (NCCA, 2009). Physical and motor development is explicitly named as a key objective of the PE curriculum, as are the skills inherent to motor proficiency and to handwriting development. They include motor control, balance and coordination. Implicit within all of the strands and strand units of the PE curriculum, is the aim to develop gross motor skills and motor proficiency through a wide range of games and activities.

Motor development is evident also, in the Writing strand of the new Primary Language curriculum (NCCA, 2019). The Writing strand is made up of nine key areas in the development of writing skills. They are: engagement; motivation and choice; conventions of print and sentence structure; spelling and word study; vocabulary; purpose, genre and voice; writing process and creating text; response and author’s intent; and handwriting and presentation. The Progression Steps of the handwriting and presentation component of writing is where motor development is named explicitly. The Progression Steps provide a pathway for progression for each individual child. They also act as an indicator for teachers in relation to the level of competency children should be able to demonstrate at each step. Progression Step C under Handwriting and Presentation indicates that children should be able to use “some muscle control to make letter-like forms” moving towards using “good muscle control” to write “some upper and lower-case letters” in Progression Step D (NCCA, 2019). It is evident from the use of terminology relating to ‘muscle control’ that the Progression Steps in relation to emergent handwriting are informed by a motor development perspective.

Table 3.4

Progression Steps for Handwriting and Presentation (Primary Language Curriculum)

a The child... explores mark-making implements and surfaces.	b The child... uses mark-making implements and surfaces to present texts in a range of formats.	c The child... uses some muscle control to make letter-like forms.	d The child... uses good muscle control. writes some upper and lower-case letters.

The explicit naming of the role that motor proficiency plays in the development of emergent handwriting skills is in contrast to the 1999 English curriculum. A search for the term ‘motor’ or ‘muscle’ yields no results, indicating that the role of motor development in relation to writing was largely overlooked. Culligan (2009) suggests that the absence of explicit fine motor instruction in the English language curriculum might have occurred as a result of the

assumption that, “by adhering to traditional practices, these skills would be automatically acquired” (p.115). While traditional practices are undefined by Culligan (2009), he is perhaps referring to the assumption that motor skill development happens for children before they begin formal education in primary schools. It might be anticipated that practices in the home and in preschool are adequate in meeting children’s motor developmental needs.

The Aistear Framework (NCCA, 2009) has since been implemented across early years’ settings and infant classrooms in Ireland. The Aistear framework highlights the importance of motor development and physical activity in the early years (NCCA, 2009). Wellbeing is one of four themes that underpins the curriculum and refers to psychological wellbeing as well as physical wellbeing. The wellbeing theme aims to help children to develop a growing sense of awareness of their bodies and to develop skills of coordination, fine and gross motor skills (NCCA, 2019). The twelve principles of Aistear emphasise that this development should occur in a rich learning environment and as a result of meaningful, playful and hands-on experiences for the child. Outdoor play is highlighted within the Aistear framework (NCCA, 2009) as being a key element of physical wellbeing. This is largely in line with the Primary PE curriculum that includes a strand on Outdoor and Adventure. Activities, which aims to develop physical skills through meaningful engagement with the outdoor environment (NCCA, 2009).

3.5.2 Time allocated to motor development across the primary curriculum

One of the most noticeable aspects of the 1999 Primary Curriculum (NCCA, 1999) in relation to motor development and handwriting is the allocation of time to Physical Education. While English language in the infant classroom is allocated approximately 4 hours and 2.5 hours is allocated to Mathematics, Physical Education is allocated only 60 minutes. The issue of time allocation is addressed by the NCCA’s (2016) consultation document for a revised curriculum. The document acknowledges that the allocation of time across the curriculum can be seen to place a value on what is important in the early years of children’s educational

experience. Therefore, optimising the use of time across the curriculum is deemed very important (p. 34). The 1999 Curriculum (NCCA, 1999) suggests the following weekly time allocations:

Table 3.5

Weekly minimum time framework suggested in the Primary School Curriculum (NCCA, 1999)

Curriculum area	Full day	Short day [infant classes]
	(Hours and minutes)	(Hours and minutes)
Language 1	4 00	3 00
Language 2	3 30	2 30
Mathematics	3 00	2 15
SESE	3 00	2 15
SPHE	0 30	0 30
PE	1 00	1 00
Arts education	3 00	2 30
Discretionary curriculum time	2 00	1 00
Total secular instruction	20 00	15 00
Religious education (typically)	2 30	2 30
Assembly time	1 40	1 40
Roll call	0 50	0 50
Breaks	0 50	0 50
Recreation (typically)	2 30	2 30
Total	28 20	23 20

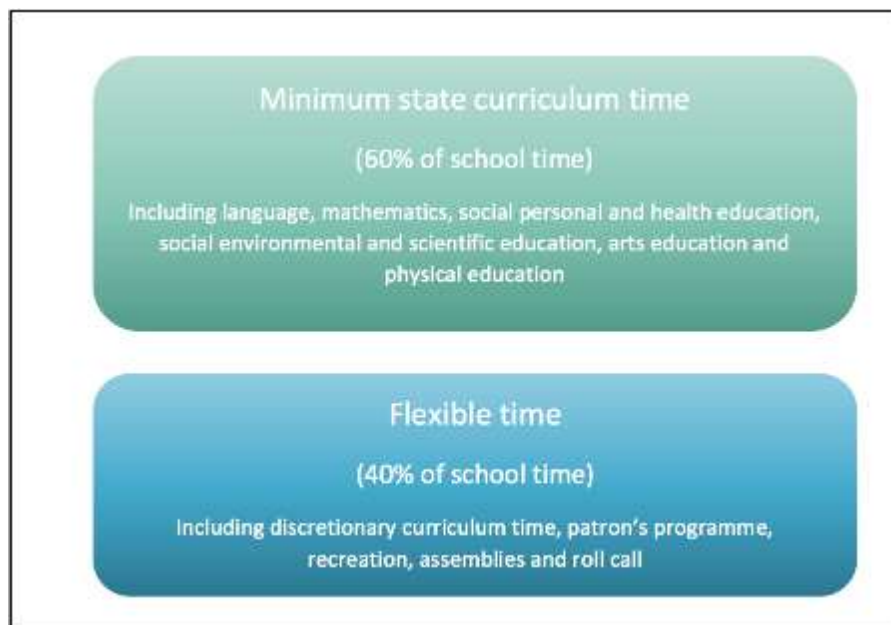
An increased time allocation for literacy and numeracy was issued in 2011 by the Department of Education (DES, 2011). From January 2012 all primary schools were required to increase the time spent on literacy, particularly on the first language of the school, by one hour overall per week. This resulted in roughly 4 hours allocated to English language in the

infant classroom. Schools were asked to find this additional time for language through a combination of approaches, including the integration of literacy skills with other curriculum areas, using some or all of discretionary curriculum time for literacy and numeracy activities, re-allocating time spent on other subjects to literacy and numeracy. There is currently little data or research on how and where schools have found the proposed additional time for language instruction (NCCA, 2016). As a result of the increase in time allocated to language instruction, much of the discretionary curriculum time may be used to meet the additional time requirements. This in turn may subsequently impact on the flexibility that teachers and schools previously had to negotiate this time and to use to best meet the needs of specific cohorts of children. Teachers have highlighted the overcrowded nature of the curriculum as a problem (NCCA, 2005, 2008). The question of how some subjects may be ‘losing out’ when time is constrained, is also a concern (NCCA, 2016). Significant to this research, PE was one of the subjects highlighted as having inadequate time allocated to it for meaningful engagement, learning and development to occur (Weeds et al, 2018).

Greater flexibility in relation to the use of time across the curriculum is critical in ensuring that children are offered a broad and holistic education (NCCA, 2016). In response to trends and developments internationally, and informed by feedback from teachers and schools, the NCCA (2016) have proposed a differentiated approach to time allocation. The aim of the new model is to better meet the learning needs of children and the needs of teachers and schools in terms of planning, teaching and assessing. It intends to provide teachers with greater flexibility in relation to how time is used to best meet the needs of children and the school community (p. 42). The table below presents the two categories of time in the proposed model for time allocation across the curriculum.

Figure 3.5

Proposed model for time allocation across the curriculum



Minimum state curriculum time refers to the least amount of time teachers and schools could spend teaching the state curriculum and the subjects specified within it (NCCA, 2016). The amount of time allocated in this category is deemed adequate to meet the learning outcomes specified by the curriculum. Critical to this research however, is the inclusion of *flexible time* as a new feature proposed in this model of time allocation. It refers to all time outside the minimum state curriculum time and includes discretionary curriculum time: assembly time, roll call and breaks. While discretionary curriculum time in the 1999 curriculum accounts for up to 10% of the total weekly time, flexible time would involve a greater proportion of time due to the incorporation of assembly time, roll call and breaks.

Noting that the proposed allocation of flexible time may seem like a modest increase from the 36% in the 1999 curriculum, the NCCA (2016) outlines that by not delineating the specific hours and minutes to be spent on each element within flexible time, schools and teachers would have greater flexibility to decide how best to use this time to meet the needs of the school. Therefore, schools may have opportunities to work with parents and the wider

community to establish how much flexible time should be used for additional teaching and learning and for cross-curriculum community initiatives. These decisions therefore would reflect what the school community sees as important for their children.

In relation to this research, the sensorimotor programme that was implemented as part of this research study could be included in the time allocated for Language 1 and for PE and integrated across the two subject areas. The main aim of the programme is to develop the sensorimotor skills necessary (PE) to improve handwriting skills (Language). The proposed time for the sensorimotor programme is roughly 25-30 minutes per day or 2 hours 30 minutes weekly. Currently, guidelines for teachers in a junior school recommend spending approximately 45 minutes daily and 4 hours weekly on the teaching of Language 1 and 60 minutes per week on PE. Added to this is 60 minutes of discretionary time and as outlined above, this time may be due to increase further to become *flexible time* as part of the NCCA's (2016) proposals for structure and time allocations in a redeveloped primary curriculum. The benefits of this flexible time allocation model are twofold: 1) teachers have more time as a result of integrated teaching and 2) children benefit from the positive learning outcomes associated with integrated learning.

3.6 Professional Learning Communities

The following section will review the efficacy of professional learning communities as a tool with which to improve teacher knowledge and practice in relation to the implementation of a sensorimotor handwriting programme in the classroom. For the purpose of this research, the review of literature in the area will focus on identifying cultures of teaching as described by Hargreaves (1994, 2001, 2003) and the emergence of teacher learning communities as an effective tool for teacher learning and evaluating.

3.6.1 Teaching Cultures

Professional learning is a key element contributing to the success of teachers' work (Malone & Smith, 2010; DuFour, DuFour, Eaker, & Karhanek 2004; Hargreaves, 2003; Grossmann, Wineburg, & Woolworth, 2001). There are many ways in which teachers can develop professionally and the ways in which teachers learn varies. Teachers learn from many groups inside and outside the school. Smith (2015) describes provider-driven, 'traditional' forms of professional development or 'one-off' short modular courses. Teachers often learn in this way, from 'experts', by taking part in courses or from in-service training provided for staff. They may also engage in post-graduate studies. Hargreaves (2001) however, suggests that teachers perhaps learn the most from other colleagues within the workplace.

Formal discussions and structured processes such as peer mentoring and the assignment of 'subject experts' for example, are ways in which teachers share knowledge and practice within schools (Hargreaves, 2001). While such structured forms of occupational learning are somewhat valuable in delivering new information to teachers, they can be limited. The limitations include a lack of trust and understanding among teachers, an inclination to judge and evaluate rather than help, and significantly - an absence of the teacher's voice in the process (Hargreaves, 1993). Structured collaborative processes may lack authenticity and rather than giving teachers an opportunity to share ideas or initiatives, they may serve to achieve compliance to changes imposed by others (Hargreaves, 1993). Often these purposeful and planned forms of collaboration are not representative of the ways in which teachers truly learn from one another. Hargreaves (1993) argues that occupational learning happens day to day and is more informal in nature. Teacher learning is dependent on how teachers do and do not relate to one another and it is through these relationships and interactions that teachers evolve and develop and learn.

Teaching cultures are developed over long periods of time. They describe the beliefs, values, routines and assumed ways of doing things among teachers who have had to deal with similar demands and challenges for years. Teachers do not develop styles or strategies in isolation of one another. Teacher cultures have a powerful influence on the strategies, beliefs and values of each teacher in a school. Understanding how or why a teacher works in a particular way can be understood only within the context of the culture of which that teacher is part. Cultures in schools help to provide teachers with a sense of identity and purpose, giving meaning to their work. While teachers may be physically isolated in the classroom, teacher cultures, psychologically, allow teachers to feel connected with the outlooks and orientations of colleagues with whom they work or have worked in the past (Hargreaves, 2001). Teacher cultures and the way in which teachers relate to each other are among the most educationally significant aspects of teachers' work and provide a vital context for teacher development.

Content and form are two key dimensions of teacher culture (Hargreaves, 2001). Content describes "what we do around here" (p. 166). It refers to the beliefs, attitudes, and routines that are shared within a particular teacher group. Form then, consists of the characteristic patterns of relationship and forms of association between members of those cultures (Hargreaves, 2001). Form may be described as the way in which teacher relations are articulated. Changes in content, for example, the beliefs, values and routines of teachers, may be dependent on prior or parallel changes to the way in which teachers relate to one another. Forms of teacher culture allow us to understand more fully, the limitations and possibilities of teacher learning and educational reform. Hargreaves (2001) identifies four main forms of teacher culture, which are briefly described in the table below.

Table 3.6

Forms of Teacher Culture (Hargreaves, 2001)

Form	Description
Individualism	The way in which teachers work in isolation of the school community, with little benefit for teacher development and educational reform. Isolated teachers receive little feedback on their value, worth and competence and opportunities for praise and support are limited.
Collaboration	The way in which teachers are united in a community that is supportive, helpful, trustworthy and open. Cultures of collaboration are not formally organised, they form organically and operate on a day to day basis. Collaborative cultures harness the sharing of ideas, initiatives and resources among all members of the teacher community.
Contrived collegiality	Refers to the formal procedure of establishing collaborative groups with the purpose to achieve a greater sense of association among teachers, to foster sharing, learning and improvement of skills. Examples include peer mentoring, joint teaching and formally scheduled meetings. Contrived collegiality as a process lacks the time, care and sensitivity that is required to create an authentic and effective collaborative culture that fosters teacher learning and educational reform.
Balkanization	The way in which a culture is made up of separate groups of teachers as opposed to a whole school culture. Sometimes groups are competitive with others and groups tend to operate independently of others. Balkanization can lead to poor communication, indifference and conflict amongst members of the school community.

Teacher culture depending on its form, as highlighted above, has the potential to impact significantly on teachers' professional learning and development. Hargreaves's definitions of the forms of culture allow us to compare and contrast between teacher cultures and to identify the characteristics necessary to achieve optimum teacher learning and educational reform. A

collaborative teacher culture, according to Hargreaves, is the most effective form of culture within which teachers are afforded the opportunity to grow and develop as professionals. Cultures of collaboration are central to the success of teachers' daily work and are found in the everyday aspects of school life. Hargreaves (2001) emphasises the point however, that collaborative cultures do not arise by accident, rather they must be created, nurtured and sustained. He highlights the need for leadership, particularly through example - in developing a culture of collaboration and believes that it is through interpersonal relations rather than formal procedures that collaborative cultures evolve and are sustained (Hargreaves, 2001).

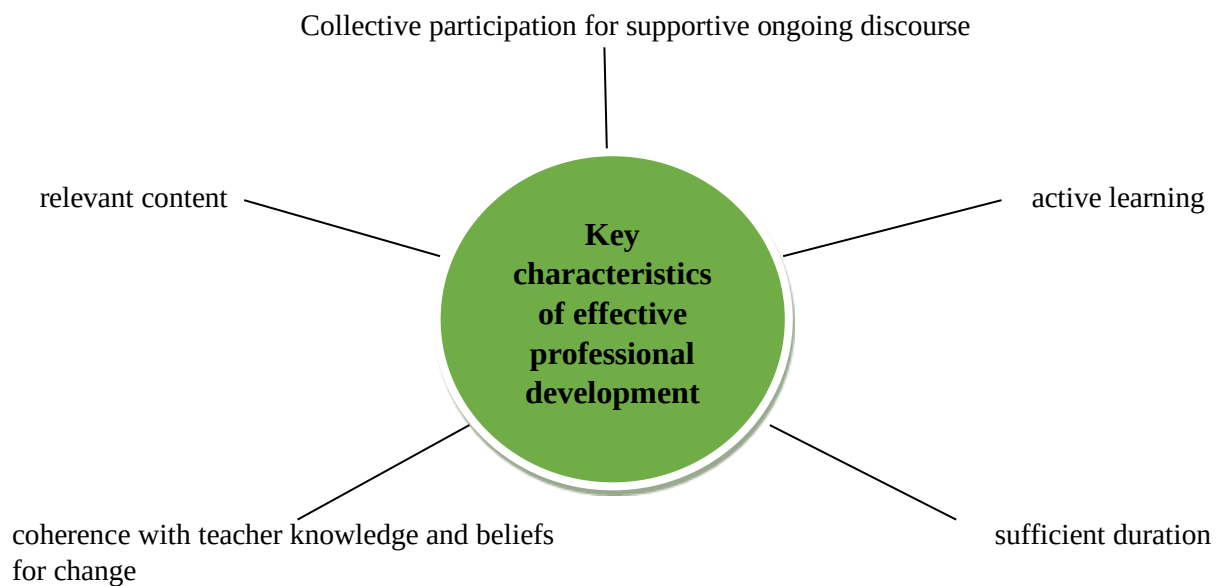
3.6.2 *A collaborative culture: The emergence of the professional learning community*

The past twenty years has seen a significant conceptual shift regarding the professional development of teachers. It is now widely recognised that teachers are key to educational change and the impact that professional development of teachers has on student learning is largely acknowledged (Eurydice, 2011). Increasing emphasis has been placed therefore on the importance of building teachers' capacity. Research indicates that educational reform is dependent on teachers' individual and collective capacity. Capacity refers to a combination of skills, motivation, culture and an infrastructure of support (Stoll et al., 2006). Such capacity building in turn is dependent on high quality, effective and professional development (Owen, 2014).

A number of key characteristics of high quality professional development that are needed for effective teaching and learning have been identified (Smith 2015, p. 248). Professional learning should be ongoing and sustained; involve active engagement on the part of the participants; be job-embedded and be collaborative and collegial in nature. Relevant content, collective participation, active learning, coherence with teacher knowledge and beliefs are noted as critical components of effective professional development (Desimone, 2009).

Figure 3.6

Desimone's key characteristics for effective professional development (Owen, 2014)



Professional development workshops or courses run over a short period of time have been shown to have a limited impact on classroom practice (Smith, 2015). For true learning to occur, it is critical that teachers become “facilitators of learning, co-learners, and negotiators, in addition to forging strong relationships with students and working with colleagues in new ways such as interdisciplinary teams or collaborating regarding multi-age student cohorts” (Owen, 2014). There is a need therefore, to provide opportunities for professional development that promotes reflective practice and allows teachers to rethink classroom roles and student expectations (Darling-Hammond & McLoughlin, 2011).

School-based professional learning communities have been shown to be an effective way in which to achieve educational reform (Cochran-Smith & Lytle, 2009). Professional learning communities involve teachers working together in collaboration, with effective communication and the sharing of knowledge (Cochran-Smith & Lytle; 2009; Hargreaves & Fullan; 1992; Grossmann, Wineburg, & Woolworth, 2001). Professional learning communities

are described by DuFour (2004) as a group of individuals who come together who share a common interest in educational reform. Three key principles underpin a sustainable professional learning community model that can become embedded in the school culture. They are a focus on results, a culture of collaboration and ensuring that all children learn. Table 3.7 below describes those key principles in further detail.

Table 3.7

Key principles of professional learning community (DuFour, 2004)

Key Principle	Description
A focus on results	The work of a professional learning community involves identifying the current level of student achievement, establishing a goal to improve the current level, working together to achieve that goal, and providing periodic evidence of progress.
A culture of collaboration	Collaborative conversations within the professional learning community call on teachers to share what has traditionally been private—objectives, strategies, resources, questions, concerns, and results. These discussions provide opportunities for teachers to support and listen to one another, and are explicitly structured to improve the classroom practice of teachers—individually and collectively
Ensuring that all children learn	The core purpose of a professional learning community should be ensuring that students experience success in their learning. A key question for a professional learning community should be ‘how will we respond when a student has difficulty learning?’ This reflective practice ensures that teachers work together to analyse and improve their classroom practice for all children.

The concept of professional learning communities informed the professional development aspect of this research study. The professional development that was designed as part of the research (detailed in the following chapter) was collaborative in nature with a strong

focus on the children's learning and on reflective practice. The initial professional learning day with teachers focused on the current level of handwriting achievement for each cohort of children, on establishing a goal to improve that level and agreeing to provide periodic evidence of progress. Periodic evidence was provided by photographs and comments using a WhatsApp group involving all of the participating teachers and the researcher. A second professional learning day involved collaborative conversations where teachers shared questions, concerns, progress and resources. The purpose of this session was to provide opportunities for teachers to listen to one another, to provide support for one another and to improve classroom practice both individually and collectively. Reflective practice was built into both professional learning days by focusing on how teachers could respond to individual children who were experiencing difficulties in engaging with the sensorimotor handwriting programme.

3.7 Conclusion

Throughout this chapter, various concepts relating to the research questions of this study were explored and relevant research in relation to the research question was evidenced and critiqued. Motor development in infancy was explored, in particular the role of the primary reflexes and how the persistence of particular reflexes impacts on handwriting development. The influence of a number of environmental influences on motor development were explored, including the importance of access to safe, outdoor space for physical play and the quality of ECEC settings.

Motor development across the 1999 Primary Curriculum, the new Primary Language Curriculum and the Aistear framework was reviewed and the issue of time allocation in relation to motor development was explored. The idea of flexible time as part of the revised curriculum was noted as a positive move towards a more integrated and holistic approach to teaching and learning in the early years. Upon review, it appears that a more fluid and flexible time allocation

model may offer scope for infant teachers to place more emphasis on the development of motor skills, should a particular cohort of children require it.

Finally, school culture and the key characteristics of effective professional development for teachers are described (Smith, 2015; Owen, 2014). Dufour's (2004) three principles of a sustainable professional learning community are outlined and are noted as being key to informing the design of the professional learning for teachers as part of this research study. Taking into account the complexity of the interplay between the individual components of motor development, handwriting developing and environmental influences, this study requires a research design that is appropriately complex and effective in establishing the baseline measures of motor proficiency for children across DEIS and non-DEIS schools; as well as capturing the experiences of the participating teachers in relation to the implementation of the programme and its impact on the participating children. The following chapter will provide an overview of the research design that was employed to explore such a focus and to address the research questions that are outlined in Chapter 1.

CHAPTER FOUR: METHODOLOGY

4.1 Introduction

This chapter will outline the research methodology that was employed to investigate the four aims of my research study as outlined in Chapter One. This study explores young children's sensorimotor development and their emergent handwriting skills. In particular, it focuses on how teachers employed a sensorimotor handwriting programme in junior infant classrooms, to address the sensorimotor needs of children in relation to their emergent handwriting development. According to Denzin and Lincoln (2005), a research methodology should not only outline the research paradigm, the research strategy and the research methods, but it should involve the researcher also. For this reason, the context of my research is described below, positioning myself, the researcher within the study.

As a teacher in an infant boys' DEIS school for eleven years, and having taught in both the mainstream setting and the SEN setting, I observed an increase in the number of children presenting in Junior Infants with underdeveloped motor skills. I saw the effects that poor motor proficiency had on the emergent handwriting skills of those children and subsequently, on their motivation and enjoyment of handwriting. The teaching of handwriting skills was a frequent item on the agenda at staff meetings, and teachers repeatedly reported children's struggles with handwriting from junior infants through to 1st class. As an SET teacher, I worked closely with occupational therapists in relation to children with handwriting difficulties who had specific developmental disorders, including Autism Spectrum Disorder (ASD) and Developmental Coordination Disorder (DCD). I learned from the occupational therapists that I worked with, that motor proficiency plays a key role in the development of emergent handwriting skills. In particular, I was interested in the emphasis that was placed on developing gross motor proficiency in relation to emergent handwriting skills.

Having also worked closely with the families of the children in my classes, and having visited many of their homes on different occasions, I developed an awareness of the impact that environmental factors can have on the development of motor proficiency in the early years. I began to understand that certain environmental factors limited the opportunities that children were being afforded to develop their motor skills in those critical early years, both in the home and in the wider community. I wondered whether this observation was specific to the context in which I was teaching.

This led to my decision to test a cohort of 178 junior infant children from both advantaged and disadvantaged communities in the wider Dublin area, using a standardised test of motor proficiency. Based on the results of this initial testing phase, I adapted a sensorimotor handwriting programme that was informed by both the quantitative data provided by the standardised test, and by relevant literature in the area. The teachers of the 178 participating children implemented the programme over a 16-week period, during which time I visited each site to observe the programme in action. Post-implementation of the programme, all of the children were invited to be re-tested to obtain a comparative score for motor proficiency at this stage of the research study. Semi-structured interviews with the participating teachers were conducted post-implementation of the programme. The variety of research methods that were employed to meet the specific needs of the research questions means that the overarching methodology employed for my study is a mixed method approach.

This chapter will firstly outline the research paradigm for the study including the ontological and epistemological framework which underpins this research, and the justification for a mixed method approach. The research methods and the design of each phase of the study will be outlined, followed by the aims, objectives and hypotheses of each phase. Next, the research participants and the key ethical considerations will be outlined and both the qualitative

and quantitative data analysis processes will be clearly described. Finally, limitations and measures that were taken to establish trustworthiness will be outlined.

4.2 Research Paradigm

4.2.1 *My ontological position*

The choice of methodology, in this case mixed methods, must be informed by a particular theoretical perspective which Crotty (2013) defines as “the philosophical stance informing the methodology and thus providing a context for the process and rounding its logic and criteria” (p. 7). In the case of this research study, the use of a standardised test as a method belongs to the scientific or positivist domain, while the use of semi-structured interviews and observation days are firmly positioned within the interpretivist domain. Both perspectives inform the methodology for this study.

The focus of the positivist research paradigm is generally on the objectivity of the research process (Creswell, 2008). Positivism can be described as the belief that one reality exists and that knowledge is objective; that science provides us with the clearest possible ideal of knowledge (Cohen, Manion, & Morrison, 2017). Historically, the French philosopher Auguste Comte initiated the term positivism (Cohen et al., 2017). Comte’s positivism was based on the idea that all genuine knowledge is based on experience and can only be validated by observation and experiment. In other words, the nature of knowledge can be verified by developing hypotheses and verification of these hypotheses is garnered through ‘*scientific experimental*’ approaches, using quantitative methods (Guba & Lincoln, 2005). The social world is excluded by the researcher within the positivism research paradigm, with Guba and Lincoln (2005) noting that the researcher acts as a ‘*disinterested scientist*’ taking an objectivist stance. Positivism therefore, depends on scientific methods to measure social phenomena and relies predominantly on quantitative, statistical information generated from data gathered through objective inquiry, to establish ‘true’ facts or universal laws. The limitations of

positivism are highlighted in its application to the study of human behaviour, where the complexity of human nature and the immeasurable quality of social phenomena is in stark contrast with the order and predictability of the natural world (Cohen et al., 2007). Within positivism, people are treated as scientific objects rather than partners whose views are respected and valued (Hagan, 2013). Cohen (2007) describes that the “difficulty in which positivism finds itself is that it regards human behaviour as passive, essentially determined and controlled, thereby ignoring intention, individualism and freedom” (p.16). This is particularly relevant to classroom-based research where the issues that arise in teaching, learning and human interactions present a difficulty to a solely positivist approach and require the kinds of interpretations that interpretivist research provides.

The focus of the interpretive paradigm is on trying to understand the subjective world of human experience, to understand the individuals being researched and their natural lived experiences, in the case of this research study, to gain understanding of teachers’ perceptions of sensorimotor development and emergent handwriting skills. It is concerned with the individual, and the individual’s penchant for interpreting situations through their own eyes, in particular socio-cultural, socio-temporal and socio-spatial contexts (Cohen et al., 2012). In relation to this study, teachers are situated in DEIS and non-DEIS contexts. This in turn may influence how they interpret situations and act upon them, depending on the context in which they teach. The quantitative data gathered through the standardised testing phase informed the insights and experiences that emerged throughout the observations and the semi-structured interviews with teacher participants (Cohen et al., 2007).

4.2.2 *My epistemological position*

Those theoretical perspectives in turn are underpinned by a particular epistemological perspective, which Crotty defines as “the theory of knowledge embedded in the theoretical perspective and thereby in the methodology” (p. 7) and which attempts to explain “how we

know what we know and to determine the status to be ascribed to the understandings we reach” (p. 18). A pragmatist philosophy underpins the epistemological perspectives that inform the methodology in this research study. Pragmatism is focused on framing or answering the research question or problem (Clarke & Visser, 2019; Biesta & Burbules, 2003). It uses a variety of methods because they are fit for purpose.

Pragmatism as a paradigm enabled the researcher in this case, to adopt a sequential design for this research study. Phase one of the research employed a quantitative method in the form of a standardised test. Phase two followed and involved the use of two qualitative methods – observation and semi-structured interviews and the quantitative method from phase one was repeated. Observation of the programme in action was important in informing the topics for inclusion in the semi-structured interviews. This employment of mixed methods ‘worked’ or allowed the research question to be answered through a combination of quantitative and qualitative methods, enabling the researcher to learn more about the research topic (Cohen et al., 2012).

4.2.3 *Choosing a research approach*

Methodology is defined as “the strategy, plan of action, process, or design, lying behind the choice and use of particular methods and linking the choice and use of methods to the desired outcomes” (Crotty, 1998, p.3). As outlined above, a mixed methods approach, often aligned to the pragmatist paradigm, appeared to be the most suitable methodology in terms of this research study, which employs both qualitative and quantitative methods of data collection. Mixed methods as a research methodology is effective in addressing multiple research questions that cannot be satisfactorily answered by a singular approach. The concept of mixing methods and combining qualitative and quantitative research originated in 1959 when Campbell and Fisk employed multimethods to study the validity of psychological traits to

“ensure that the variance was reflected in the trait and not in the method” (Creswell, 2004, p.174).

Mixed methods research is defined by Johnson and Onwuegbuzie (2004) as “the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study” (p. 17). It has become popular as the newest development in research methods according to Creswell (2012). Johnson and Onwuegbuzie (2004, p. 17) describe mixed methods as the ‘third wave’ or third research movement that moves past the paradigm debate by providing a ‘logical and practical’ alternative approach. Advocates of mixed methods research suggest that linking both quantitative and qualitative data enables confirmation and corroboration of information and provides a clearer representation of the phenomenon under study (Creswell, Plano, & Clarke, 2007). Reiterating this view, Tashakorrie and Teddlie (2003, p. 15) state “a major advantage of mixed methods research is that it enables the researcher to simultaneously answer confirmatory and exploratory questions and therefore verify and generate theory in the same study”. The rationale behind using mixed methods is that there could be more learned about the research topic by combining the strengths of qualitative research with the strengths of quantitative research while compensating for weaknesses of each method at the same time (Johnson & Onwuegbuzie, 2004). This principle, that using both qualitative and quantitative approaches provides a better understanding than either approach alone, is referred to as the “fundamental principle of mixed methods research” (Johnson & Onwuegbuzie, 2004, p. 18).

One of the advantages of using a mixed methods approach is that triangulation is a natural part of the process, on account of the variety of methods being employed, and also due to the fact that the data are mixed during the research process (Creswell, 2007), allowing the researcher to draw insight from a variety of sources either sequentially or concurrently. Denzin first used the term *triangulation* in 1978 to describe this integration of methodologies in the

study of the same phenomenon (Creswell, 2004). The concept of triangulation was based on the assumption that any biases inherent in any single method would be neutralised when used in combination with other data sources, investigators and methods (Creswell, 2004). A mixed method approach, should therefore, in theory, overcome potential shortcomings of both qualitative and quantitative traditions.

Creswell (2009) describes how integration of data might occur (p. 14). For example, the results from one method could help to identify participants to study or question to ask for the other method. Additionally, both data sources could be merged into one large database or the results used side by side to reinforce each other. Key to this research, Creswell notes, that “methods can serve a larger, transformative purpose to advocate for marginalised groups” (p.14). Triangulation of data sources can strengthen the research by gathering and integrating different kinds of data bearing on the same phenomenon (Creswell, 2012). In relation to this study, the benefit of using a mixed method approach was that it enabled the researcher to triangulate the data gathered from the standardised test, the observation days and the semi-structured interviews. The concurrent nature of the data collection process allowed for cross-validation of findings to occur and presented an opportunity to determine if there was convergence, differences or a combination of both emerging from the data (Creswell, 2009). The researcher was able to process and analyse the quantitative data from phase one and it provided the rationale for adapting a sensorimotor handwriting programme for implementation in junior infant classrooms to address the emergent handwriting skills of junior infant children. The observation days of the programme in action provided qualitative data in the form of Field Notes that further contributed to answering the research questions, and informed the topics for the semi-structured interviews in phase two. Teachers’ knowledge, perceptions and understanding of sensorimotor development and emergent handwriting were gathered and used

to interpret and support the quantitative data that were gathered pre- and post-implementation of the programme.

4.3 Ethical Considerations

Ethical considerations were addressed carefully throughout each phase of this research study. The researcher was guided and informed by the DCU Ethical Guidelines and received ethical approval from DCU's ethical governing body in May, 2018. Relevant literature in the area also informed and guided the ethical procedures that were followed throughout this research process, in particular Denzin and Lincoln (2005), who challenge a number of ethical considerations including consent and beneficence. The ethical considerations that were deemed pertinent to this research study are outlined in detail below, and include anonymity, beneficence and autonomy.

4.3.1 *Anonymity*

Parents of the participating children were assured that their child's right to anonymity would be protected. This information was communicated to parents by sending home a letter with each child detailing the nature and purpose of the research study and a consent form (Appendices 1 and 2). Parents were informed that the class teacher and the school principal would have access to each individual child's BOT-2 test results and that results would be communicated to parents verbally, and in writing if requested. Permission was sought from parents to take photographs of the programme being implemented during the observation days. Parents, teachers and school principals were assured that the names of their children, teachers and school would not be used in the writing up of this research study, and that pseudonyms would be used instead. Permission was sought specifically from the parents of Jayden; whose photograph is used in the concluding chapter of this thesis.

4.3.2 *Beneficence*

According to Denzin and Lincoln (2000), “beneficence, including risks and benefits, cannot be quantified, nor can a clear meaning be given to acceptable risk or benefits that clearly serve a larger cause” (p. 37). It is argued that the researcher must consider both the costs and the benefits for participating in the research, and that justice extends far beyond what may be considered ‘typical’ ethical considerations, for example, fair selection procedures. Denzin and Lincoln (2000) argue that a commitment to justice by the researcher should result in an adherence to the principles of love, care, kindness and fairness and that shared responsibility and a commitment to honesty, truth and balance is paramount.

In line with this guidance, the welfare of the participating children remained the principal concern of the researcher throughout the research study. Throughout the testing phase, the researcher endeavoured to ensure that each individual child felt safe and secure in the testing environment. Each testing environment in each school was selected in collaboration with the class teacher and in close proximity to the classroom. The researcher visited each classroom prior to the commencement of the testing phase to familiarise the children with the researcher and to prepare the children for the process. This involved showing the children some of the testing equipment (a balance beam, a tennis ball) and describing what games they would be participating in.

A number of direct benefits to participants were identified during phases one and two of this study. They were as follows:

1. Participating teachers were provided with all of the necessary resources (Appendices 3, 6, 7, 13) to implement the sensorimotor handwriting programme.
2. Participating teachers were invited to attend two training days on the sensorimotor handwriting programme in Marino Institute of Education, Dublin
3. Every child who participated in phase one was provided with the opportunity to participate in a 16-week sensorimotor handwriting programme which was adapted to meet the needs

of the children based on the results of phase one of the study and informed by relevant research in the area (Appendix C).

4. The 178 children who participated in phase one were provided with the opportunity to be re-tested using a standardised test of motor proficiency, the BOT-2 (Bruininks & Bruininks, 2005). This provided teachers and parents of the participating children with further rich and comprehensive data to describe children's progress in relation to their motor proficiency post-implementation of the sensorimotor handwriting programme.
5. Each class teacher and each principal of the participating schools received a written copy of the standardised test results for motor proficiency at two points over the school year. These test results were communicated to parents of the participating children.

A direct benefit of this phase of the study was that each child was tested using a standardised test of motor proficiency, the BOT-2 (Bruininks & Bruininks, 2005) This provided the teachers of the participating children with rich and comprehensive data in relation to individual children's motor proficiency upon entry into school.

4.3.3 *Autonomy*

Based on the principle of autonomy or self-determination (Denzin & Lincoln, 2005, p. 140), all participants, children and teachers, were fully informed about the nature of the study and were afforded the opportunity to make their own decisions about whether they would like to participate. While consent or autonomy might usually be thought about in terms of 'informed consent' and 'consent forms', Denzin and Lincoln (2005, p.37) point out that true consent is more than merely seeking the agreement of people to participate in the research study. They write about consent as being respectful, caring for others and treating people with dignity. The researcher as part of this study endeavoured to carry out true consent throughout each phase of this study, in relation to the child and teacher participants. The participating teachers were informed that their anonymity could not be fully guaranteed as there was the possibility that

their colleagues who were aware of their involvement and may later read the thesis or publication of the research findings may be able to identify that participant teacher from the school and teacher demographics

Children's rights to partake in the decision-making process were acknowledged by seeking their assent using an age appropriate visual consent form (Appendix D) and by issuing a plain language statement. If children refused to participate in the test or expressed a desire to withdraw or showed signs of distress, the researcher acknowledged and respected this. There were two occasions whereby the children did not want to perform a task or a number of tasks and the researchers respected their decision to opt out of the task. There was also an occasion whereby a child for whom English was not their first language, had difficulty in accessing the language associated with the tasks. Visual prompts were used in this case and the researcher endeavoured to make sure that the child felt reassured and that their needs and wants were being communicated.

Prior to collection of the data during phase one, written consent was obtained from the caregivers of child participants. The researcher met with the parents and caregivers in three of the DEIS schools where the principal deemed it important to verbally impart information about the study and to ensure that parents fully understood what their child's participation involved and to answer any questions that parents may have had.

4.4 Overall Research Design

Phase one of this research study employed a largely quantitative approach. This phase of the study sought to identify a baseline measure of motor proficiency of 178 junior infant children across six schools, three DEIS schools and three non-DEIS schools in the Dublin area, using a standardised test of motor proficiency - the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2), (Bruininks & Bruininks, 2005). Once a baseline measure across all schools was identified, the researcher sought to compare measures of motor proficiency across

DEIS schools and non-DEIS schools. Throughout this initial data collection phase, the researcher also made qualitative field notes based on observations of the children in each school, and based on incidental conversations with teachers and principals in each school.

Phase two of this research study employed a mixed methods approach, whereby both qualitative and quantitative approaches were used. Phase two involved the adaptation of, and the implementation of, a sensorimotor handwriting programme (Keller, 2007). The sensorimotor handwriting programme, described in more detail later, was informed by the data gathered in phase one, and supported by the relevant literature as reviewed in Chapter Two.

The sensorimotor handwriting programme was implemented by 10 junior infant class teachers in all six schools of the 178 participating children from phase one. The programme was implemented over a 16-week period (October 2018 - March 2019). During this phase, the necessary supporting resources for the implementation of the sensorimotor handwriting programme were planned and produced. The teachers of the participating children from phase one attended two professional learning days (October 2018, January, 2019), in relation to delivering the sensorimotor handwriting programme during this second phase of the study. The initial training day (October, 2018), happened prior to implementation of the programme and the second training day (January, 2019), took place at the halfway point, 8-weeks into implementation of the programme. Throughout the 16-week implementation period, the researcher visited each site to observe the research participants (teachers and children), engaging with the sensorimotor handwriting programme. Field notes from those observation days support the qualitative findings outlined in Chapter 8.

Post-implementation of the programme, a quantitative approach was employed for the second time, whereby all of the participating children were retested using the same standardised test of motor proficiency – the BOT-2. This second testing period took place throughout May and June 2019. Post-implementation of the programme, a qualitative exploratory approach was

also taken, whereby semi-structured interviews were conducted (June 2019), to explore the knowledge and understanding of the participating teachers of the participating children, in relation to motor development and emergent handwriting skills. The semi-structured interviews were used also to determine the perceived efficacy by teachers of the sensorimotor handwriting programme. Figure 4.1 below illustrates the overall research design for this study.

Research Design of the Study

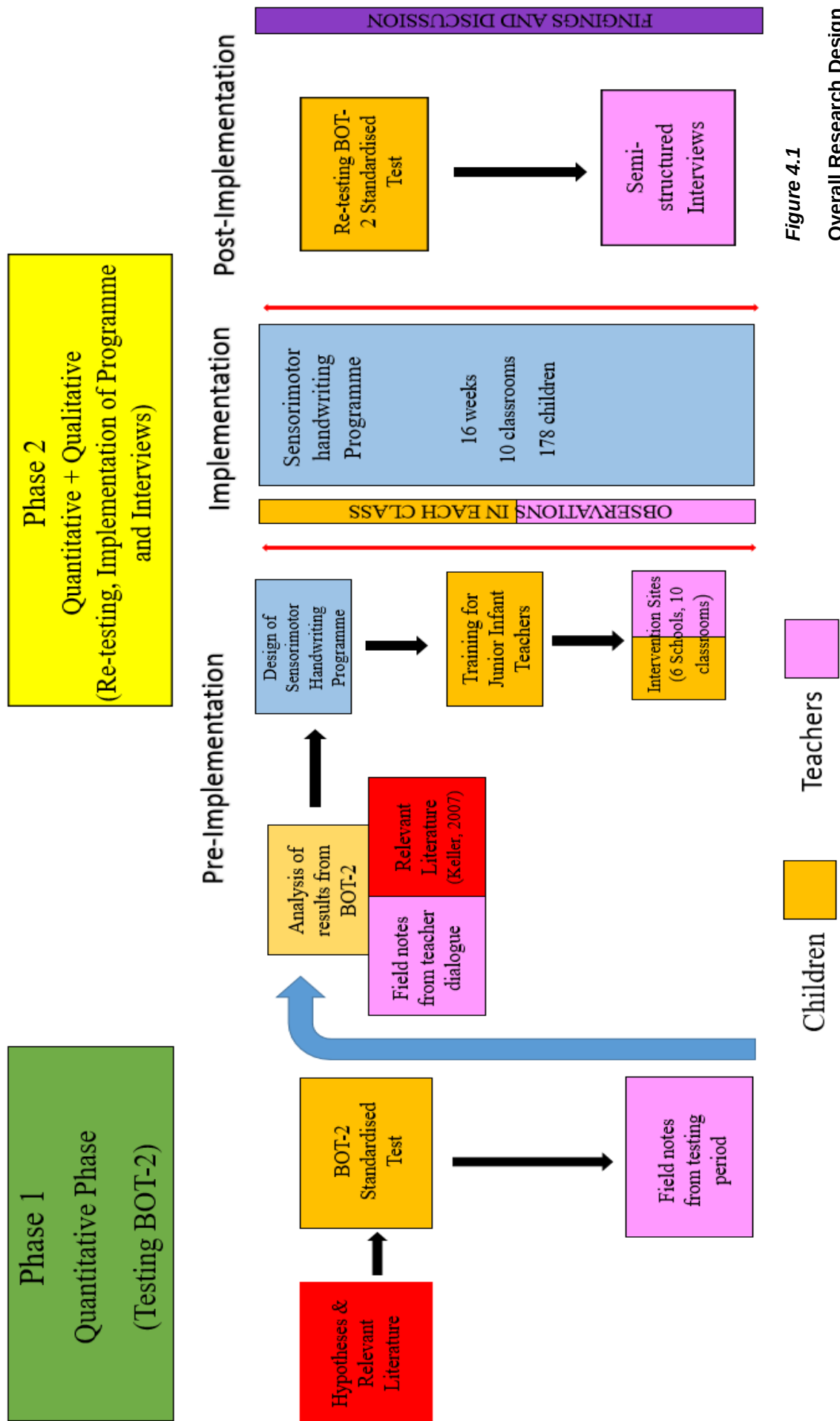


Figure 4.1

Overall Research Design

4.5 Aims, Objectives and Hypothesis

4.5.1 Aim of phase one

The primary aim of this initial phase was to administer a standardised test of motor proficiency (BOT-2), to a cohort of 178 junior infant children across the three DEIS and three non-DEIS schools in the Dublin area. In doing so, the aim was to quantitatively capture comprehensive data that would provide a baseline measure of the motor proficiency of a sample of junior infant children upon entry into school, across a diverse range of socio-economic backgrounds.

4.5.2 Objectives for phase one

The objectives for phase one were:

- 1) To obtain a baseline measure of the motor proficiency of a sample of 178 junior infant children upon entry into school, across six schools, three DEIS schools and three non-DEIS schools in the Dublin area.
- 2) To investigate whether there were differences in the motor proficiency of children upon entry into school in DEIS schools and in non-DEIS schools.

4.5.3 Hypothesis

The above objectives were based on the existing empirical evidence presented in chapter two in relation to the current decline in children's motor development (O'Brien, Belton, & Issartel, 2016), and in relation to the impact of sociocultural factors on motor proficiency (Behan et al., 2019). The hypothesis stems from the researcher's own experience of teaching in a DEIS school for 12 years also. The researcher observed a decline in children's motor proficiency during her time teaching in a North inner city junior school and noted a number of environmental factors that appeared to inhibit motor development. This led to the hypothesis for phase one of this research study – that amid concerns of a general decline in children's motor development, children entering junior infants in DEIS schools have lower levels of

motor proficiency than those in non-DEIS schools as a result of environmental and socioeconomic factors.

4.5.4 *Aim of phase two*

The first aim of phase two was to equip the participating teachers with the appropriate knowledge, information and resources that would enable them to implement the sensorimotor programme in their classrooms. The second aim was to obtain a measure of the participating children's motor proficiency post-implementation of the sensorimotor handwriting programme. The final aim of phase two was to gather rich qualitative data that would describe teachers' existing knowledge and understanding of the links between motor development and emergent handwriting skills in the early years and to find out whether or not teachers perceived the sensorimotor programme to be effective in improving children's emergent handwriting skills and to identify individual components of the programme that were perceived as effective.

4.5.5 *Objectives for phase two*

The objectives for phase two were to:

- Equip the participating teachers with the appropriate knowledge, information and resources to enable them to implement the sensorimotor programme in their classrooms.
- Obtain a measure of the motor proficiency of the participating children from phase one, post-implementation of the sensorimotor handwriting programme
- Explore teachers' existing knowledge and understanding of motor development and emergent handwriting skills
- Determine whether or not teachers' perceived the sensorimotor handwriting programme to have been effective in improving children's handwriting skills
- To ascertain individual components of the programme that teachers perceived to be effective

4.6 Design of the Sensorimotor Handwriting Programme

The Sensorimotor Handwriting Programme (Figure 4.2) is based on the format of the Handwriting Club programme by Melissa Keller (2001). The programme was adapted in relation to the content, the format, the implementation and the accompanying resources (Appendix M). The adaptations to the programme were based on relevant literature in the area (Dinehart, 2014) and the quantitative data collected during phase one using the BOT-2 standardised test of motor proficiency. Incidental conversations with teachers and principals and observational field notes from the testing period also during the initial data collection phase informed the design of the programme.

Dinehart's (2014) review of current research in the area of handwriting in early childhood education informed the design of the Sensorimotor Handwriting Programme in four major ways:

- (a) the programme should include explicit handwriting instruction relating to letter form rather than take a purely sensorimotor approach;
- (b) the programme should be delivered as early on as possible in the school year to respond to the need to develop 'handwriting readiness' skills for the development of handwriting later in the year;
- (c) individual and specific planning of instruction to meet individual needs and consistent reviewing of student's progress is key to the success of the programme. Therefore, observations of the programme being implemented took place over the 16-week implementation period;
- (d) an intervention that was easy to implement and deliver by teachers was noted as a benefit. Therefore, professional development days were facilitated for teacher participants and a user friendly resource pack were key elements of this programme.

Based on those four key findings from Dinehart's (2014) review of the current research and on observations and incidental conversations with teachers and principals during the initial data collection phase, the following guiding principles for the Sensorimotor Handwriting Programme were developed.

The programme should:

- be delivered in a mainstream class setting, by non-specialists (teachers) and without the use of expensive equipment
- include a Sensorimotor Handwriting Programme manual and a PowerPoint presentation for the programme to be easily implemented and replicable
- include activities that incorporate the sensorimotor skills that are prerequisites of handwriting: proprioception, visual perception and fine motor skills
- include sensory-based strategies that can be facilitated by non-specialists
- include explicit teaching strategies in relation to letter formation
- be high in intensity and duration
- be evaluative - children to be tested pre- and post-programme using a standardised measure, teacher interviews and parent questionnaires
- take place in an Irish / European context
- be informed by the curriculum (NCCA, 1999), teacher guidelines, and resource materials for teaching handwriting (NCCA, 2017).



Sensorimotor Handwriting Session Format

1. Gross Motor Warm-Up Activities (5 minutes)

Choose 1 or 2 activities from a selection of activity cards (e.g. crab walk, jumping jacks, balance on one leg, cross crawls)

- Weeks 1-4: Proprioception
- Weeks 4-8: Balance & stability
- Weeks 12-16: Bi-lateral coordination and crossing the midline

2. Fine-Motor Warm up- Activities (5-10 minutes inclusive of distributing materials)

Choose an activity per group / per child each day making sure that all activities are covered over the course of the 16 weeks.

- 4 weeks: Clay, therapy putty, silly putty, play-doh
- 4 weeks: Clothespin games, tongs, tweezers, chop sticks
- 4 weeks: Interlocking construction games, mega blocks, lego, links
- 4 weeks: Squeezey toys and materials, foam balls, rubber balls, popping bubble wrap

3. Visual Perception Work (5 minutes)

Complete one worksheet per session. Worksheets cover the following skills

- Form and constancy
- Visual discrimination
- Visual Closure
- Visual Sequencing

4. Letter Introduction (2-3 minutes)

- Teacher models writing the letter on the board and describes the steps (can use Jolly Phonics here)
- If not introducing letters yet, explicit modelling of pre-writing patterns
- Students imitate by writing in the air using large arm movements and repeating the steps aloud
- Students then continue to say the steps while writing on the table with pointer finger

5. Guided Practice (10 minutes)

- Write on board
- Write on another students back and have him or her guess the letter
- Write on large sheets using a range of materials : colour change markers, scented markers, battery operated pens, paint, chalk, finger paint, shaving foam.
- Write in sand, rice, lentils, glitter bags

6. Semi-independent practice (5-10 minutes)

- Write in handwriting copy or sheet with teacher monitoring

7. Independent Practice Homework

Figure 4.2

The Sensorimotor Handwriting Programme

4.7 Sampling

The participating children and the participating teachers and their schools were recruited using a purposive recruitment approach (Braun & Clarke, 2013). Potential schools that met the inclusion criteria (junior infant classes, DEIS and non-DEIS in Dublin) were identified and informed about the study by the researcher (Appendix E). If a junior infant teacher in the school was interested in being involved and inviting the children in their class to partake in the study, they were asked to inform the researcher by telephone or by email. The researcher then met with the teacher on the school site and provided further information about the study and consent and assent forms for the potential participating children and their parents.

4.7.1 *Inclusion and exclusion criteria*

The aim of phase one was to obtain a baseline measure of the motor proficiency of a sample of junior infant children upon entry into school across DEIS and non-DEIS schools. Therefore, children in junior infants in a DEIS or non-DEIS school, regardless of age were eligible to participate. Children presenting with developmental delays, ASD and/or any other additional needs were eligible to participate. The rationale for this eligibility criteria was based on the aim of phase one: to provide comprehensive and descriptive data on the motor proficiency of junior infant children upon entry into school. This study did not aim to gather data in relation to the motor proficiency of children with additional needs, rather it aimed to obtain a baseline measure of motor proficiency, in a sample cohort of typical junior infant classrooms, in the Dublin area. Therefore, it was reasoned that all children should be eligible to participate in the study.

Phase two involved the implementation of the Sensorimotor Handwriting Programme. All of the class teachers of the participating children from phase one were eligible to participate. All of the children who participated in phase one were eligible to take part in the programme, regardless of their score in the initial testing phase. The rationale for the inclusion of all children

in the sensorimotor handwriting programme was based on the data which showed that even those children who scored overall average or above on the BOT-2 Test of Motor Proficiency still had scores that were below average or well below average in individual subtests. These scores are outlined in further detail in Chapter 4. The decision to include all of the children in the programme was based on the rationale therefore, that all of the children stood to benefit from participation in the programme.

4.7.2 The research participants

The sample for this research study consisted of 178 junior infant children. Table 4.1 illustrates the participant demographic.

Table 4.1

Table 3.6.1 Descriptive statistics			
	N	% Male	%Female
All participants	178	42%	58%
DEIS Schools	86	33%	59%
Non-DEIS schools	92	66%	41%

The participating children for phase one of the study came from six schools, three DEIS schools and three non-DEIS schools across the wider Dublin area. Provided below is a detailed breakdown of the schools that the participating children attended (Table 4.2).

Table 4.2**The schools of the participating children**

Pseudonym	School Type	School Demographic
School A	DEIS	Located in the North inner city in Dublin with approximately 100 students. It is an infant boys' school.
School B	DEIS	Located in the North inner city in Dublin with approximately 300 students. It is a vertical girls school
School C	DEIS	Located in the Northside of Dublin city. It has approximately 130 students. It is a mixed infant school
School D	Non-DEIS	Located in a South Dublin suburb. It has approximately 700 students. It is a vertical mixed school.
School E	Non-DEIS	Located in North County Dublin. It has approximately 400 students. It is a vertical mixed school.
School F	Non- DEIS	Located in North Dublin. It has approximately 900 students. It is a vertical mixed school.

Participants for phase two comprised of the 10 junior infant teachers of the 178 participating children from phase one. The 10 teachers therefore, also came from the six schools in the Dublin area, as outlined above. Table 4.3 illustrates the teacher participant demographic. Participants in phase two also included the 178 children who were tested in phase one of the research and who then took part in the sensorimotor handwriting programme. Of those 178 participating children, 162 were in school and present for the second testing period. This limitation of the comparative data is outlined in further detail later in the chapter.

Table 4.3**The Participating Teachers**

Pseudonym	School	Participant Demographic
Eleanor	School A	Early forties female teacher in a DEIS schools with 16 years' experience in DEIS school only
Barbara	School A	Late twenties female teacher in a DEIS school with 3 years' experience in DEIS school only
Susie	School B	Early thirties female teacher in a DEIS school with 8 years' experience in DEIS school only
Sarah	School B	Early forties female teacher in a DEIS school with 14 years' experience in DEIS school only
Nicola	School C	Mid- twenties female teacher in a DEIS school with 8 years' experience in DEIS school only
Aoibheann	School C	Mid-twenties female teacher in a DEIS school with 7 years' experience in DEIS school only
Greta	School D	Early thirties female teacher in a non-DEIS school with 4 years' experience in both DEIS and non-DEIS schools
Hannah	School E	Mid-twenties female teacher in a non-DEIS school with 3 years' experience in non-DEIS school only
Isla	School E	Mid-twenties female teacher in a non-DEIS school with 6 years' experience in non-DEIS school only
Vivienne	School F	Late thirties female teacher in a non-DEIS school with 16 years' experience in non-DEIS school only

4.8 Data Collection**4.8.1 The BOT-2 Standardised Test of Motor Proficiency**

The BOT-2 standardised test of motor proficiency was used twice during the study. The first use was at the outset to obtain a baseline measure of the motor proficiency of all 178 participating children and to compare motor proficiency of those children in DEIS and non-DEIS schools. The second was post-implementation of the programme, for the purpose of obtaining a comparative measure of motor proficiency across all participating children and to compare post implementation, motor proficiency of those children in DEIS and non-DEIS

schools. While it was the intention that all of the participating children would re-tested using the BOT-2, as stated, a number of children were absent on the scheduled day of testing, resulting in 163 of the original 178 participating children being re-tested.

The BOT-2 is a standardised, norm-referenced, individually administered measure of fine and gross motor skills of children aged 4 to 21 years. It is intended for use by practitioners and researchers as a discriminative and evaluative measure to characterize motor performance, specifically in the areas of Fine Motor Precision, Fine Motor Integration, Manual Dexterity, Bilateral Coordination, Balance, Running Speed and Agility, Upper-Limb Coordination and Strength. Among the intended uses for the BOT-2 is to assist with research objectives and to create and to develop motor training programmes (Brown, 2019). This is one of the reasons that the BOT-2 was deemed a suitable testing instrument for this research study.

The BOT-2 has 53 items (Complete Form) or 14 items (Short Form) categorised into four composites that are further arranged into eight subscales: fine motor manual control composite (fine motor precision; fine motor integration), manual coordination composite (manual dexterity; upper-limb coordination), body coordination composite (bilateral coordination; balance); and strength and agility composite (running speed & agility; strength). Scores for the Complete Form and the Short Form are reported as total point scores; standard scores; or percentile ranks. Findings can be reported as Descriptive Categories ranging from “Well-Below Average” to “Well-Above Average”.

The Complete Form of the BOT-2 (53 items) is time consuming to administer and score, requiring approximately between 50 and 70 minutes to administer the complete form, with scoring and completion of the record form reported to take approximately 20 minutes (Deitz, Kartin & Kopp, 2007). In the case of this study, the role of the researcher was to administer and score all of the tests to the 178 participating children over two time periods of time during

the school year. Time as a limitation therefore was acknowledged, which led to the decision to employ the BOT-2 Short Form instead of the full version. Below is an example (Bruininks & Bruininks, 2005) of the BOT-2 Short Form that was administered to all participating children (Figure 4.3). The duration of each individual test was between 20 and 30 minutes, with scoring time approximately 10 minutes.

Figure 4.3

BOT-2 Short Form

Figure 3.21 Completed Short Form page

SHORTFORM														
Subtest 1: Fine Motor Precision											Raw Score	Point Score		
3	Drawing Lines through Paths—Clocked	0 errors	Raw Score	0-21	0-10	10-14	15-18	19-21	22-25	26-29	30	7		
6	Folding Paper	6 points	Raw Score	0	1-2	3-4	5-6	7-8	9-10	11	12	3		
Subtest 2: Fine Motor Integration											Raw Score*	Point Score		
2	Copying a Square	0	Basic Shape	0	Closure	0	Edges	0	Orientation	0	Overlap	0	5	
7	Copying a Star	0	Basic Shape	0	Closure	0	Edges	0	Orientation	0	Overlap	0	5	
Subtest 3: Manual Dexterity											Raw Score	Point Score		
2	Transferring Pennies	9 pennies	Trial 1	10 pennies	Trial 2	Raw Score	0-3	3-6	6-9	9-12	12-15	15-18	18-21	4
Subtest 4: Bilateral Coordination											Raw Score	Point Score		
3	Jumping in Place—Same Sides Synchronized	2 jumps	Trial 1	5 jumps	Trial 2	Raw Score	0	1	2-4	5			3	
6	Tapping Toes and Fingers—Same Sides Synchronized	10 taps	Trial 1		Trial 2	Raw Score	0	1	2-4	5-8	10		4	
Subtest 5: Balance											Raw Score	Point Score		
2	Walking Forward on a Line	6 steps	Trial 1		Trial 2	Raw Score	0	1-2	3-4	5	6		4	
7	Standing on One Leg on a Balance Beam—Eyes Open	33 seconds	Trial 1	0.9 seconds	Trial 2	Raw Score	0.0-0.9	1.0-2.9	3.0-5.9	6.0-9.9	10		2	
Subtest 6: Running Speed and Agility											Raw Score	Point Score		
3	One-Legged Stationary Hop	28 hops	Trial 1		Trial 2	Raw Score	0	1-2	3-4	5-6	7-8	9-10	11-12	7
Subtest 7: Upper-Limb Coordination											Raw Score	Point Score		
1	Dropping and Catching a Ball—Both Hands	5 catches	Trial 1		Trial 2	Raw Score	0	1	2	3	4	5	5	
6	Dribbling a Ball—Alternating Hands	5 dribbles	Trial 1	5 dribbles	Trial 2	Raw Score	0	1	2	3	4-5	6-7	8-10	4
Subtest 8: Strength											Raw Score	Point Score		
2a	Knee Push-ups	7 push-ups	Raw Score	0	1-2	3-5	6-10	11-15	16-20	21-25	26-30	31-35	3	
2b	Full Push-ups	10 push-ups	Raw Score	0	1-2	3-5	6-10	11-15	16-20	21-25	26-30	31-35	4	
3	Sit-ups	10 sit-ups	Raw Score	0	1-2	3-5	6-10	11-15	16-20	21-25	26-30	31-35	4	
Notes & Observations											Total Point Score	60		

Total Point Score
Short Form
(Max = 60)

4.8.1.1 Standardisation

The battery was first developed in 1978 as the Bruininks Osereysky Test of Motor Proficiency (BOTMP), before being revised between 2002 and 2005 (Brown, 2019). The revision process of the BOT-2 can be viewed as a contributing factor to its validity and reliability. Focus groups were conducted with experienced users of the BOTMP. They included occupational therapists, physical therapists and developmental adaptive physical education teachers (Deitz et al., 2007). A product survey was established based on the findings that emerged from the focus groups and was distributed to professionals using the BOTMP, including researchers and university faculty members. Input was further sought from professional reviews and research relating to motor development and the BOTMP. Six key goals emerged as a result of the data obtained and were used to guide the revisions: 1) to improve the functional relevance of the test content; 2) to expand coverage of fine and gross motor skills; 3) to improve measurement among 4-5 year olds; 4) to extend norms through 21 years 11 months; 5) to improve item presentation and; 6) to improve the quality of the equipment in the testing kit.

Norms were established on a national representative sample of 1520 children, adolescents, and young adults aged between four years and 21 years, and normative data are reported for 12 age groups. For ages 4 – 12, normative data are reported for one-year intervals; for ages 13-14, normative data are reported for 2-year intervals; and for ages 17- 21, a 5-year interval in applied (Deitz et al., 2007). The normative sample included children with a range of disabilities and norms account for the highest incidence of disability requiring specialised educational services: emotional or behavioural disturbance, specific learning disability, mental retardation, developmental delay and speech and language impairment (Bruininks & Bruininks, 2005).

4.8.1.2 Reliability

The BOT-2 manual outlines three reliability studies (Bruininks & Bruininks, 2005). These studies relate to inter-rater reliability, test-retest reliability and internal consistency and reliability. Confidence intervals based on the standard error of measurement are reported for the Short Form standard score. Correlations for analysis of reliability were corrected for variability of the norm group (Cohen, Cohen, West, & Aiken, 2003) and are reported as adjusted *rs*.

4.8.1.3 Validity

Validity was examined in relation to content validity, internal structure of the instrument, ability to differentiate between clinical and non-clinical groups and by conducting studies examining the relationship between children's scores on the BOT-2 and their scores on other tests that measure similar constructs (Deitz et al., 2007). Studies demonstrated that the scores of children on subtests and composites of the BOT-2 correlate to scores of children on other measures of motor and visual-motor skills (Dietz et al., 2007) This indicates the construct validity of the BOT-2. In relation to the BOT-2 Short Form in particular, Ghaeraei et al. (2017) evaluated the validity, reliability and sensitivity of the BOT-2 Short Form. Results of this study found that the BOT-2 Short Form has an appropriate validity and reliability as well as a high sensitivity in preschool children.

A number of studies contradict these findings however, with Brown (2019) arguing that few studies have been published in the peer reviewed literature in relation to the psychometric properties of the BOT-2 Short Form. Brown (2019) suggests that the 14 items version of the BOT-2 Short Form did not meet the requirements of structural validity. Fransen et al's (2014) study investigated the convergent and discriminant validity between two competence

assessment instruments in Flemish children: 1) the BOT-2 Short Form and; 2) the Koperkoordinations Test fur Kinder (KTK). Results indicated that levels of agreement in relation to classification in children scoring below percentile 5 and 15 and above percentile 85 and 95 were fair to moderate. The findings from this study conclude that the evaluation of motor competence should not be based upon a single assessment instrument.

4.8.2 BOT-2 testing schedule

The researcher endeavoured to begin the quantitative data collection period as early in the school year as possible, to get as true a baseline measure as possible of children's motor proficiency upon entering junior infants. There were limitations involved in this process that are discussed later in the chapter. Table 4.4 below illustrates the initial testing schedule for phase one.

Table 4.4

Testing Schedule for Phase One

School	Number of children tested	Dates of Testing
School A	19	4 th September- 7 th September
School B	34	10 th September – 14 th September
School C	33	17 th September – 21 st September
School D	21	24 th September – 28 th September
School E	45	2 nd October – 6 th October
School F	26	8 th October – 12 th October

Phase two of the data collection period took place post-implementation of the programme. The researcher endeavoured to mirror the testing schedule from phase one, to ensure that equal time had elapsed for each child to be retested. The testing area was replicated from phase one, ensuring proximity to the classroom and visibility at all times. The researcher endeavoured to maintain consistency across all of the settings in relation to the set-up of the environment. This was done by ensuring that the standardised equipment was used (balance beam, tape for walking the line, photocopies of written tasks, tennis-ball) across all of the

settings. The researcher endeavoured to maintain consistency for each of the children being assessed by using the verbal cues provided by the BOT-2 manual to give instructions and feedback on each task. Each child was asked the same question in relation to whether they had played any sports outside of school. Consistency in relation to language was maintained to the best of the researcher's ability. Through dialogue and negotiation with the class teachers, the researcher was able to replicate the same testing schedule from phase one. Table 4.5 below illustrates the testing schedule for phase two.

Table 4.5

Testing Schedule for Phase Two

School	Phase Two: Dates of Testing
School A	6 th May-10 th May 2019
School B	13 th May-17 th May 2019
School C	20 th May-25 th May 2019
School D	27 th May-31 st May 2019
School E	3 rd June-14 th June 2019
School F	17 th June- 21 st June 2019

4.8.3 Professional learning days

Prior to commencing the implementation of the programme, all of the participating teachers were invited to a Training Day in Marino Institute of Education on the 8th November 2018. Teachers received a manual (Appendix F) that outlined all of the elements of the programme, along with a developmental rationale for programme and a Gross Motor PowerPoint presentation to support the implementation of the activities (Appendix G). Teachers were provided with a resource box that contained all of the equipment they would need to carry out the 16-week programme (Figure 4.4). Participants engaged in professional discussions during this training session and shared ideas and resources in relation to the

development of emergent handwriting skills. The field notes recorded by the researcher during these sessions inform the findings and are integrated into the discussion in Chapter 7.

Figure 4.4

Equipment for the sensorimotor handwriting resource boxes



The role of the researcher during the professional learning days was largely that of a facilitator. The role of the facilitator can have a significant impact on the efficacy of professional learning (Hadar & Brody, 2020), something that the researcher was acutely aware of. The first task of the researcher therefore, was to prepare carefully and thoroughly in relation to the organisational aspect of the professional learning days. This involved choosing an appropriate setting, providing refreshments and ensuring that all research participants were welcomed and introduced to each other upon arrival. The role of researcher involved taking an

active part in the group discussions that ensued during each stage of the professional learning day, while identifying topics for the group to discuss and ensuring that the group stayed with the learning agenda.

The role of researcher further related to professional expertise. The researcher required a level of competency in relation to the information and knowledge being shared via the PowerPoint presentation, as well as knowledge about “personality, group-dynamics, interpersonal-skills such as listening and diagnosing, personal self-awareness of values and ethical frameworks, and personal qualities including empathy and caring” (Hadar & Brody, 2020, p. 600).

All of the participating teachers were invited to return to Marino Institute of Education on the 4th January 2019, 8 weeks into implementation of the programme. The purpose of this meeting was to review the implementation of the programme, to discuss how to adapt or amend any specific components of the programme and to engage in professional discussion in relation to how the implementation of the programme was going. Photographs from the observation days that had taken place in the first 8-weeks were shared with all participants (Appendix H), and again, professional discussion ensued. During this second professional learning day, the role of the researcher was to focus on teachers learning through their experience of having implemented the programme for a number of weeks at this stage. This enabled the researcher to emphasise connections between their teaching experiences and the contextual knowledge relating to motor development and handwriting that was presented during the initial professional learning day. The researcher endeavoured to act as an agent of change, in encouraging the participants to reflect on their practice and their learning, and in doing so to enhance classroom and whole-school practice (Hadar & Brody, 2020).

4.8.4 *Observation of the programme in action*

Throughout the 16-week implementation of the programme, the researcher visited the classroom of each of the participating teachers to observe the programme being implemented. The purpose of the observation days was to provide the researcher with first-hand experience of the research participants engaging with the sensorimotor handwriting programme. Observation as a research method, enabled the researcher to gain unique insights in relation to the implementation of the programme on each individual site, that may not have been possible to capture solely through the use of semi-structured interviews. Observational methods enable the researcher “to note body language and other gestural cues that lend meaning to the words of the persons” (Denzin & Lincoln, 2005, p. 729). In this way, the observation days provided another layer to the thematic analysis of the qualitative data and the emergence of the themes outlined later in Chapter 5.

Creswell (2007) describes the qualitative observation process as that ‘in which the researcher takes field notes on the behaviour and activities of individuals at the research site’ (p.181). Field notes (Appendix I) were taken during the observation and again after the observation, having had a conversation with the teacher. The observation schedule was devised in collaboration with each individual class teacher of the participating children. The researcher endeavoured to cause as little disruption to the class timetable as possible in scheduling the observations. The role of the researcher during the observation days was that of the observer-as-participant, whereby the researcher was known to the participating teachers and children but endeavoured to relate only to them as a researcher (Angrosino, 2007, p.54). The observer-as-participant role involved the researcher conducting observations for brief periods of time (between 30 and 40 minutes) which provided a context for researcher when conducting the semi-structured interviews post-implementation of the programme. Table 4.6 below illustrates the observation schedule for phase two.

Table 4.6**Observation Schedule**

School	Participating Teacher	Dates of Observation
School A	Eleanor	12/03/19
School A	Barbara	12/03/19
School B	Sarah	28/11/18
School B	Susie	12/03/19
School C	Aoibheann	19/03/19
School C	Nicola	19/03/19
School D	Vivienne	20/05/19
School E	Hannah	29/11/19
School E	Isla	29/11/18
School F	Greta	21/03/19

4.8.5 Semi-structured interviews

Semi-structured interviews were conducted with the teachers of the participating children from phase one. The aim of the semi-structured interviews was to explore in-depth the teachers' knowledge and understanding of motor development and emergent handwriting skills and to examine their perceptions about the efficacy of the Sensorimotor Handwriting Programme. The questions were designed to also gather information relating to the participating teachers' perceptions of the contextual factors that influence motor development

and for information about their own practices for developing motor competency and handwriting skills. The semi-structured interviews were piloted (Wengraff, 2001) with two of the researcher's teaching colleagues prior to taking place with the participating teachers. In light of methodological research that points to the importance of constructing and wording questions (Smith, 1995), feedback in relation to the wording of some questions was taken on-board and the questions were amended. Interviews took place on site in the participant's schools at a time that was convenient for each individual. Interviews were recorded by a digital device (with the participants' consent). The duration of each interview was dependent on the amount of dialogue and detail that individual participants engaged in, with the average interview lasting 35 minutes.

According to Braun and Clarke (2013, p. 78), semi-structured interviews provide an opportunity for participants to engage in dialogue about things that are important to them and that the researcher has not anticipated. In this way, the researcher ensured that they remained flexible, while being cognisant of using the interview guide (Appendix J) in such a way as to ensure rigour and systematisation in the collection of data (Kvale, 2007). Questions were organised so that they flowed logically (Braun & Clarke, 2013), and were categorised into broad, topic-based sections: 1) motor development and handwriting development 2) the sensorimotor handwriting programme 3) environmental influences. The interview guide was designed and carried out to allow the participants to expand on their perceptions, experiences and understanding in relation to motor development, handwriting development, sensorimotor handwriting programme and environmental influences. Questions were 'funnelled' in such a way that they moved from the general to the specific (Braun & Clarke, 2013), and the use of probes was employed to encourage participants to expand further on their answers and to provide more detail. In some instances, probing involved adding specificity to questions, which made explicit for the participant, the further type of detail required (Kvale, 2007).

4.8.6 Interview schedule development

The semi-structured interview schedule (Appendix J) with the teachers of the participating children was developed through a negotiation process with each individual participant. The researcher was informed by Braun and Clarke's (2013) guidelines on preparing for face-to-face interviews and took the following points into consideration when developing the interview schedule:

- 1) Only one interview was scheduled per day
- 2) The quantitative and qualitative data collection processes did not occur during the same time period
- 3) The site and time of the interview was made as convenient as possible for each individual participant

4.9 Data Analysis

4.9.1 Quantitative data analysis

Raw scores for each of the 14 items of the 8 subtests in the BOT-2 (Bruininks & Bruininks, 2005) from phase one and from phase two were entered into SPSS27 for analysis. Standard scores ranging from 20-80 (standard deviation 10) were obtained using the BOT-2 Manual for each participant for motor proficiency from the raw scores of all 14 items. Scores on the 14 items were summed to create a standard score for motor proficiency. Descriptive competency categories (well-below average, below average, average, above average and well-above average) were assigned to each individual standard score and the number of children in each descriptive competency category was summed and calculated into a percentage. Table 4.7 below (Bruininks & Bruininks, 2005, p. 256) illustrates the scale scores, standard scores, percentile ranks and standard deviations from the mean that correspond to each of the descriptive categories.

Table 4.7

Descriptive Categories Corresponding to Scale Scores, Standard Scores, Percentile Ranks and Standard Deviations from the Mean

Descriptive Category	Scale Score Range	Standard Score Range	Percentile Rank Range	Standard Deviations from the Mean
Well-Above Average	25 or greater	70 or greater	98 or greater	2.0 or greater
Above Average	20-24	60-69	84-97	1.0 - 2.0
Average	11-19	41-59	18-83	$\bar{1}.0$ - $\bar{1}.0$
Below Average	6-10	31-40	3-17	$\bar{2}.0$ - $\bar{1}.0$
Well-Below Average	5 or less	30 or less	2 or less	$\bar{2}.0$ or less

An independent *t*-test was used to analyse differences in motor proficiency in School Type 1 (DEIS) and School Type 2 (non-DEIS) at T1 (T1 = pre-implementation of the programme). Independent *t*-tests were also used to analyse score differences obtained by each child in each of the 14 subtests in School Type 1 and School Type 2 at T1 and T2 (T2 = post-implementation of the programme). Quantitative results are reported in detail in Chapter Five.

4.9.2 Qualitative Data Analysis

Analysis of the qualitative data was carried out using a Thematic Analysis (TA) approach (Braun & Clarke, 2013). For analysis of qualitative data which takes a textual form, thematic analysis is an appropriate approach as through the process of coding, it requires careful attention to each word, phrase, sentence and paragraph of that textual data.

A further strength of this method is that the results of TA are accessible to a wider audience, in the case of this research, to the participating infant teachers (Braun & Clarke, 2013).

A significant limitation of the method is the focus on patterns across data sets (Braun & Clarke, 2013). This means that any sense of continuity or contradiction within individual accounts or the individual voices of participants' risk being lost. In an attempt to counteract this, transcripts were coded on an individual basis allowing for data to be analysed based on each individual teacher; this was followed by coding across the transcripts, to establish patterns across the data sets while remaining cognisant of the individual experiences, perceptions, knowledge and understanding conveyed by each teacher (Braun & Clarke, 2013). Table 4.8 below illustrates the stages of coding and analysis that took place starting with the transcription of the recorded interviews in June 2019.

Table 4.8

Stages of Thematic Analysis (Braun & Clarke, 2013)

Stage	Thematic Analysis Method
1	Transcription
2	Reading and familiarisation, taking note of items of potential significance
3	Complete Coding across 10 transcripts
4	Searching for themes
5	Reviewing themes – making a thematic map (provisional themes and subthemes and the relationships between them)
6	Defining and naming themes
7	Writing and finalising the analysis

4.9.3 Transcription

Transcriptions of the recorded material were prepared orthographically within 3 months of the recordings. The average word count for each transcript was 4,800 words. An orthographical style transcription process was deemed suitable for this study as it enabled the researcher to focus on transcribing the spoken words in the data as opposed to a phonetic or paralinguistic transcription style. In line with a TA approach to data analysis, this allowed the researcher to focus on *what* was said in relation to addressing the research questions, rather than *how* it was said (Braun & Clarke, 2013).

An immersion in the dataset followed. Immersion is described by Braun and Clarke as a process of becoming intimately familiar with the content of the dataset (Braun & Clarke, 2013) and by Robson (2002) as the least structured and most interpretive approach to data analysis, emphasising researcher insight (Robson, 2002). During this stage, notes were taken of any ‘noticings’ (Braun & Clarke, 2013) or items of potential significance.

4.9.4 Coding

Following the transcription process, a rigorous process of manual coding ensued. Manually coding the dataset involved a thorough, systematic and interpretative process which enabled the researcher to become deeply immersed in the dataset and to capture different elements of the dataset that are most meaningful for answering the research questions. Manual coding provides opportunities for the researcher to engage in an authentic interpretative process that is “driven by what the analyst sees in, and makes of, the data” (Braun & Clarke, 2013, p.220). While the use of computer programmes such as NVivo were considered to “assist” (Braun & Clarke, 2013, p. 220) with coding and analysis, based on the limitations of such technology, the manual method was preferred. Some of those limitations include focusing on quantity or frequency over quality and meaningful insight. Additionally, “over-coding” (Braun & Clarke,

2013, p. 219), or using features of the programme not necessary for the particular analysis and research questions is another limitation of using computer programmes in data coding.

Complete coding was applied to the transcriptions, whereby any words or phrases that were identified as relevant or interesting in relation to the research questions were coded. In applying complete coding, the researcher aimed to identify “anything and everything” (Braun & Clarke, 2013, p.206) that was deemed relevant to the research question. This type of inductive coding was chosen over deductive coding, whereby data are selected based on pre-existing theoretical and analytic knowledge deriving from the literature review. Complete or inductive coding allows the data to speak for themselves before becoming more selective later on in the analytic process. Coding took place in a systematic manner on hard-copy data. Each time that an item was deemed potentially significant and interesting in relation to addressing the research questions, it was given a code name and the associated text was marked by a using different coloured highlighter (Appendix K).

The application of this rigorous manual coding method resulted in the collation of the coded data into 15 clusters of codes:

1. Confidence	2. Increased Motivation	3. Enjoyment	4. Competency
5. Link between motor skills and handwriting	6. Teaching approaches and learning experiences	7. Previous knowledge	8. Gaps in initial teacher education
9. Programme positively received, rated and regarded by teachers	10. Renewal of Resources	11. Fitting into the curriculum	12. Fidelity to the programme
13. Parental Involvement	14. Quality of early learning and care settings	15. Resources in the community	

Each cluster of codes was clearly titled and excerpts of collated data from the transcriptions were assigned to each code. This process of coding was followed by a deeper analysis of a search for patterns across the codes (Braun & Clarke, 2013) to establish candidate themes. While frequency of patterns across the dataset was an important factor to consider in relation to the emergence of themes, the process of manual coding aimed to capture any element of the data that was meaningful and potentially significant in relation to addressing the research questions. A review of the codes led to the identification of any overlap between codes and similarities between codes which subsequently led to the development of four overarching themes: 1) the impact the sensorimotor handwriting programme on children as perceived by teachers; 2) the impact of the professional development initiative and sensorimotor handwriting programme on teachers; 3) the sensorimotor handwriting programme and; 4) the impact of environmental influences on children's motor development.

4.10 Methodological Limitations and Establishment of Trustworthiness

This research study explores young children's sensorimotor development and their emergent handwriting skills. There were a number of limiting factors in the study. Firstly, due to the constraints of being a single researcher, each of the 10 classes was tested in sequence, as opposed to being tested at the same time. Therefore, School A was tested in the first week of September, while School F was tested at the beginning of October. In terms of attaining a true baseline measure of junior infants' motor proficiency upon entry into school, the study would have benefited from having a team of researchers to carry out the data collection phase at the same time. Secondly, the sample for the study was recruited using a purposive approach (Braun & Clarke, 2013), resulting in choosing only schools that were available to me and that satisfied the criteria for the study. In this way, the study was confined by convenience with all schools being located within the greater Dublin area. The sample represents a small subset of the population as a result, without any claim to representation.

As outlined earlier, studies (Brown, 2019; Fransen et al., 2014) relating to the validity and reliability of the testing instrument, the BOT-2 Short Form suggest that motor competence should not be based upon a single assessment instrument. While further studies indicate the validity and reliability of the testing instrument (Gharaei et al., 2017), it is important to acknowledge the limitations in light of the evidence presented.

A further limitation related to researcher effect and power relations stemming from my position in relation to the research study as researcher, as former class teacher and resource teacher in a DEIS school, including one of the participating schools, and as lecturer involved in initial teacher education and continuing professional development of teachers. I could not claim to be taking a phenomenological approach to the study but rather a hermeneutical approach. The approach is hermeneutical because it is beyond doubt informed by my teaching experience and the convictions that have arisen from that experience which would render taking a purely phenomenological approach impossible. While adopting a hermeneutical approach I was however, confident in my ability to bracket (Ahern, 1999) any potential bias that might arise as a result of my teaching experiences in DEIS schools and to work with the evidence in that light. Throughout the quantitative data collection phase across all of the schools, I endeavoured to remain objective and to carry out the standardised test with consistency in terms of instructional language, verbal prompts and the set-up of the testing environment. During the qualitative data collection phase, I remained aware of any assumptions and preconceptions that could arise during the interviews with teachers stemming from my own experiences. I sought to document the participating teachers' perceptions and knowledge in relation to motor and handwriting development, environmental influences and the sensorimotor handwriting programme in a rigorous and authentic manner.

Further efforts to limit researcher bias pertain to a number of measures taken to establish the trustworthiness of the research. This involved tending to the criteria of credibility, transferability, dependability and confirmability (Lincoln & Guba, 1985) in line with a mixed methods approach appropriate to the positivist and interpretivist paradigm underpinning this research study. The credibility of a study is described by Lincoln and Guba (1989) as being determined by whether or not readers, when confronted with the experience, can recognise it. Credibility “addresses the ‘fit’ between respondents’ views and the researcher’s representation of them” (Tobin & Begley, 2004 as cited in Nowell, Morris, White, & Moules, 2017, p. 3). Credibility in relation to this study was addressed as follows: triangulation was achieved by obtaining data from the standardised test and from interviews and observations in each setting and by gathering field notes throughout phase one and phase two of the research; peer debriefing was undertaken by reviewing and refining my perceptions, insights and analyses with a professional outside the context of the research study and who had professional expertise to provide feedback; member checking was achieved during and after each phase of data collection, by engaging the participating teachers in dialogue and providing summaries of my interpretations, while inviting feedback and verification.

Transferability or generalisability refers to “whether or not the results generated in one study can be applied to wider or different populations” (Braun & Clarke, 2013, p. 280). The quantitative findings in relation to the measures of motor proficiency of a small sample of junior infants in DEIS and non-DEIS contexts could potentially be applied to a wider population. In relation to the qualitative data, contextual information has been presented in relation to the six participating schools which should provide scope for the reader to assess transferability of findings to other contexts.

Dependability relates to the researcher ensuring that the research process is “logical, traceable, and clearly documented” (Tobin & Begley, 2004, as cited in Nowell et al., 2017, p. 3). Confirmability relates to the researcher being able to demonstrate that the findings, conclusions and interpretations of a study have been derived from the data (Nowell et al., 2017). An audit trail is one such measure that can be taken to demonstrate dependability, providing the reader with markers such as the justification for theoretical, methodological and analytical decisions throughout the research study. The researcher endeavoured to carry out an audit trail throughout this research by presenting evidence of the choices made regarding theoretical and methodological issues and by providing a clear rationale for such decisions. An audit trail has further been addressed by keeping records of the raw data, field notes, interview guides, transcripts, observation schedules and photographic evidence. The scheduling of appointments with participants for data collection, and signed letters of consent allow for confirmability on the processes by which the study was conducted. All of the measures taken to establish trustworthiness support the credibility of this study.

Having outlined the research design and the methodological processes above, the following two chapters seek to describe the research findings that emerged from an analysis of both the qualitative and the quantitative data.

CHAPTER FIVE: MOTOR PROFICIENCY ASSESSMENT RESULTS

5.1 Introduction

This chapter reports the quantitative findings from phase one and phase two study which involved the administration of the BOT-2 test to the 178 child participants across the six participating schools in order to determine: 1) an overall baseline measure of motor proficiency of junior infant children in DEIS and non-DEIS schools; and 2) differences in motor proficiency of junior infant children in DEIS and non-DEIS schools 3) the efficacy of a sensorimotor handwriting programme to improve motor skills relating to emergent handwriting over a 16-week period.

5.2 Overall Baseline Measure of Motor Proficiency of Junior Infant Children in DEIS and non-DEIS schools (pre-implementation of the programme)

In total, 178 children were tested using the BOT-2 (2005), across the six participating schools over a 6-week testing period between 02.09.18 and 19.10.18. Table 5.1 illustrates the child participant demographic.

Table 5.1

Descriptive statistics

	N	% Male	%Female
All participants	178	42%	58%
DEIS Schools	86	33%	59%
Non-DEIS schools	92	66%	41%

Table 5.2 below illustrates the overall percentages of competency across all six schools combined and the mean standard score across all 178 children in the six participating schools, pre-implementation of the programme.

Table 5.2**Percentage of participants overall competency in each category**

Combined School Type 1 & Type 2	
Descriptive Competency Category	
Well Below Average	8%
Below Average	23%
Average	59%
Above Average	9%
Well Above Average	5%
BOT-2 Score	
Standard Score	47

Overall, 59% of children across school Type 1 (DEIS) and school Type 2 (non-DEIS) combined achieved an average score for motor proficiency, relative to their age at the time of testing. Thirty-one percent of children in total scored either below average or well below average for their ages in relation to motor proficiency.

5.3 Baseline Measure of Motor Proficiency in DEIS schools compared to non-DEIS schools (pre-implementation of the programme)

Table 5.3 below compares the percentage of children in each competency category in DEIS and non-DEIS schools, pre-implementation of the programme.

Table 5.3**Competencies according to school type**

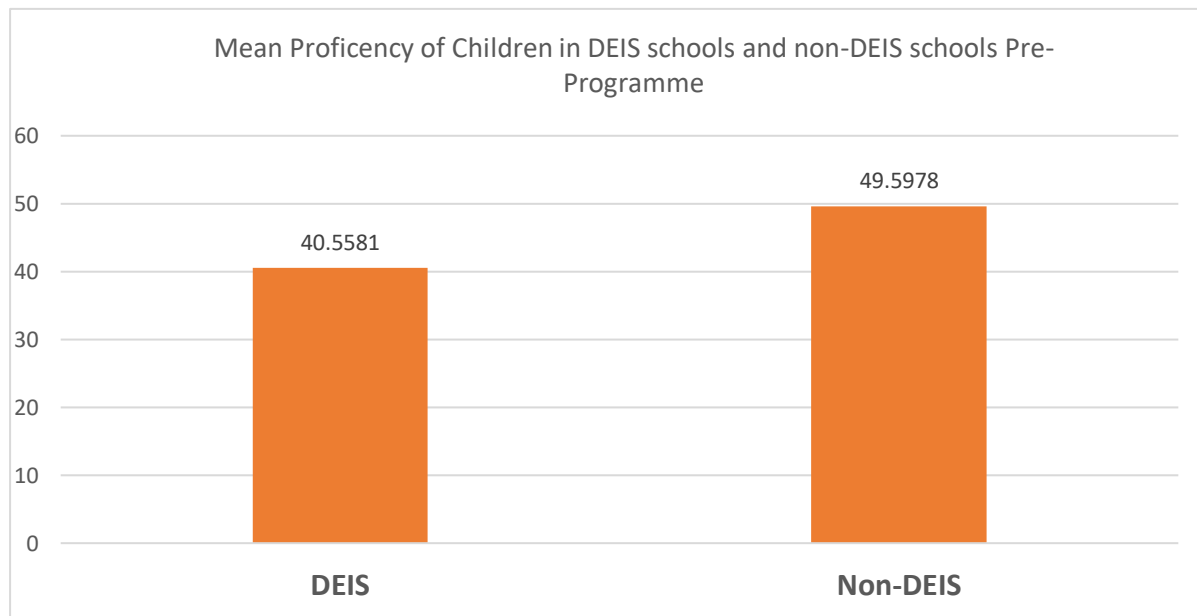
	DEIS	Non-DEIS	<i>p</i> -value
Competency Category			
Well Below Average	13%	3%	
Below Average	36%	12%	
Average	42%	75%	
Above Average	9%	9%	
Well Above Average	0%	1%	
BOT-2 Score			
Standard Score	42	51	0.001

Evidently, 42% of children in DEIS schools scored average in relation to their motor proficiency for their age, compared to 75% of children in non-DEIS schools. In total, 49% of children in DEIS schools scored either below average or well below average compared to 15% of children in non-DEIS school.

An independent *t*-test showed a significant difference (Figure 5.1) between the mean motor competency of participants in the three DEIS schools and the three non-DEIS schools pre-implementation of the sensorimotor handwriting programme.

Figure 5.1

The Mean Motor Proficiency According to School Type Pre-Implementation of the Programme



There was homogeneity of variance for motor proficiency, as assessed by Levene's test for equality of variances ($p = .516$). Children in DEIS schools had a mean motor proficiency score of 40.56 compared to children in non-DEIS who had a mean score of 49.60. There was a statistically significant difference in the mean motor proficiency score between DEIS schools and non-DEIS schools, $t(176) = 6.434$, $p < .001$. As there was a significant difference between means for motor proficiency between DEIS and non-DEIS schools ($p < .05$), we can reject the

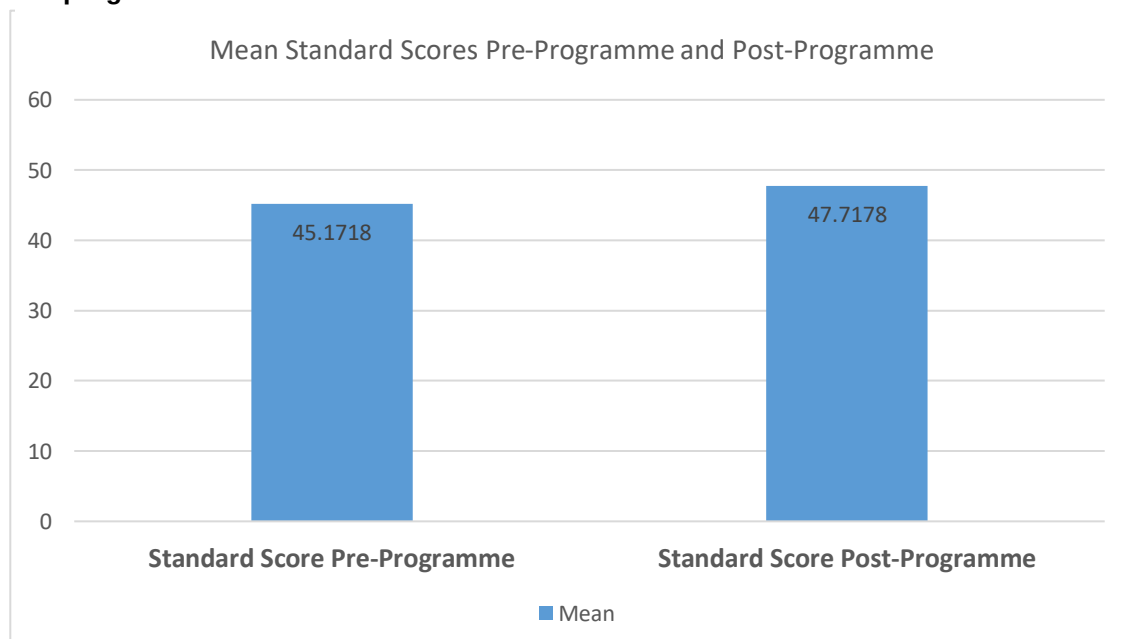
null hypothesis of there being no difference in the motor proficiency of children in DEIS and non-DEIS school, and accept the alternative hypothesis.

5.4 Measures of motor proficiency in DEIS in non-DEIS schools (post-implementation of the programme)

Paired sample *t*-tests were used to analyse changes in the mean motor proficiency in DEIS and non-DEIS schools over the two time points – pre-implementation of the programme and post-implementation of the programme. Mean motor proficiency scores for DEIS and non-DEIS schools combined, and significant differences over time are presented in the Figure 5.2 below. The graph illustrates that there was a statistically significant difference in the mean standard score for motor proficiency for children in DEIS and non-DEIS-schools pre-programme ($M = 45.17$, $SD = 10.04$) compared to post-programme ($M = 47.71$, $SD = 9.64$), $t(162) = -4.62$, $p < .005$ (two-tailed). This means that post-implementation of the programme, on average, children across all of the schools scored higher in relation to motor proficiency.

Figure 5.2

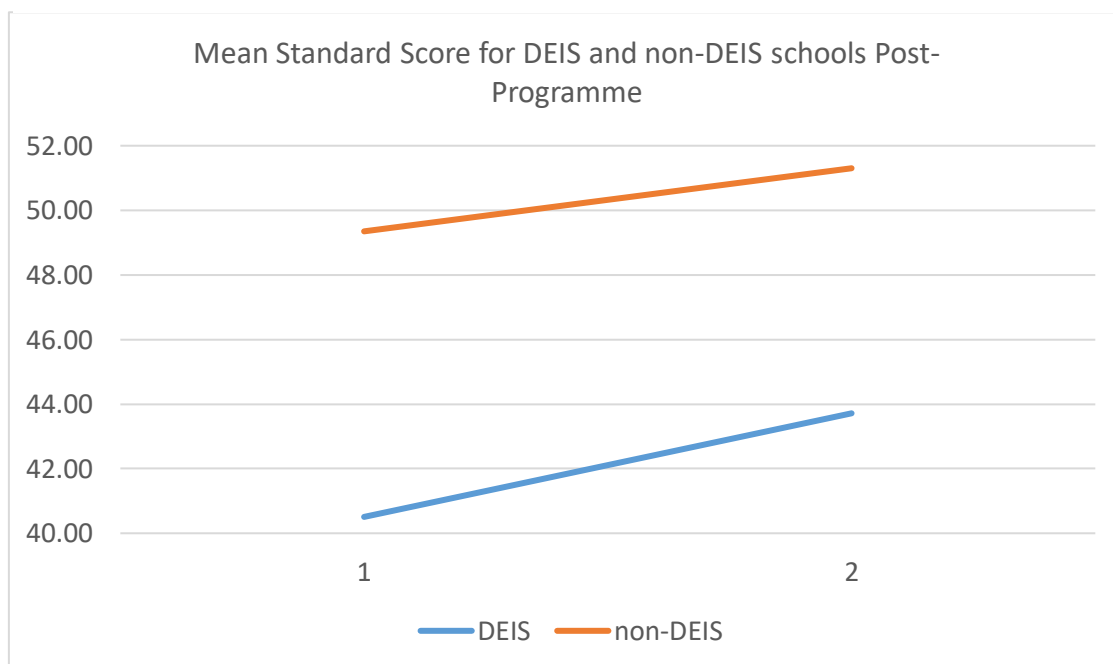
Mean Standard Scores for DEIS and non-DEIS schools pre- and post-implementation of the programme



A mixed between-within subject analysis of variance was conducted to assess the impact of school type on the mean standard scores of motor proficiency across two time points (pre-implementation of the programme and post-implementation of the programme). This is illustrated in Figure 5.3 below. There was no significant interaction between time and school type, Wilks' Lambda = .992, $F(1, 161) = 1.23$, $p = .257$, partial eta squared = .008. However, there was substantial main effect for time, Wilks' Lambda = .88, $F(1, 161) = 21.89$, $p < .005$, partial eta squared = .66. The main effect comparing school type was significant, $F(1, 161) = .40.26$, $p < .005$, partial eta squared = .200. On average, children's mean scores were higher post-implementation of the programme, and this trend was the same for both school types. As is illustrated in Figure 5.3, the disparity between DEIS and non-DEIS schools stayed consistent.

Figure 5.3

The impact of school type on the mean standard scores pre- and post- implementation of the programme



5.5 The impact of school type on subtest scores (pre- and post-implementation of the programme)

Table 5.4 below illustrates the standard mean subtest scores for DEIS and non-DEIS schools pre- and post-implementation of the sensorimotor handwriting programme. The mean for each subtest score increased in both DEIS schools and non-DEIS schools across the two time points, with the exception of Subtest 4 which saw a decrease in the standard mean in DEIS schools over the two time points.

Table 5.4

Comparison of mean subtest scores across DEIS and non-DEIS schools pre- and post-implementation of the programme

	Pre-Programme		Post-Programme	
	DEIS	Non-DEIS	DEIS	Non-DEIS
Drawing Lines	2.04	3.51	3.77	4.28
Folding Paper	1.32	2.05	1.38	2.66
Copying a Square	2.91	5.51	3.92	4.52
Copying a Star	.73	.90	.69	1.60
Transferring	2.56	3.67	4.19	4.83
Jumping in Place	1.35	1.95	2.01	2.49
Tapping Feet and Fingers	2.03	2.66	3.43	3.95
Walking on a Line	2.83	3.33	3.31	3.64
Standing on One Leg	2.70	3.05	3.34	3.64
One-Legged Stationary Hop	1.66	2.72	2.60	3.71
Dropping and Catching a Ball	1.45	2.83	2.95	4.26
Dribbling a Ball	.31	.58	.92	2.58
Knee Push-Ups	1.21	1.86	2.56	2.80
Sit-Ups	1.22	1.91	2.74	2.98

A mixed between-within subjects analysis of variance was conducted to assess the impact of two different school types (DEIS, non-DEIS) on children's raw scores on each of the 14 items or subtests in the BOT- Short Form 2 across two time periods (pre- and post-implementation of the programme). While the mean scores for all subtests bar Subtest 4 increased between the two time points (pre- and post-implementation of the programme), the DEIS schools recorded a more significant increase in the mean standard score in each subtest than the non-DEIS schools.

Effect sizes were calculated according to Cohen's (1988) (Cohen 1988) criteria where 0.01, 0.06 or 0.14 represented small, medium and large effect sizes respectively. Mean scores by time effect and time school type effect for each variable are illustrated in tables 5.4 to 5.17. Findings are presented below in relation to each of the 14 subtests. To account for multiple comparisons, a Bonferroni adjustment was applied to the alpha level that was used as a threshold for significance. This involved setting a more stringent alpha level for comparison by dividing the alpha level (.05) by the number of subtests (14) which equalled .00357 (Pallant, 2010).

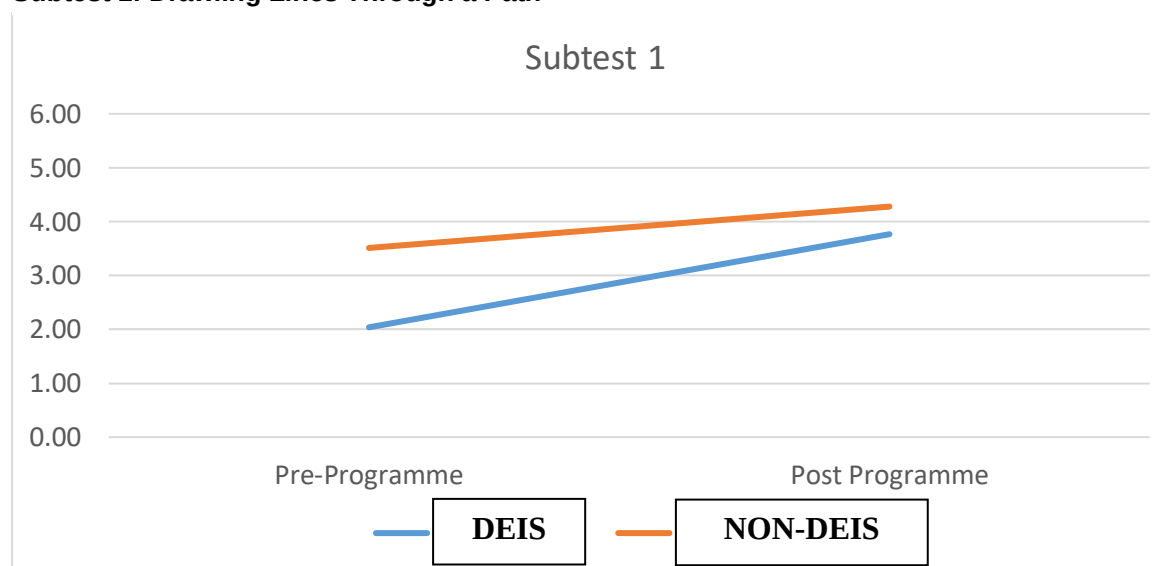
5.5.1 Subtest 1: Drawing Lines Through Paths – Crooked (Fine Motor Precision)

The drawing of lines through paths activity assessed children's control of their finger and hand movements. The objective of the task was to draw a line within a specified boundary (a path), and performance was evaluated on how well the child remained within the boundary. The emphasis of this test was on precision and it was therefore an untimed test (Bruininks & Bruininks, 2005). There was a significant interaction between school type and time, Wilks' Lambda = .94, $F(1, 161) = 10.1$, $p = .002$, partial eta squared = .059. There was a substantial main effect for time, Wilks' Lambda = .7, $F(1, 161) = 68.23$, $p < .001$, partial eta squared = .3, with both school types showing a significant increase in scores across the two time periods. The main effect comparing the two types of schools was significant, $F, (1,161) = 19.441$, $p <$

.001, partial eta squared = .108. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.4.

Figure 5.4

Subtest 1: Drawing Lines Through a Path

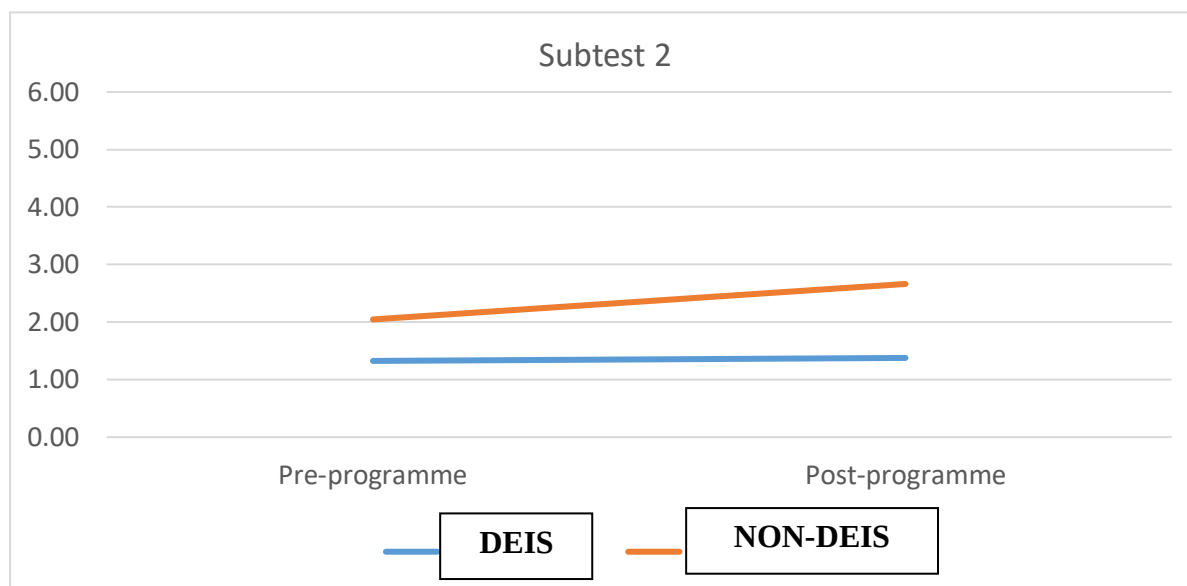


5.5.2 Subtest 2: Folding Paper (Fine Motor Precision)

The folding paper assessment was the second activity in the fine motor precision category. Like the drawing lines through a path activity described above, it assessed children's control of finger and hand movements. Children were required to fold paper within a specific boundary and again, performance was evaluated on how well the child remained within the boundary. The emphasis of this test was on again precision, and it was also an untimed test (Bruininks & Bruininks, 2005). Results of this subtest showed that there was no significant interaction between school type and time, Wilks' Lambda = .97, $F(1, 161) = 4.82$, $p = .03$, partial eta squared = .03. There was no substantial main effect for time, Wilks' Lambda = .96, $F(1, 161) = 6.76$, $p < .001$, partial eta squared = .04, with both school types showing only a minimal increase in scores across the two time periods (see Figure 5.5).

Figure 5.5

Subtest 2: Folding Paper



The main effect comparing the two types of schools was significant, $F(1,161) = 26.7, p < .001$, partial eta squared = .142. This means that while children in both DEIS and non-DEIS schools showed an improved mean score post-implementation of the programme, that improvement is not deemed statistically significant. The effect of school type on the improvement of the means scores was also not statistically significant.

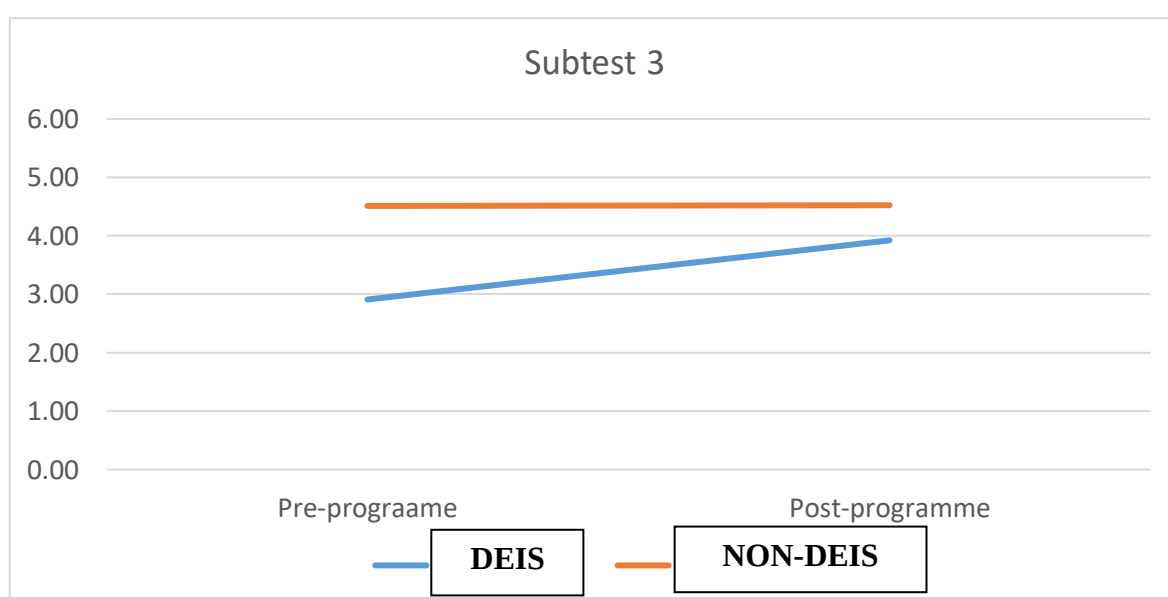
5.5.3 Subtest 3: Copying a Square: (Fine Motor Integration)

The copying a square activity assessed children's ability to reproduce drawings of geometric shapes that ranged in complexity from a square to a star. The children were asked to reproduce a drawing of a square as accurately as possible. As with the fine motor precision activities described above, this drawing task required precise control of finger and hand movement and was therefore untimed. Children were required to reproduce a drawing without additional visual aids and guidelines, meaning that this subtest also measured their ability to integrate visual stimuli with motor control - visual-motor integration (as outlined earlier in Chapter 3). Results from this subtest showed that there was a significant interaction between school type and time, Wilks' Lambda = .93, $F(1, 161) = 11.84, p = .001$, partial eta squared = .07. There was a substantial main effect for time, Wilks' Lambda = .93, $F(1, 161) = 12.4, p =$

.001, partial eta squared = .07, with both school types showing an increase in subtest 3 scores across the two time periods (see table x). The main effect comparing the two types of schools was significant, $F(1,161) = 28, p < .001$, partial eta squared = .15. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.6.

Figure 5.6

Subtest 3: Copying a Square



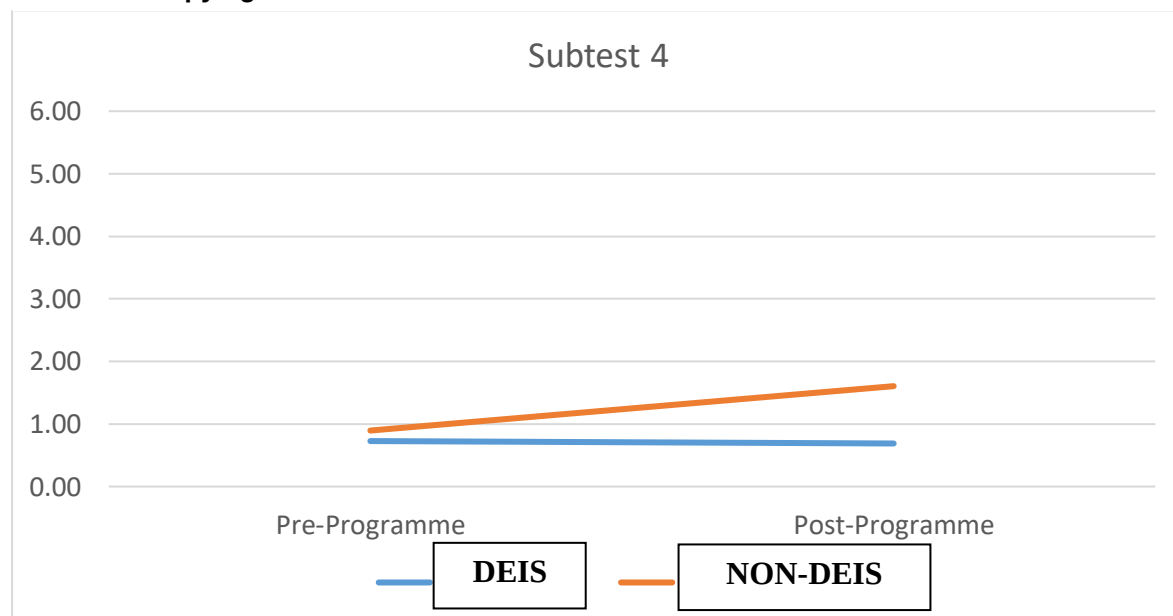
5.5.4 Subtest 4: Copying a Star (Fine Motor Integration)

The copying a star activity was the second and more complex activity in the fine motor integration category. Like the copying a square activity, it assessed children's ability to reproduce drawings of a geometric shape and assessed their visual-motor integration proficiency. The children were asked to reproduce a drawing of a star as accurately as possible. As outlined above, this task required precise control of finger and hand movement and was therefore untimed. Results from this assessment showed that there was no significant interaction between school type and time, Wilks' Lambda = .96, $F(1, 161) = 6.31, p = .013$,

partial eta squared = .04. There was no substantial main effect for time, Wilks' Lambda = .97, $F(1, 161) = 6.06$, $p < .001$, partial eta squared = .03, with both school types showing only a minimal increase in scores across the two time periods (see Figure 5.7). The main effect comparing the two types of schools was not significant, $F(1,161) = 6.653$, $p = .011$, partial eta squared = .040. This means that while children in both DEIS and non-DEIS schools showed an improved mean score post-implementation of the programme, that improvement is not deemed statistically significant. The effect of school type on the improvement of the means scores was also not statistically significant.

Figure 5.7

Subtest 4: Copying a Star



5.5.5 Subtest 5: Transferring Pennies (Manual Dexterity)

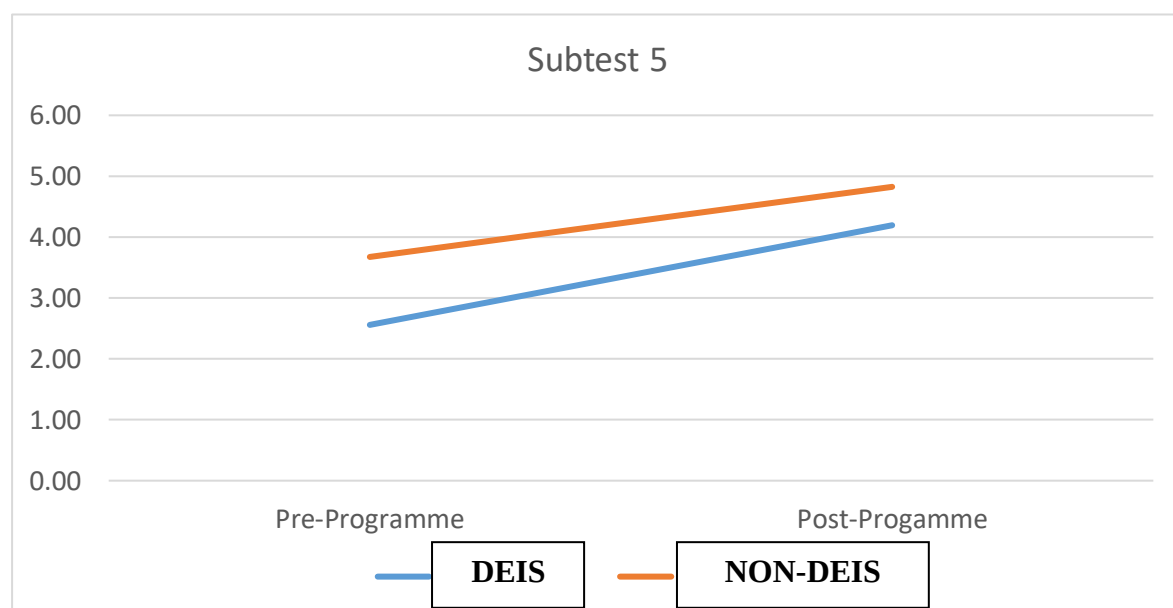
This subtest employed a goal directed activity that involved reaching, grasping and bimanual coordination with small objects. Children were asked to pick up plastic pennies with their dominant hand and transfer them into a box which was placed on the opposite side of the body. While this activity is not an everyday task, it is intended to replicate everyday tasks such as using utensils and buttoning buttons, making puzzles and building with blocks.

The emphasis of this subtest was on accuracy but this was also a timed assessment and each child was instructed to perform the task as quickly as possible. The purpose of the timed element of this subtest was to more precisely differentiate levels of manual dexterity (Bruininks & Bruininks, 2005).

Results of this subtest showed that there was no significant interaction between school type and time, Wilks' Lambda = .96, $F(1, 161) = 6.73$, $p = .01$, partial eta squared = .04. There was a substantial main effect for time, Wilks' Lambda = .42, $F(1, 161) = 222.08$, $p < .001$, partial eta squared = .0580, with both school types showing an increase in subtest 5 scores across the two time periods. The main effect comparing the two types of schools was significant, $F(1,161) = 31.6$, $p < .001$, partial eta squared = .0164. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.8.

Figure 5.8

Subtest 5: Transferring Pennies

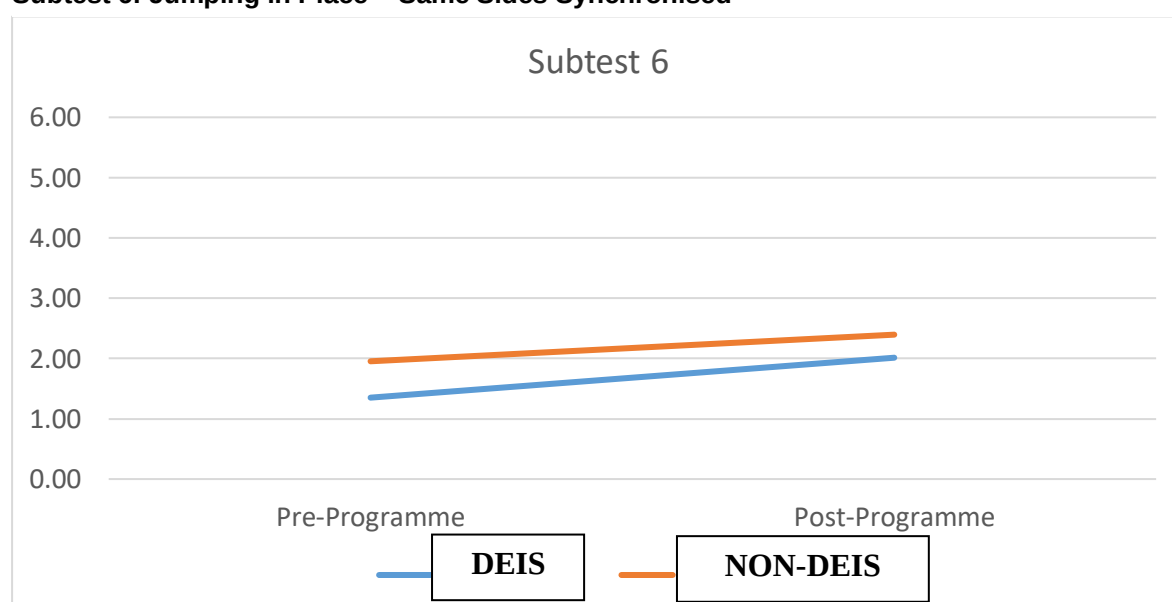


5.5.6 Subtest 6: *Jumping in Place- Same Sides Synchronised (Bilateral Coordination)*

This subtest measured the motor skills involved in playing sports and many recreational games. Children were asked to jump in a synchronised manner while staying in the same place. The activity required body control, and sequential and simultaneous coordination of the upper and lower limbs. Results of this subtest showed that there was no significant interaction between school type and time, Wilks' Lambda = .99, $F(1, 161) = 1.23$, $p = .269$, partial eta squared = .008. There was a substantial main effect for time, Wilks' Lambda = .84, $F(1, 161) = 30.86$, $p < .001$, partial eta squared = .0161, with both school types showing an increase in subtest 6 scores across the two time periods. The main effect comparing the two types of schools was significant, $F(1,161) = 10.88$, $p = .001$, partial eta squared = .063. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.9.

Figure 5.9

Subtest 6: Jumping in Place – Same Sides Synchronised

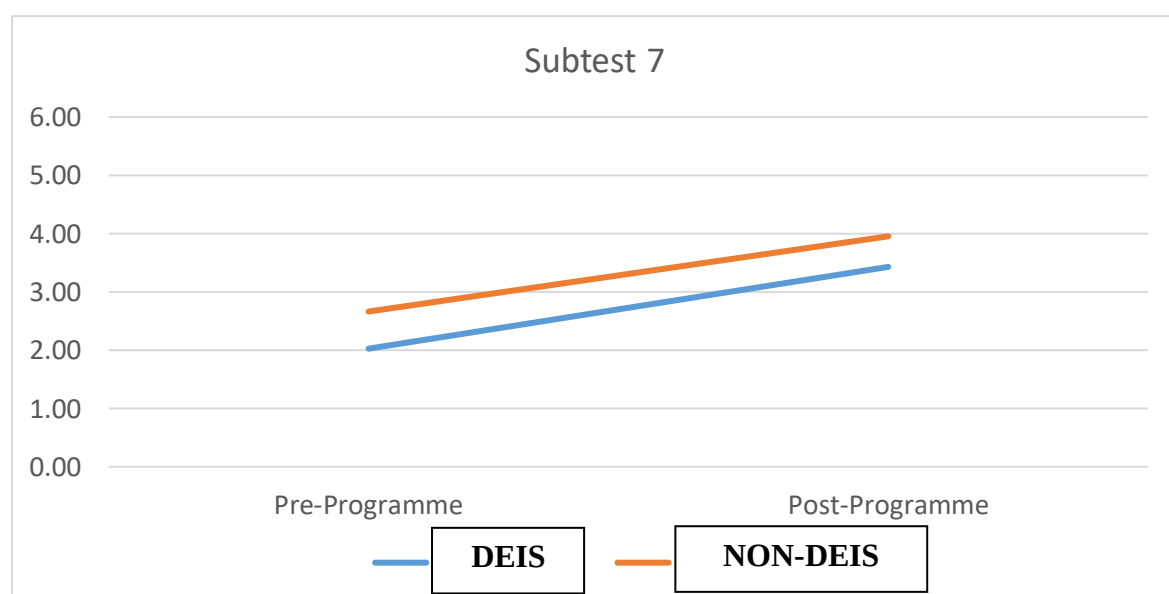


5.5.7 Subtest 7: Tapping Feet and Fingers – Same Sides Synchronised (Bilateral Coordination)

This subtest required children to tap their feet and fingers while synchronising opposite sides of the body. Like Subtest 6 as described above, it measured children's body control, and sequential and simultaneous coordination of the upper and lower limbs. Results of this subtest showed that there was no significant interaction between school type and time, Wilks' Lambda = 1, $F(1, 161) = .224$, $p = .637$, partial eta squared = .001. There was a substantial main effect for time, Wilks' Lambda = .55, $F(1, 161) = 129.54$, $p < .001$, partial eta squared = .446, with both school types showing an increase in subtest 7 scores across the two time periods. The main effect comparing the two types of schools was significant, $F(1, 161) = 17.33$, $p < .001$, partial eta squared = .097. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.10.

Figure 5.10

Subtest 7: Tapping Feet and Fingers – Same Sides Synchronised

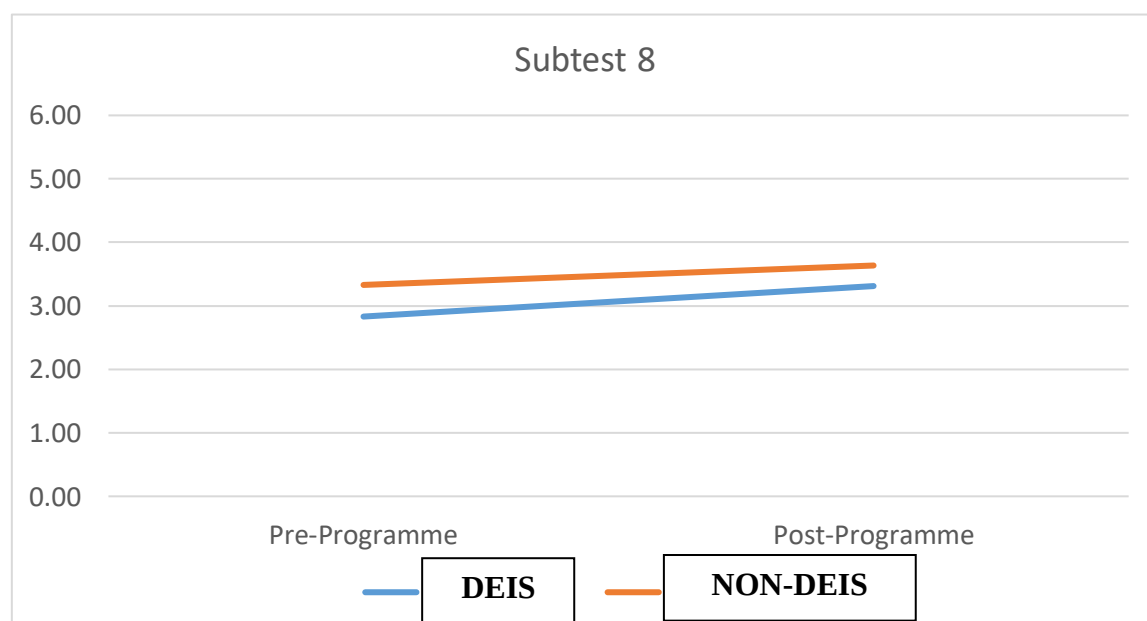


5.5.8 Subtest 8: Walking Forward on a Line (Balance)

This subtest, and subtest 9 below, assessed motor control skills that are integral for maintaining posture when standing, walking or carrying out daily tasks such as reaching for an item on a shelf. This activity in this subtest required children to walk along a line on the floor which was marked by masking tape. This activity measured stability of the trunk, stasis and movement, and the use of visual cues. Results of this subtest showed that there was no significant interaction between school type and time, Wilks' Lambda = .99, $F(1, 161) = .68$, $p = .412$, partial eta squared = .004. There was a substantial main effect for time, Wilks' Lambda = .92, $F(1, 161) = 13.72$, $p < .001$, partial eta squared = .079, with both school types showing an increase in subtest 8 scores across the two time periods. The main effect comparing the two types of schools was not significant, $F(1,161) = 9.48$, $p = .002$, partial eta squared = .056. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.11.

Figure 5.11

Subtest 8: Walking Forward on a Line

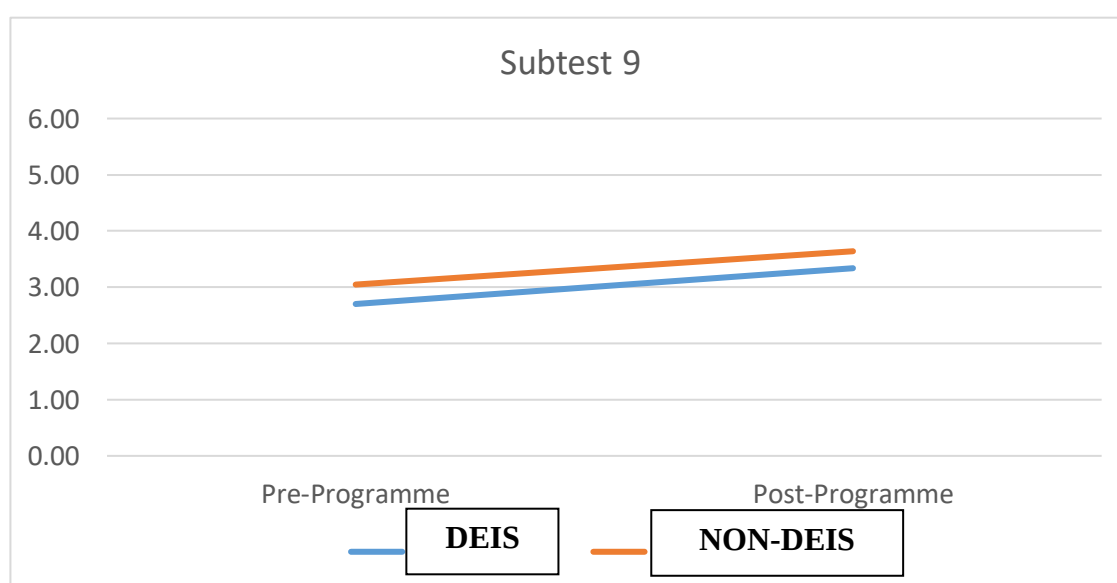


5.5.9 Subtest 9: Standing on One Leg on a Balance Beam – Eyes Open (Balance)

Like Subtest 8 described above, this subtest assessed three areas that affect balance: stability of the trunk, stasis and movement, and use of visual cues. This subtest required children to stand on one leg on a balance beam with their eyes open. Results of this subtest showed that there was no significant interaction between school type and time, Wilks' Lambda = 1, $F(1, 161) = .007$, $p = .935$, partial eta squared = .000. There was no substantial main effect for time, Wilks' Lambda = .96, $F(1, 161) = 5.32$, $p < .001$, partial eta squared = .032, with both school types showing only a minimal increase in subtest 9 scores across the two time periods (see table x). The main effect comparing the two types of schools was not significant, $F(1,161) = 1.17$, $p = .281$, partial eta squared = .007. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.12.

Figure 5.12

Subtest 9: Standing on One Leg on a Balance Beam – Eyes Open

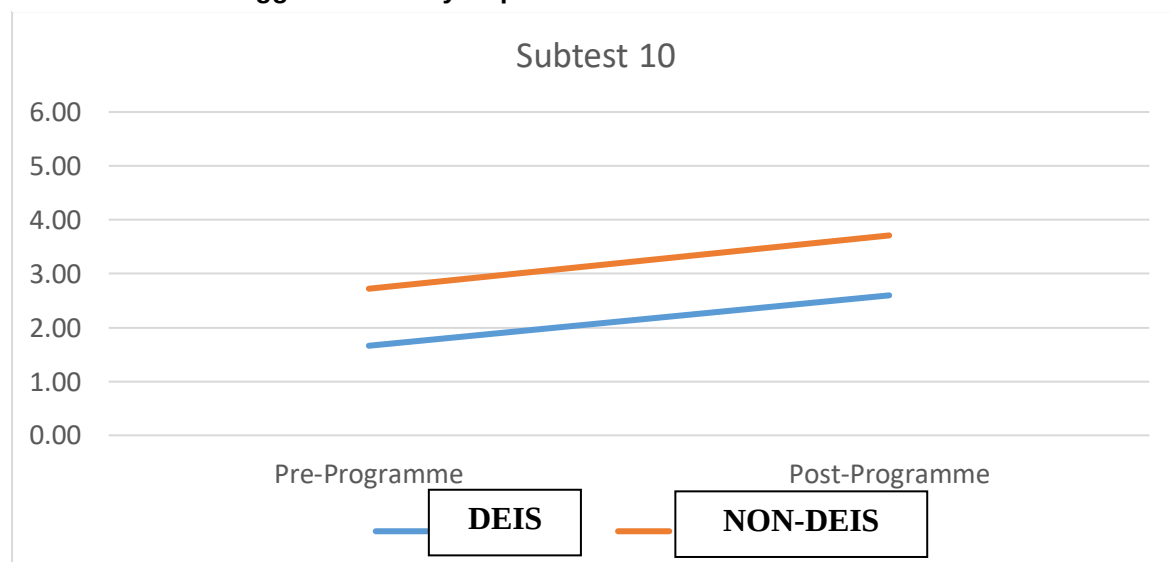


5.5.10 Subtest 10: One-Legged Stationary Hop (Running Speed and Agility)

This subtest required children to carry out as many one-legged stationary hops as they could in 15 seconds. It assessed children running speed and agility. Results from this subtest showed that there was no significant interaction between school type and time, Wilks' Lambda = 1, $F(1, 161) = .031$, $p = .860$, partial eta squared = .000. There was a substantial main effect for time, Wilks' Lambda = .8, $F(1, 161) = 40.76$, $p < .001$, partial eta squared = .202, with both school types showing an increase in subtest 10 scores across the two time periods. The main effect comparing the two types of schools was significant, $F(1,161) = 21.16$, $p < .001$, partial eta squared = .116. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.13.

Figure 5.13

Subtest 10: One-Legged Stationary Hop



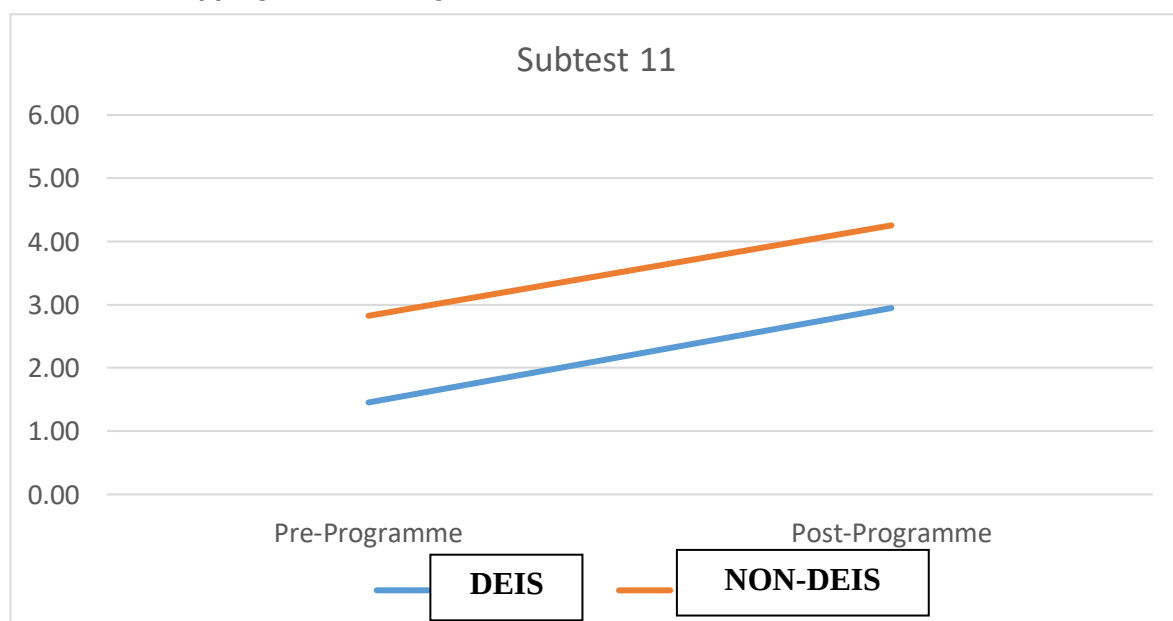
5.5.11 Subtest 11: Dropping and Catching a Ball – Both Hands (Upper Limb

Coordination)

This subtest required children to drop and catch a ball using both hands. It assessed children's visual tracking with coordinated arm and hand movement. Results from this test showed that there was no significant interaction between school type and time, Wilks' Lambda = 1, $F(1, 161) = .045$, $p = .832$, partial eta squared = .000. There was a substantial main effect for time, Wilks' Lambda = .63, $F(1, 161) = 96.01$, $p < .001$, partial eta squared = .374, with both school types showing an increase in subtest 11 scores across the two time periods. The main effect comparing the two types of schools was significant, $F(1, 161) = 30.459$, $p < .001$, partial eta squared = .159. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.14.

Figure 5.14

Subtest 11: Dropping and Catching a Ball – Both Hands

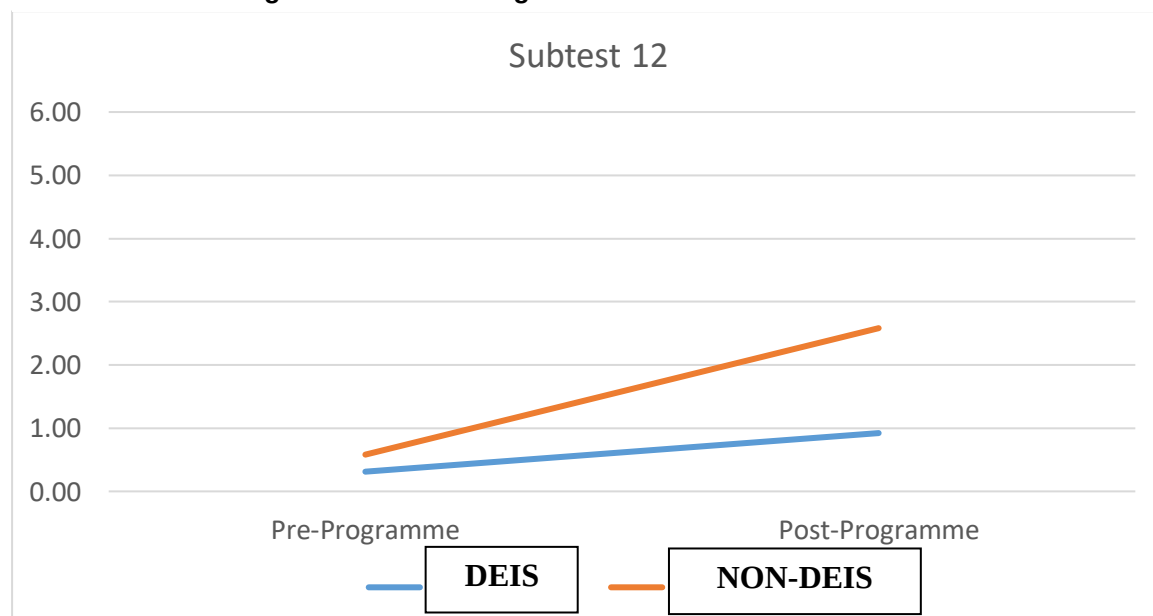


5.5.12 Subtest 12: Dribbling a Ball – Alternating Hands (Upper Limb Coordination)

This subtest, like subtest 11 above, assessed children's visual tracking with coordinated arm and hand movement. Children were required to dribble a tennis ball using alternating hands. Results from this test showed that there was a significant interaction between school type and time, Wilks' Lambda = .88, $F(1, 161) = 21.11$, $p < .001$, partial eta squared = .116. There was a substantial main effect for time, Wilks' Lambda = .68, $F(1, 161) = 74.5$, $p < .0001$, partial eta squared = .316, with both school types showing an increase in subtest 12 scores across the two time periods (Figure 5.15). The main effect comparing the two types of schools was significant, $F(1,161) = 16.98$, $p < .001$, partial eta squared = .095. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but there was not a statistically significant difference the rate of improvement between DEIS and non-DEIS schools.

Figure 5.15

Subtest 12: Dribbling a Ball – Alternating Hands

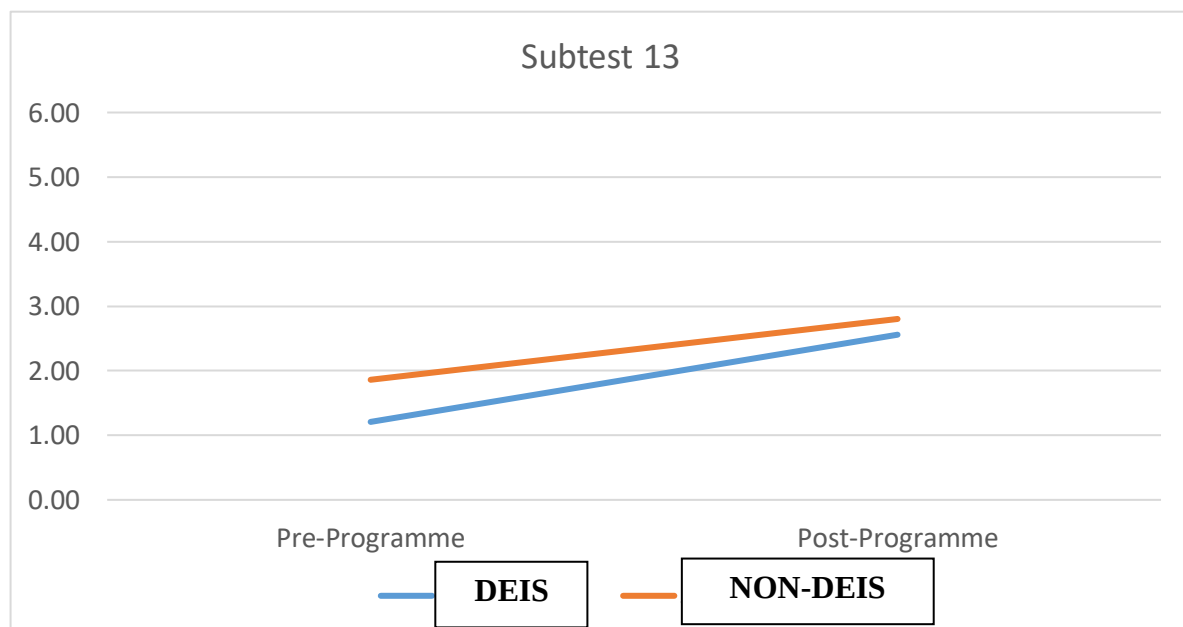


5.5.13 Subtest 13: Knee Push-ups (Strength)

Subtest 13 assessed children's trunk and upper and lower body strength. Children were required to perform as many knee push-ups as they could in 30 seconds. Results from this test showed that there was no significant interaction between school type and time, Wilks' Lambda = .99, $F(1, 161) = 2.20$, $p = .140$, partial eta squared = .013. There was a substantial main effect for time, Wilks' Lambda = .7, $F(1, 161) = 69.27$, $p < .001$, partial eta squared = .301, with both school types showing an increase in subtest 13 scores across the two time periods. The main effect comparing the two types of schools was not significant, $F(1,161) = 6.48$, $p = .012$, partial eta squared = .039. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.16.

Figure 5.16

Subtest 13: Knee Push-ups

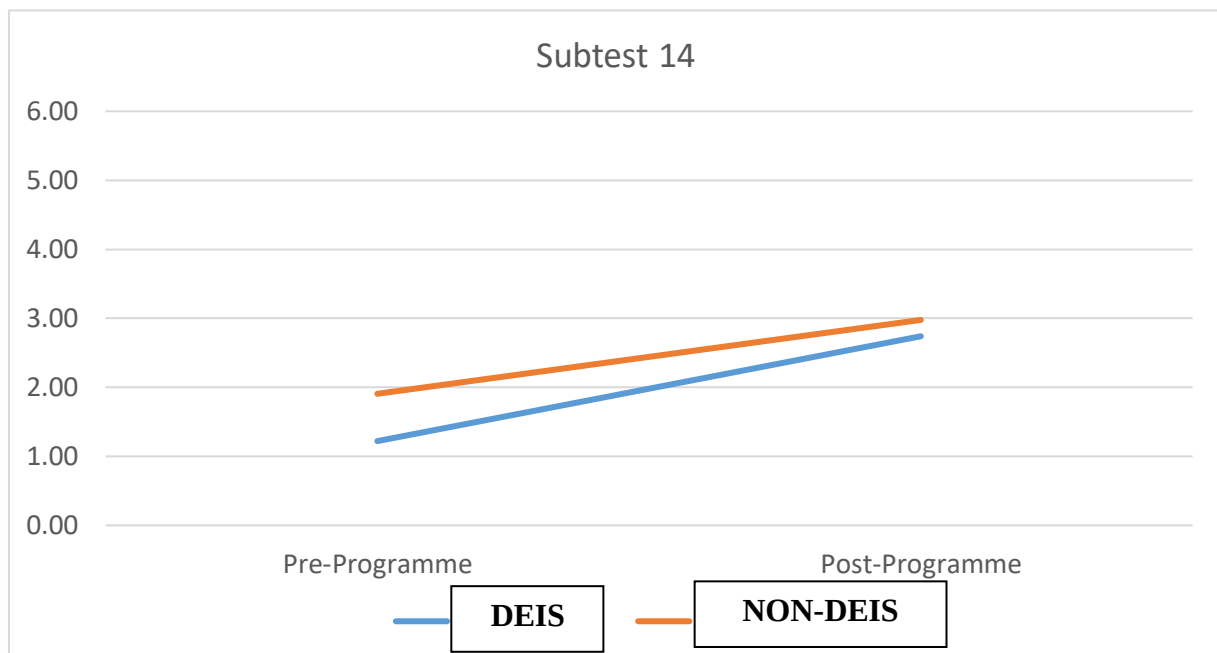


5.5.14 Subtest 14: Sit-ups (Strength)

Like subtest 13 described above, this subtest assessed trunk and upper and lower body strength. Children were required to perform as many sit-ups as they could in 30 seconds. Results from this test showed that there was no significant interaction between school type and time, Wilks' Lambda = .97, $F(1, 161) = 4.34$, $p = .039$ partial eta squared = .026. There was a substantial main effect for time, Wilks' Lambda = .53, $F(1, 161) = 143.8$, $p < .001$, partial eta squared = .472, with both school types showing an increase in subtest 14 scores across the two time periods (Figure 5.17). The main effect comparing the two types of schools was not significant, $F(1,161) = 9.254$, $p = .003$, partial eta squared = .054. This means that children in both schools improved in terms of the mean standard score for this subtest post-implementation of the programme, but that children in the DEIS schools saw a more substantial increase in scores post-implementation of the programme, which can be seen in Figure 5.17.

Figure 5.17

Subtest 14: Sit-ups



This chapter presented the results of the BOT-2 assessment of motor proficiency that emerged through an analysis of the quantitative data. Analysis of the data supports the finding that the children's motor proficiency across all of the six participating schools improved over course of programme. Prior to the implementation of the programme, children from the DEIS schools scored lower on motor proficiency and the difference in the mean standard scores between DEIS and non-DEIS was statistically significant. Post-implementation of the programme, the difference between the standard scores of motor proficiency for the children in the DEIS and the non-DEIS scores was no longer statistically significant. An analysis of each of the 14 subtests showed that overall, the DEIS schools recorded a more significant increase in the mean standard score than the non-DEIS schools, with the exception of one subtest. The following chapter will outline the findings that emerged from an analysis of the qualitative data in relation to the sensorimotor handwriting programme, pedagogical approaches, teacher expertise and children's learning.

CHAPTER SIX: THE SENSORIMOTOR HANDWRITING PROGRAMME: PEDAGOGICAL APPROACHES, TEACHER EXPERTISE AND CHILDREN'S LEARNING

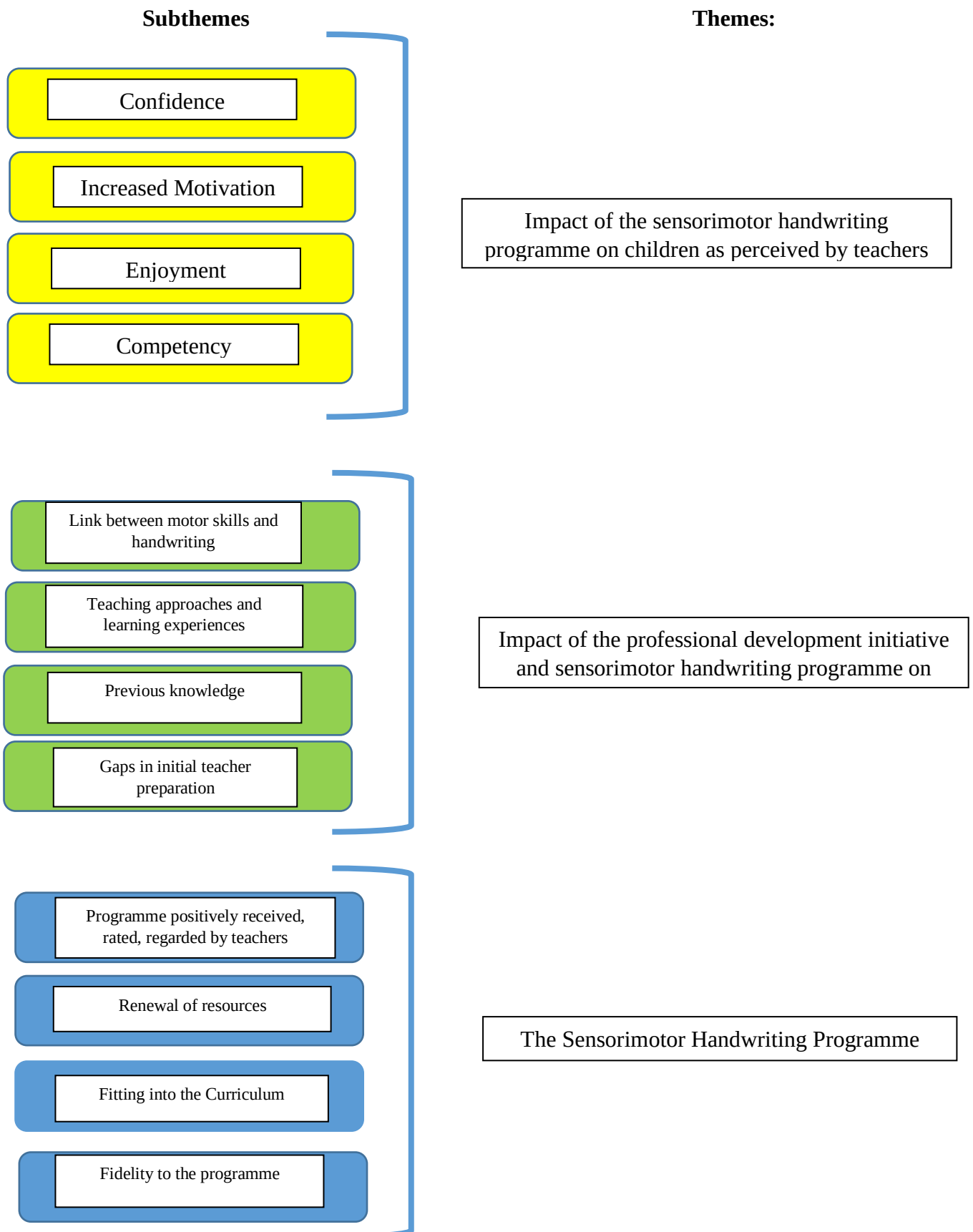
6.1 Introduction

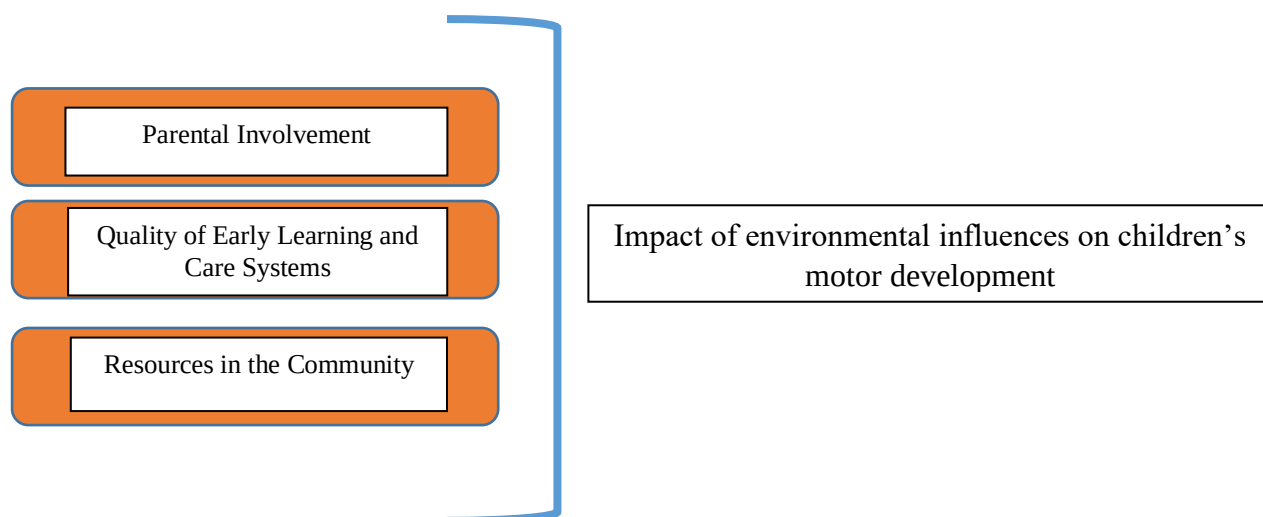
This chapter reports the qualitative findings from phase one and phase two of this study. Qualitative data collection, as outlined in Chapter 4, involved the employment of semi-structured interviews with all ten participating teachers as well as observation of the sensorimotor handwriting programme being implemented in order to determine: 1) the pedagogical approaches that should be included in a sensorimotor handwriting programme; 2) the supports that teachers require to be able to implement a sensorimotor handwriting programme effectively in a junior infant classroom; 3) the effects of a sensorimotor handwriting programme on the development of fine and gross motor skills, on the emergent handwriting skills and on the enjoyment of handwriting lessons of junior infant children; 4) the perceptions and knowledge of teachers regarding the relationship between motor development and emergent handwriting skills and 5) the perceived professional development needs of teachers in relation to the teaching of handwriting and sensorimotor development.

This chapter begins with a visual representation (Figure 6.1) of the subthemes and the four overarching themes that were developed from the process of thematic analysis (Braun & Clarke, 2011) as described in detail in chapter four. Each overarching theme will be presented with supporting material from the semi-structure interviews and field notes from the observation days. The teacher's pseudonym and school are used to reference quotes that are extracted from the semi-structured interview transcripts. Field notes are represented by the abbreviation FN followed by the date on which the note was made.

Figure 6.1

Clusters of Codes and Overarching Themes





6.2 Impact of the sensorimotor handwriting programme on children from teachers' perspectives

6.2.1 Confidence

Engagement with the sensorimotor handwriting programme appears to have improved children's confidence in relation to their emergent handwriting skills. Vivienne (School F) pointed toward the developmental appropriateness of the programme as a possible reason why children who may have opted out of handwriting tasks in the past felt able to partake in the sessions.

I had a boy who was extremely reluctant to write anything. He had a lot of avoidance going on and the behaviours were creeping up and up and up. But he has actually got it now and I just think that's going to creep into every subject then for him. Because he was blocking his whole education because he couldn't actually colour, he couldn't write, he couldn't do anything...

Like when doing formal lessons, he would just not do anything in his copy. It'd be just 'I can't do that!'. And he'd go under the table. So in that session (sensorimotor handwriting session) he'd love it. It's funny.

It was just more pitched at his level I think... (Vivienne, School F)

Eleanor (School A) spoke of children who had previously felt fear in relation to handwriting, in particular letter formation, but who did not appear to feel this fear or reluctance in relation to the sensorimotor handwriting programme.

Fearful of not getting the letter right and having a meltdown because of it (Eleanor, School A).

Others spoke of children's pride in being able to write their letter and how they were eager to show off their progress to their teacher.

You could see their pride in being able to write the letters... (Greta, School D)

Like they kind of have, what's the word, pride in their work (Barbara, School B)

Greta (School D) suggested that a reason for increased confidence among her cohort of children was that the programme was less teacher-led and more child-led, enabling the children themselves to develop positive learning dispositions including confidence and independence.

I think I really liked that the kids were in control of their kind of learning there.

I think sometimes when it's very teacher-led you're concentrating on who is listening, what they have achieved...but when you are sitting back and observing them and seeing their interactions and watching them...once they're set up and they have their captains organised and everything, you can see how well that they're communicating with one another or communicating with me as well. (Greta, School D)

Nicola (School C) referred to a child's awareness of their 'messy' writing and their ability to name that with confidence and to suggest a strategy to remedy it.

My writing was very messy on that whiteboard, I should have used the pegs this morning (Nicola, School C).

In relation to the visual perceptual element of the programme in particular, Sarah (School B) spoke of the struggle children endured at the beginning of the programme and of the progress that they had made by the end of it.

Then at the end it was just “yep, I’m doing this” instead of “I can’t do it, I can’t do it”

She couldn’t write her name, and I don’t know if it’s because of the programme, but since then (when she mastered the visual perceptual tasks) she has been able to write her name (Sarah, School B).

Sarah concluded her interview by stating:

I was just “wow”. It was great to see and the children’s confidence building, that they found something so difficult at the start, and then they just mastered it really (Sarah, School B).

The researcher observed the implementation of the programme in Eleanor’s (School A) class on 12.03.19. During the gross motor part of the lesson, one child said to the researcher “look at my balancing” (FN, 12.02.19). The researcher noted the pride in the child’s tone and in how pleased he was with his success at the task.

6.2.2 Motivation

Analysis revealed that children’s motivation to write appeared to be significantly improved by their engagement with the sensorimotor handwriting programme. Teachers spoke of a definite change in children’s attitudes and motivation to attend to handwriting tasks. The resources that were used as part of the programme were cited as one possible reason for the children’s increased motivation.

You introduce all those things (new resources) they were excited and eager to become involved in. And that has made such a difference. I have seen...more eagerness to write here than I would have in my last class (Nicola, School C).

Susie (School B) spoke of how motivated children were for their handwriting lessons and how eagerly awaited handwriting time was.

They are always asking when they are using Ms. Lambe's stuff. I would say 'Oh we are coming to it' (Susie, School B).

They really, really want to write and they want to do more...

Nicola (School C) spoke of children's increased motivation to engage in handwriting tasks outside of the programme itself.

They actually take a whiteboard now and they decide that they want to do letters or they want to make things in terms of letters or different things, you know, and it's a bit more exciting for them kind of, you know (Nicola, School C).

Another suggested reason for the increase in children's motivation was the focus that the teacher themselves was putting on the programme. The children knew and understood that it was important in some way to the teacher and they wanted to do well.

I just think they're actually really interested in writing now whereas before when I had junior infants...they were like, oh we just have to do this writing now (Sarah).

6.2.3 *Enjoyment*

Children's enjoyment of the programme emerged as a significant subtheme following a thorough analysis of the data. Teachers spoke of the children's engagement with, and their

enjoyment of the programme. In particular, they spoke of the children's enjoyment of the materials and resources and of the interactive nature of the programme.

Okay it's time to write and they would *cheer*, like it was unbelievable. Like every time I said 'it's handwriting time' they would cheer. Like literally like 'Yeaah!!! It's my favourite thing'. Like the amount of them that would have said it was their favourite thing (Hannah, School E).

The children absolutely loved highlighters...blown away. I'm like 'Why didn't I use these years ago?' Anything to do with a highlighter they were just obsessed with. So, the highlighters were a big hit. Again, they loved the shaving foam, they loved the sand (Isla, School E).

Little things you know, like the pearl clay, my kids loved that (Vivienne, School F).

I'd say the gross motor they loved. The fine motor they loved because of all your resources (Sarah, School B).

Teachers spoke of children's enjoyment of the writing process in comparison to other years and referred to the structure or the 'set up' as being a possible factor in relation to this.

The kids themselves enjoy the process of writing more. So, even compared to last year. So, I've had infants for two years, last year, I feel they enjoyed the whole writing set up this year more (Nicola, School C).

They love it, they absolutely loved it (Sarah, School B).

In reference to the repetitive nature of the programme, one teacher reported that children did not appear to mind repeating the same activities but rather, they enjoyed the repetition. The structure and the predictability of the programme was viewed as a strength by the teachers. The

station teaching structure appeared to work well for most teachers, in particular the child-led element of it.

They didn't seem to like kind of get annoyed if the activity was the same, like they enjoyed using those as many times as they could (Susie, School B).

I thought the framework was brilliant. I really liked the structure of it, I have a very busy group as all junior infants are, I have 29 so I found that once they were used to the structure...it was their learning time, it wasn't teacher talking and telling them too much (Greta, School D).

6.2.4 Competency (*emergent writing skills, letter formation*)

The quantitative data as outlined above in Chapter Five, shows a significant increase in all of the participant's motor proficiency over the two time points, pre- and post-implementation of the programme, across all six schools. The statistical analysis is supported by the qualitative analysis, with participating teachers commenting on the progress that children made in relation to their emergent handwriting skills and their motor skills as a result of having engaged with the sensorimotor handwriting programme.

Vivienne (School F) mentioned that the pencil grip of children in her class had improved. She spoke about progress being slow at first and her relief at noticing progress as time passed.

And one of the things has been that the pencil grip has come out of it. But for a long time you're just walking around going 'Oh my God, are they actually getting any better?' For a long time (Vivienne, School F).

Isla (School E) spoke about noticing a significant improvement in children's letter formation in comparison to other years that she had taught junior infants.

It was huge like. Like their writing, because we do that pre-cursive writing, so like it is difficult, some of the letters, but to see how they write now is, it's amazing like, it really is (Isla, School E).

Eleanor (School A) too commented on a marked improvement in children's letter formation in comparison with other years.

I think given, yeah, given that there were, there's a lot of very weak kids to start with, and it was only even when I was writing up the reports and sort of thinking about their writing and things in particular that I think they, even though they may not have come on in leaps and bounds, they *definitely* made more progress than they would have done if they hadn't been doing it (the sensorimotor handwriting programme) (Eleanor, School A).

She noted that there was only one child who has not mastered letter formation by the end of the year.

Because it was only *one* kid, I could say at the end of the year that wasn't writing quite well. Now, you know, there's still probably problems with letter formation and, but when we were sort of, I was doing an activity a couple of weeks ago where they had all the letters and they were practising letters line by line, and there was only one child who really couldn't still manage to sort of make a fairly good stab at any of the letters (Eleanor, School A).

Susie (School B) spoke of children's improvement in the area of left to right orientation specifically.

Left to right orientation, they are kind of a bit better at that. Even when we were doing the news writing in the copies, they were a bit better now starting at the edge of the

page, whereas at the beginning they would start anywhere. So, you could see they improved (Susie, School B).

Nicola (School C) mentioned that the programme has provided her with opportunities to observe the children's progress in their handwriting development. She noted that she was more aware of challenges they were experiencing now in relation to their motor development.

Yeah. So, I'd know like, you know before you'd be doing a worksheet or something for jolly phonics and you'd be thinking oh God, I'll run around and check and see what way they're holding pencils or that kind of thing. Whereas I feel now I know if they struggle more with fine motor and gross motor skills, you know (Nicola, School C).

Greta (School D) too, spoke about the programme offering more opportunities for observing the children's progress. Greta attributed this to the child-led nature of the programme.

I think I really liked that the kids were in control of their kind of learning there. And it made me be able to observe a lot more. I think sometimes when it's very much teacher-led you're concentrating on who is listening, what have they achieved, but when you're sitting back and observing them and seeing their interactions and watching them your focus is really on them... (Greta, School D).

Greta (School D) commented specifically also, on children's progress in relation to their gross motor development and their posture.

I definitely think it has brought them on in leaps and bounds. Even for one or two kids I was concerned about their, what is it, seating, posture, that one or two kids were lying across, like lying on their tummies across the table a lot or standing up or falling off their chair and I think that that gross motor development and the fine motor skills has just helped strengthen their core a little bit. And it also made me very aware that they

were struggling with their core to sit at their seats, and it made me change a few things, it wasn't just that they were distracted, it was just that they were finding it difficult (Greta, School D).

Vivienne (School F) spoke of challenges she encountered in relation to differentiation. She noted that some children in her cohort were 'so ready' and very capable in relation to their motor development and pre-writing skills, while others were slower to make progress and needed her to work with them more intensively.

So, for me a lot of the children in my class are very, very able. So, I felt sometimes then I was kind of like, oh, I felt a little frustrated sometimes because of the gap. That I had my children that I wanted to work on and I probably, in hindsight, could have differentiated a bit more and I could have had them maybe doing a bit more on the handwriting side. Because they were just so ready (Vivienne, School F).

6.3 Impact of the professional development initiative and sensorimotor handwriting programme on teachers

6.3.1 *Increased awareness of the link between motor development and handwriting*

Participants commented on new knowledge that they acquired in relation to the role of gross motor skills in handwriting development. Isla (School E) spoke about having taught fine motor and gross motor skills previously but without having connected those skills to the development of emergent handwriting.

I would have taught gross motor skills and fine motor skills, but I wouldn't have necessarily put them all in the same lesson, and to just have them all there, you could just see how much it benefitted them, you know? To warm up their body, warm up their hands, warm up their eyes – all those three things together. They loved it, but then it was *really* beneficial for them as well (Isla, School E).

Greta (School D) too commented that she has not previously linked gross motor skills to handwriting development.

I would have seen that as two entirely different lessons. So, I would have done a handwriting, writing lesson and then gross motor development would have been movement breaks, PE but it wouldn't have necessarily been the bridge to build their handwriting skills (Greta, School D).

Aoibheann (School C) echoed these views and spoke about not having previously seen the connection between fine motor skills, gross motor skills and handwriting.

I suppose the ideal of it developing in tandem with fine motor developing, in tandem with gross motor, and the fact that the approach was... that it would all happen in one chunk of time, and the significance of starting broad and then narrowing down to specific movements of writing. That intuitively makes sense now, but I wouldn't have seen that necessarily as an advantage to do it all at the one time. You know when children are younger, that they need to develop their gross motor skills and their core strength, in order to be able to write (Aoibheann, School C).

Nicola (School C) also commented on how she had not previously associated gross motor development with handwriting development and spoke about the children's enjoyment of the gross motor element of the programme.

I would have focussed a lot on fine motor activities but might not have kind of went near the gross motor part, you know. Whereas I find now they actually get really excited when it's time for like their exercises and they even start to do it in the yard or PE, that kind of thing (Nicola, School C).

Sarah (School B) spoke about her new learning in the area of motor development and how she was able to see the connection now between motor development and emergent handwriting.

Especially the cross body, and using both sides of the body, that has...I've learned so much from that, that's the one thing that jumps out for me. I hadn't realised the importance of that, and it makes so much sense now. And just even I suppose putting those in place before the writing occurs, it just makes so much sense now, whereas before we wouldn't have given any attention to that really (Sarah, School B).

She commented on how she now viewed writing as a whole body with core strength and posture playing a key role.

Now it's about getting the whole body working and getting used to the movements that are needed for it. Even the fact that you need your arm - of course you're using your arm, but I would never have thought of that before, the amount of the arm. Like, I thought hands and fingers, and that was it. Even before it was...getting your fingers ready, it was like okay, doing all this, there was no arm movement. Just even the way the posture as well, well obviously we said two feet on the floor, and straight back, and back in the chair against...but there was no... you're engaging your core, and it was kind of...I wasn't thinking... (Sarah, School B)

She reflected on the possible factors that may be contributing to what she considered a decline in children's motor development.

And just, it's got me thinking a lot about how children don't have the opportunities to develop their fine and gross motor skills. In the past, I suppose we wouldn't have had the level of difficulty with motor skills as we do now, and it seems to be down to them spending more time indoors and on their screens and everything. Like their motor skills,

I suppose with screens and everything, that kind of motor skill, the fine motor skill, would be well developed, but other motor skills not so much (Sarah, School B).

Sarah (School B) spoke of her surprise at the difficulties that children experienced in attempting to complete what she perceived as simple gross motor tasks as part of the programme, and the progress that they had made at the end of the 16 weeks.

Like, I couldn't believe that simple tasks like making their body sit against a wall was so difficult for them, but the progress that was made over all the weeks that we engaged in the sensory motor programme was unbelievable. Even the whole knee to elbow, that was unreal, like at the start they just couldn't do it, and then over the few weeks it was perfected (Sarah, School B).

Hannah (School E) echoed Sarah's sentiments in relation to new learning in the area of gross motor development.

I think the gross motor element as well, I never would have done a gross motor warmup. And I definitely think I have... having taken part in the study I have now realise the importance of posture, arm position, leg position, throughout handwriting, and I never would have put and emphasis on that, I definitely don't think I did last year. So, I feel this year, having put the emphasis, the kids even have the vocab for it, like 'helping hand' 'proper back' (Hannah, School E).

Figure 6. 2 depicts the participating children in School engaging in the gross motor element of the sensorimotor handwriting programme.

Figure 6.2

Children in School A engaging in gross motor warm-up activities



6.3.2 Increased knowledge of teaching approaches and learning experiences to promote motor development and emergent writing skills

An analysis of the data showed that all of the participating teachers reported that they had learned new teaching approaches and learning experiences to promote motor development and emergent handwriting skills in the infant classroom.

Hannah (School E) spoke of the use of a wide variety of materials as being key to her learning. She referred to the writing tools that she used in the past as “stubby crayons and pencils”. She reported being taken aback by the impact that new and varied writing tools could have not only on children’s motivation but on their emergent writing skills.

...even grip wise it showed us...it gives them different ways to handle each thing
(Hannah, School E).

Eleanor (School A) spoke about having used all of the teaching approaches prior to implementation of the programme in isolation of one another.

You'd do your gross motor separately, you'd do your fine motor separately, and you'd do your handwriting I think at a different time in the day (Eleanor, School A).

The new teaching approach for Eleanor (School A) was putting all of the elements together in a sequential programme, that she viewed as beneficial to the children's motor and emergent writing development.

I love that sort of progression through the steps...all sort of following one after the other before you even get to the steps of handwriting (Eleanor, School A)

Nicola (School C) spoke of how she would use the outdoor environment more in relation to handwriting development going forward. She reported a new knowledge in how she would integrate handwriting development and outdoor play.

I realise now you can do a lot of things outside as well. Like even you know, the chalk on the ground and that kind of thing... (Nicola, School C).

Vivienne (School F) referred to how she had previously relied on workbooks to teach handwriting skills in the infant classroom. She spoke of "not having enough other resources" prior to implementing the sensorimotor handwriting programme. She spoke also of the new knowledge she had acquired in relation to children's gross motor development.

I think the gross motor exercises were really good. I think I always knew that I was supposed to be doing them but marching was really...like, it's amazing how they couldn't do it at the start (Vivienne, School F).

Aoibheann (School B) reported that she believes the children's ability to successfully manipulate smaller, more complex pieces of Lego was as a result of the children practicing first with big Duplo blocks as part of the sensorimotor handwriting programme.

I've now moved onto quite small, difficult Lego...we've gone from the big Duplo to the smaller ones that you gave us...and they're all able for it (Aoibheann, School B).

She spoke also of how going forward she would set this as a motor development goal for children – to move from Duplo to Lego as the children demonstrated capacity to do so.

It would be a goal to get them onto it sooner, definitely... (Aoibheann, School B).

Barbara (School A) reported that her teaching approach to fine motor skills had changed as a result of newly acquired knowledge about the variety of fine motor activities that are possible. She also made reference to the importance of activities involving a sensory element.

...there was a huge variation but they're all very easy to do like just even working with the pegs...I think the Theraputty, using different material so that it's not just play dough, it's something that has good sensory feedback... (Barbara, School A).

Greta (School D) reported a new teaching approach in relation to children's seating arrangements in the classroom. She spoke about previously believing that it was important for children to "to sit on their bums, cross-legged" when they were listening to a story. Since taking part in the research study she reported a deeper level of understanding in relation to children's motor development and how she could support that in the classroom.

It's okay to develop their core and let them lie on their tummies, and hold themselves up (Greta, School D).

6.3.2 Compensation for gaps in initial teacher education

All ten of the participating teachers spoke about not being able to recall receiving any training in the area of sensorimotor development as part of their undergraduate degree training. Sarah stated that she could not remember any training in the area and that she left college understanding that letter formation should begin straight away in junior infants.

There's none in teacher training, not that I can remember anyway. I don't remember anything about that...I think we would have thought of junior infants as being ready to engage in... straight into letter formation (Barbara, School A).

As well as an absence of teacher training in relation to sensorimotor development, many teachers spoke about a lack of focus in the areas of writing generally. Eleanor recalled learning about reading and oral language instruction but was unable to remember receiving training in relation to handwriting development and fine motor development.

No, my memory in college, maybe it's just the things that stuck with me, but my memory was *much* more in terms of reading and oral language than writing, because I *remember* all the stuff about the big book and LEA, do you know – Language, Experience, Approach and that *all* sticks with me, and I don't have a memory of any sort of ideas to go out there with fine motor (Isla, School E).

Greta (School D) echoed this view somewhat, that she recalled handwriting and reading being highlighted as part of Aistear but failed to recall much about sensorimotor development. She suggested sensorimotor development as an area that could be focused on further as part of a module in the Bachelor of Education degree course.

I really don't think I can recall learning much about it to be honest, and I think it could be something that could be highlighted in a module in college I think, it could be, I think there's a lot of focus on handwriting and Aistear and reading skills, but I don't think there was the same focus on phonics with a sensory motor development (Greta, School D).

Isla (School E) recalled receiving training in relation to the Writing Workshop but noted that she did not recall ever learning about how to teach writing explicitly or from the beginning.

Oh, very lacking in any sort of... I don't *ever* remember being taught about writing to be honest. As in obviously writing workshops and all that, but I don't remember ever being told explicitly or taught explicitly about the beginnings of writing... we didn't have explicit sort of focus on developing those skills that we've been focusing on in this programme (Isla, School E).

Isla (School E) and Aoibheann (School C) both spoke about leaving their undergraduate degrees without having received much training in relation to emergent handwriting development or sensorimotor development but noted that they learned about it 'on the job'.

I think you learn a lot more in teaching when you're in the classroom and see what they need...do you know you learned as you kind of went through it? (Isla, School E).

But it was more kind of, when I came to work in a school, that I realised what things... that that was part of literacy (Aoibheann, School C).

Aoibheann (School C) noted that she would not have viewed playful fine motor activities as 'academic' or 'work' for children when she was in college.

I wouldn't necessarily, even in my teacher training, wouldn't necessarily have really known that that was academic, that that's fun (Aoibheann, School C).

Vivienne (School F) echoed the views of others - that there was a lack of focus on sensorimotor and handwriting development - but wondered whether she should have taken more responsibility herself to upskill in the area of handwriting development and sensorimotor development.

Oh, I have to say it probably was quite poor. Yeah. I don't really remember... see, I did the postgrad training, I don't really remember getting much training on handwriting at all. Maybe it was in a section of literacy but I think no major focus on it. But I didn't

specialise in any kind of younger education or anything like that. So, that's probably my own fault, I don't know. And it was never something that I actually thought to do myself any further. It was never really discussed that much (Vivienne, School F).

6.4 The Sensorimotor Handwriting Programme

Participants talked about how they would approach handwriting instruction in the future and reflected on change to their practice that might have occurred as a result of their participation in this research study. Many commented on their intention to continue to implement the programme the following year.

6.4.1 *Positively received, regarded and rated by teachers*

Isla (School E) talked about a change in her practice in relation to handwriting instruction and emphasised her new learning in the area of motor development as a result of engaging with the sensorimotor handwriting programme.

I definitely would approach handwriting completely differently from now on. Even I think if I had an older class I would just, I think bringing it back to basics sometimes is important. Like, you know, get them developing their gross motor, their fine motor, like that gets neglected as they go up and it's all just about writing, writing, writing, whereas sometimes they need, you know it's no use to just say 'write neater' or '[00:17:04.3] your handwriting' if you're not showing them how. So that will change definitely. I would definitely, like I said, I would approach my handwriting differently now teaching a Junior class all the time. Like definitely be keeping the gross motor, their fine motor, bit of visual perception and stuff like that, I would *definitely* keep that up. I think that was so beneficial this year. Yeah, I suppose that would be the big thing (Isla, School E).

Isla (School E) mentioned that the programme and her participation in this research validated the emphasis that she already placed on gross motor development.

I'm a big believer in trying to push their gross motor. Like their PE and stuff like that, like I... movement breaks, like I said, so I would keep going with that. I think it's validated that to me in my head a little bit, if you get me? Like that I'm like 'Okay, there's a point to that'... (Isla, School E).

Sarah (School B) spoke about her priorities having changed and her new learning since implementing the sensorimotor handwriting programme.

...my priorities would definitely change...this year I've learned so much...I just think it's a wonderful programme and I was in awe of it really, when it was happening under my eyes... (Sarah, School B).

During a conversation with Vivienne (School F) following observation of the implementation of the programme in her classroom, she stated (FN, 20.05.19) that:

I just don't use the books anymore. I know there's much more to it now so I do other things too (Vivienne, School F).

When the researcher asked Vivienne (School F) if the sensorimotor handwriting programme has changed her practice in relation to handwriting instruction, she replied:

It's changed. I understand the importance of fine and motor skills now and that handwriting is so much more than the book (Vivienne, School F).

During a conversation with Greta (School D) following the observation of the programme in her classroom, Greta (School D) spoke about how the programme provided more structured movement opportunities for children in her class who had sensory needs. She reported that the

programme allowed children to engage in movement activities in a more meaningful way than typical ‘movement breaks’ (FN, 21.03.19).

All of the participating teachers reported that they planned to continue to implement the programme in the future in the junior infant classroom.

I’d happily implement the programme...Like I definitely would implement the programme and to the best of my extent include every aspect of it for next year as well (Hannah, School E)

Greta (School D) reported that she learned a lot from the professional development days and from the other participating teachers.

I thought it was brilliant. I even took away so much from the meetings, from the groups and from listening to the other teachers describing their infant classrooms, and what they’re doing... (Greta, School D).

6.4.2 Issues with fitting the programme into a busy and full curriculum (maintaining coherence and integrity of curriculum)

One particular subtheme that was reoccurring throughout the interviews with teachers was the issue of curriculum objectives and teachers’ concerns about other subjects losing out as a result of time spent on the sensorimotor handwriting programme. Some felt conflicted in relation to wanting to spend time implementing the programme because they perceived it to be beneficial to the children’s learning and developing but also expressed anxiety around other subject areas being allocated less time as a result.

Because of the programme as well I *do* feel that as much as I love doing it and everything, I do feel, and it’s not that I wouldn’t do it again, I do feel that other subjects possibly suffered, and things like PE *may* have suffered (Hannah, School E).

In terms of managing, time management...I wouldn't let it take up quite so much of the year, because I *do* feel that other subjects did suffer this year (Barbara, School A).

I feel at the start of the programme we were spending so much time with this that some other subjects might have suffered slightly. I'm not sure which ones. But I happily was putting the time into this, but I definitely think curriculum time wise I had to adjust for other subjects (Eleanor, School A).

Teachers expressed some concerns around where to fit the programme into their planning and some spoke of struggling in relation to integrating the programme across curricular areas.

I mean in terms of my monthly reports and stuff last year it was certainly under writing, PE...yeah probably realistically only really in those areas, but I'm terrible for seeing...the linking, yeah (Susie, School B).

One teacher spoke of her conflict in relation to not being able to integrate her phonics lesson with the sensorimotor handwriting programme. This meant that she was allocating 40 minutes solely to the programme without covering her phonics lesson in that time. The teacher explained that it was school policy to teach cursive script from junior infants. Therefore, the Jolly Phonics programme was taught in isolation of a separate handwriting lesson so that the children were not exposed to the print letter formation element of the Jolly Phonics programme. They focused only on the letter name and sound and then engaged in a separate letter formation lesson later in the day.

The only barriers were just timetabling...I feel that if I was timetabling it because it wasn't linked with a phonics lesson, it was linked with just a handwriting lesson that 40 minutes was hard to give. Even though I think it is so important but I think if it was linked with the phonics... (Vivienne, School F).

All of the teachers planned for the programme under Literacy. Some integrated the programme across their plans in Maths, PE, Visual Arts and SESE which helped them in relation to any anxiety they were feeling about ‘fitting it all in’.

I still do it as part of literacy. But I would do it more so now part of...well the gross motor aspect with PE...I’ve found that you could include it in Visual Arts...but it’s predominately literacy (Hannah School E).

There are obviously lots of opportunities to bring in other subjects. If you happen to be doing pattern in maths, you could encourage them to incorporate that into whatever their activity is. There’s all language around... there’s huge opportunities for language, if you’re making snakes you can talk about long or short, if that’s your last kind of... there’s a lot of overlap there. So, if you’re familiar with the infant curriculum, there are plenty of opportunities to integrate it, I definitely think so (Nicola, School C).

When you actually included this as a cross-curricular thing, so that this is actually some visual arts time, this is actually some like, no PE, but like, you can balance it out as well but at first that was the challenge, that it was taking time (Aoibheann, School C).

They had the Aistear...at the start it was just mark making but now they’re trying to form words with that. So it’s that cross-curricular thing that you’re including in lots of different areas (Barbara, School A).

Some teachers spoke of how they previously delivered fine motor instruction – generally in the morning time at stations. They spoke of integrating this fine motor session with the handwriting session successfully.

We would have always done a lot of fine motor stations. Like you know, when they come in in the morning they have 20 minutes’ kind of fine motor stations...I would see

it linking in much more with handwriting directly now. You can see it in their PE as well. The gross motor helps them there (Isla, School E).

Allocating time for the programme was an issue for other teachers too who expressed anxiety and concern about how much time it took up during the day. Some found that integrating their phonics programme into the programme worked well for them and eased their concerns in relation to curriculum time demands. Other teachers reduced the number of days that they implemented the programme.

It was hard, very hard at the start. I found I was taking nearly an hour at it, at the start, it was really...I found that very difficult...so basically what I did was I incorporated the phonics then. I'd run straight into phonics and then get them to do whatever letter we were doing, then write the letter after that, so it just meant that time wise, two things were blended together (Sarah, School B).

I was doing five days a week and I found that a little bit too much on me. And what I did then was I changed...I think I went to four and I took Friday off. And then I kind of pushed it back to three (Vivienne, School F).

While the allocation of time was evidently a concern for all of the participating teachers, many teachers also expressed a feeling of relief in relation to slowing down literacy learning in the first term. The experience of teaching the programme appeared to give teachers an enriched perspective on pacing in response to the developmental stages of the children in their classes. Many spoke a 'rush to formal literacy learning' and how the sensorimotor programme in some way, gave them permission to slow down and to focus on the developmental stages that children needed to move through before they were ready to begin formal handwriting instruction.

...I really feel like this, doing this programme gave me the excuse to really do what I wanted to do, which was like, slow down, really focus on the prewriting aspect of it. And just see them, see the fact that them playing with Lego, or them playing with marla, for a long time, was actually the right thing to do. Like, I feel like there was almost like a guilt, especially, just in the beginning when I was getting used to it a couple years ago, teaching junior infants. You were like, oh god, is it okay for them to be playing with marla for this long (Aoibheann, School C).

We also took our time this year. So, last year in infants we had...we were following a new handwriting book Go with the Flow, with Brendan Culligan, and we tried to do every lower case and every capital letter. And that was bonkers (Isla, School E).

This year I have noticed such a difference. We've only done lower case letters and it's made such a difference to their writing. To them taking their time...we've been able to access that much time to practice handwriting (Isla, School E).

Some of the teachers spoke of how they had become advocates for slowing down in relation to handwriting instruction in junior infants.

Yeah I have been pushing it a bit to say we really need to slow down on the handwriting and spend time on the multisensory and the pre-writing. Everybody agrees, I just think that we didn't really know how to go about it so this research has been really helpful with that (Greta, School D).

We had decided as a staff that we weren't going to do phonics until after Christmas because we were going to work on syllables and sounds and letters and all of that kind of thing...leave out the letter formation (until January) (Nicola, School C).

Other teachers reflected on their past practice in relation to rushing handwriting instruction and their newfound awareness of the need to give children time to develop the necessary prerequisite skills.

I probably would have focused way too much on the finger exercises and not enough on all the groundwork that goes into it and probably started handwriting way too soon with children. Kind of like getting them to run before they could walk (Aoibheann, School C).

Like, going straight into letters without having done enough. Well, obviously doing the pre-writing, but mainly in a book and not enough using the other resources. And then after you're finished that section of the book you just kind of start in without any really assessment or anything (Vivienne, School F).

I think if I was to start off again in September and focus like on the shapes and that kind of thing at the start, you know, we didn't do the writing part obviously till January, until we started phonics (Nicola, School C).

Really putting the time into the day, because everything, you know, some years I possibly wouldn't have spent *half* of what I should have done on writing (Sarah, School B).

The rush to get all the...everything, writing, happening in such a way, and starting off in September straight into it, like, I'm thinking of it now, no, put the groundwork in first, and that would be the priority first (Eleanor, School A).

Well especially if I'd start with junior infants again. Like I'd definitely like peel back on everything that I would kind of done before like you know even you'd be thinking at the start of junior infants oh we'll do a few little like pre-writing worksheets and

stuff. Like I wouldn't do any of those kinds of things now. It would just be hands on for like at least January nearly, you know, before I'd try and do those kinds of things (Susie, School B).

Teachers being 'allowed' to slow down and go back to basics in terms of what the children need developmentally when they begin in junior infants, emerged as an important finding.

I suppose junior infants this year has been...like, I've been three years at it now, and this year I've learned so much, it just goes to show you, bringing it back (to developmental skills) (Aoibheann, School C).

I just felt, it's junior infants, this is what they need, so I was prepared to give it that time (Sarah, School B).

6.4.3 Issues with Renewing Resources

Participants commented on the handwriting resources that were made available to them to enable them to implement the sensorimotor handwriting programme. Some participants spoke about the cost and availability of resources and how replicable the programme would be. All participants spoke about their surprise at how much the children enjoyed the variety of resources and what an impact varying the resources had on the children's motivation.

I *definitely* don't think the interest would have been as high without the programme. You know, without the resources, without all the different activities. Like *that's* what they loved about it, but then because they did all that, by the time they came to their writing stage of it, their writing was really strong, do you know? So, I think... I think the programme definitely had an impact on that (Isla, School E).

Sarah spoke about the lack of availability in her school of the resources that were used in the programme. She noted that some of that equipment was cheap and that accessing the necessary

resources might act as a barrier to implementation should the school decide to adopt the programme going forward.

Some of it we wouldn't have, like those droppers; the shaving foam we wouldn't have, now that's cheap, obviously; the putty, the Theraputty we wouldn't have; tongs, we wouldn't have either unless it was in a science kit or something. Yeah, there were a few things that we mightn't have (Sarah, School B).

Susie (School B) spoke of the children's enjoyment of the wide range of resources and activities that were part of the programme. She commented that they particularly enjoyed the sensory element of the resources.

I liked the rice. I still have trays with their rice in it and their coloured rice – they put food colouring in it. They like using that. I think they just like the feel of it. Then I love the shaving foam. I literally flew through cans of shaving foam. I would say five cans were gone by the end of it, but they loved it. I literally let them write with the shaving foam on the table. That was good fun (Susie, School B).

Barbara (School A) echoed this view and commented on how much variety that was in the programme in relation to activities and resources. She too noted that the children responded particularly well to the sensory element of activities.

There was a huge variation but they're all very easy to do like just even working with the pegs. It's stuff that you have in the classroom, it's just organising it. I think the theraputty, using different material so that it's not just play, or play dough, it's something that has a good sensory feedback, the kind of clay... (Barbara, School A)

She referred to the resources as inexpensive and easily accessible in most school environments.

Yeah. All kind of inexpensive stuff that the children really enjoy using

Yeah. I think just I know in our school there's kind of resources all over the school. So you just have to kind of group everything together but I do think all schools have them kind of toys like the Duplo blocks, most classes have them it's just keeping them separate then from your other play toys, pegs, clothes pegs, all of that is kind of in schools and if not I think it should be easy enough to kind of get your hands onto it (Barbara, School A).

Nicola (School C) spoke of the children's enjoyment of the new and varied resources that were part of the programme. She commented on not having previously thought about using a material like clay in a handwriting lesson before. She like others, referred to the 'messy' or sensory element of the resources as being particularly enjoyable for the children.

My class loved the Theraputty and the slime and you know, like really kind of messy things and like even using the clay and stuff or the fact that that was in like little lunchboxes whereas before I just used clay for art. I didn't think to use it for writing kind of, do you know that way (Nicola, School C).

Vivienne (School F) too made reference to the variety of materials being a strength of the programme and how she had not previously reflected on how simple changes to writing materials could have such an impact on children's engagement and interest.

The children absolutely loved highlighters... I'm like 'Why didn't I use these years ago?' Anything to do with a highlighter they were just obsessed with. So, the highlighters were a big hit (Vivienne, School F).

Like others, Vivienne (School F) also mentioned that children particularly enjoyed resources that had a sensory element.

Again, they loved the shaving foam, they loved the sand. Probably could have used water a bit more as well, with the brushes and that. They loved the paintbrushes in the air (Vivienne, School F).

Hannah (School E) commented on the importance of having a variety of materials to achieve the same learning objective.

The use of different tongs and tweezers. We would have just had one simple blue one last year and now I understand the importance of using the different sizes... And probably just when using them that you can use them with a variety of resources, so not just pom poms and beads, like, using them, or using pegs. You can pick up lots of different materials. So, the activity, the process is the same but the activity in front of them is different (Hannah, School E).

She too spoke about the children's enjoyment of resources and materials that had a sensory element.

The putty. So, the resources wise, putty was excellent with them. Like, cutting playdoh, I spent the whole of last year never cut playdoh with them. Using pencil in playdoh. Lots of the water play was excellent (Hannah, School E).

6.4.4 Fidelity versus need for some adaptation to suit individual circumstances

The idea of fidelity in relation to the implementation of the programme and teachers' concerns about whether or not they were implementing the programme correctly was identified as a significant finding. Teachers expressed a desire to see the programme in action or to have a demonstration of a session at the CPD days. They felt that this would have helped ease concerns they carried in relation to 'doing it right'.

At the start, I suppose I was kind of overthinking it, nearly...I think maybe, do you know what, it could have been a nice idea to see somebody doing it, that might have been nice (Sarah, School B).

I suppose maybe just at the start that we might have had a run through kind of us doing it (Vivienne, School F).

Like before I was panicking, you need to do it at a certain time of this day and trying to fit it in... (Susie, School B).

It emerged also, that some teachers had to adapt the programme and changed certain elements of it or reduced the number of days they implemented it to suits the needs of their class.

Because I kind of have my little way now of doing it. It might be different to the way it was originally put out in the plan, but that's kind of how I would do it (Vivienne, School F).

All but one of the teachers did not implement the programme five days a week for 16-weeks. Many spoke of having to reduce the days because of wider school commitments and curricular demands.

There were times of the year where it was really, like Christmas we just had to stop it, you know, that bit earlier, or different times when you're coming up to midterm, you know? Stuff that you couldn't fit it at all in. Seachtain na Gaelige... (Isla, School E).

...reduced it back to four and then down to three... (Vivienne, School F).

Other teachers spoke about sticking as rigidly to the programme as possible.

I would say over the whole programme there might have been...I'd say there was probably two days that I didn't do it all for whatever reason...but no...everything else fell by the wayside to do the programme for me (Eleanor, School A)

I thought it was... I found it quite easy to follow – I really prioritised it this year. I suppose I wanted to give it a good go, in order to compare it to other years (Sarah, School B).

6.5 Impact of environmental influences on children's motor development

6.5.1 *Teachers' perceptions of the influence of parents and the home environment on children's motor development*

Participants commented on the role of parents and the home environment on children's motor and emergent handwriting development. There were DEIS and non-DEIS variations in teacher's perceptions of the influence of parents and the home on children's motor development. Some teachers in the non-DEIS schools reported during the interviews and again during the observation days that parents had shown a keen interest in the research and were eager to find out more about their children's motor development. Teachers in the DEIS schools did not report this same level of interest from parents in relation to their children taking part in the research.

Hannah, teaching in a non-DEIS school commented about how the parents of the participating children had shown an interest in the programme while it was being implemented over the 16-week period.

Like, parents are nearly more aware, our parents, because you're out there (referring to the researcher testing outside the classroom door), they're seeing, like parents have been constantly checking in (Hannah, School E).

She spoke about the sensorimotor programme having a positive impact on parents in relation to their awareness of their children's handwriting development.

In a good way. Like 'What was this?' One parent has commented during the year, I think this is her first junior infant and she was saying 'The writing is amazing.' And

she was like ‘That must be all that great work that the [00:28:22.7] is doing.’ ...like, they’re more just aware of it (Hannah, School E).

Hannah (School E) reflected on the possibility of having a parent teacher meeting with parents to speak to them and inform them in a more structured way about the sensorimotor handwriting programme. She commented on a lack of opportunities to formally meet face to face with parents to have discussions with them about teaching and learning.

And I, now I’m taking a step back this year thinking...we don’t get a chance to talk to the parents about that, other than through a homework note or other than one on one. Definitely don’t have a meeting with the parents (Hannah, School E).

She expressed a view that it is important to involve parents and acknowledged their willingness to be included in their children’s education

Like I definitely think parents are very receptive so they would, like in our school they’re very willing, very eager to become involved in stuff (Hannah, School E).

Hannah (School E), like others, identified parents as being chiefly responsible for their children’s’ education.

Like, parents at the end of the day are the primary educators of the kids. So, for them, like knowledge is... What’s that phrase? ... Power. So, we’re giving them the knowledge, giving them the vocab, giving them the instructions (Hannah, School E).

She suggested that some parents would benefit from a structure being put into place to have formal discussions with the teacher. She commented that parents themselves may not initiate such discussions independently as a result of feeling ‘nervous’.

Some of them is that, that it is that nervous thing (Hannah, School E).

In contrast, Aoibheann (School C) teaching in a DEIS school spoke about parents' perceptions of playful learning as unimportant. She referred to parents' interpretations of the type of 'attractive' resources or 'fun' activities that formed part of the sensorimotor handwriting programme as not being 'academic' and not 'real work' (Aoibheann, School C).

I think parents' attitudes as well probably would need to be changed a little bit, because they think work, even now I was telling them I'm going to bring them forward to senior infants, and they're like, it's a lot more work, isn't it? I was like, [00:36:27.3] that was work. When they come in in the morning, they see you with these things that look really attractive and its fun, and they're kind of going, oh the real work hasn't started yet. Sometimes if parents are late, they don't think they've missed something (Aoibheann, School C).

Nicola (School C), teaching in the same DEIS school also spoke about parents' misconceptions around what constitutes as 'work' in junior infants. She suggested that in the future, she would communicate clearly with parents about what the programme entailed and what the purpose of it was. She commented on the need to make parents more aware of why the programme was being implemented and felt that this would aid parents understanding of motor and handwriting development.

I'd focus more on that, maybe tell the parents at the start of the year like this is what I want you to kind of do for the year and these are the kinds of exercises that we'll be doing and kind of make them a bit more aware. Because sometimes I think when they see like an exercise coming home, some people, parents don't even nearly sit down like they just think it's like a little game, you know that way. Whereas I think they need to kind of understand why we're doing it nearly, you know (Nicola, School C).

A number of the teachers spoke about being able to identify children who had experienced some level of input in relation to motor development in the home prior to coming to school. Analysis of the data indicated that those teachers in DEIS schools reported that children appeared to have underdeveloped motor skills. This is compared to teachers in non-DEIS schools who reported being able to identify children who had developed some level of motor competency in the home upon entry into school.

Isla (School E) teaching in a non-DEIS school, spoke about being able to identify the children who had engaged in activities in the home to develop their motor skills prior to coming to school.

I think you can see the ones at the start of the year who've developed it obviously a lot more at home. Who are colouring, who are drawing, who are writing, who are doing lots of different activities with their hands. Even household stuff. You can see the difference, you know, in kids that are doing a lot of that at home, and the kids that aren't (Isla, School E).

Nicola (School C), teaching in a DEIS school commented on being able to identify those children who had been not been encouraged to develop their motor skills at home prior to starting school. She mentioned specific life skills that children struggled with upon entry into school and referred to a learned helplessness or a dependence on the parents or caregiver to do things for them.

Do you know when the kids first start, like you can see that some of the parents do everything for them. Like even zipping up coats and all those kinds of things. Some of the kids don't even use certain muscles. Like I have one child in the class who's still being fed by her mam at home and you can see a huge difference then like that she's nearly awkward then when she's doing the exercises, you know (Nicola, School C).

Susie (School B), teaching in a DEIS school also mentioned being surprised by many children's inability to complete basic life tasks like zipping their coats up, upon entry into primary school. She attributed some of the responsibility for this to the home environment.

I suppose they should be doing bits at home as well. Even putting on their coats, some of them still can't put their coats on in junior infants. Even one or two doesn't get the hang of buttons, even the clicky buttons. Life skills (Susie, School B).

Nicola (School C) expressed a view that some children may have more developed motor skills as a result of their parents encouraging their independence. She spoke about some children being unable to perform basic daily tasks as a result of being 'mollycoddled'.

...they are used to people doing everything for them. I would have one with a lot of needs. She wouldn't even take a folder out of her bag. I have eventually got there now; she brings it to me (Nicola, School C).

Greta (School D) wondered about the impact of the home environment on the development of the children in her class in comparison to another school she had taught in in the North inner city. She commented on how she was impressed by the developmental readiness of the children in her class in relation to their motor skills.

I was definitely impressed by it, I worked in inner city before and they didn't have the same, I didn't believe they had the same gross motor development for whatever reason. Some of them it was just even observing them going up and down stairs. Whereas this group seemed to be a little bit more advanced than that (Greta, School D).

Barbara (School A) spoke about having previously assumed that motor skills would be developed in the home by children's engagement in basic household tasks. Her time spent

teaching in a DEIS school had changed her assumptions and she commented on the need to spend more time in junior infants' developing these skills.

Yeah, I kind of would have assumed that they do a lot of that kind of work at home, that they are doing the colouring, they do in I don't know, washing the dishes or something that hands-on activities. But no, I have realised that school kind of especially in our area we need to be doing more work on that. They're just not getting the experiences at home or they're not out playing, digging in the dirt, all those kind of things, so they don't have the strengths, core strength or the finger strength (Barbara, School A).

Barbara (School A) noted that in a school 'in our area' that 'we need to be doing more work on that'. She refers to her school in the North inner city and her perception that the teachers in this school need to do more to develop children motor skills.

Barbara's (School A) perceptions about children in DEIS schools needing more input in relation to motor development are supported by the quantitative data presented in Chapter 5. An analysis of the quantitative data showed a significant difference in the baseline measure of motor proficiency for the three DEIS schools compared to the three non-DEIS schools pre-implementation of the programme. Post-implementation of the programme, the statistical data showed that there was no longer a significant difference in the mean standard scores between the children in the DEIS schools compared to the non-DEIS schools. Barbara's (School A) comments that DEIS schools would benefit from more input in relation to motor development are supported by the data which indicates that the implementation of a programme designed to address those needs was effective.

Eleanor (School A), also teaching in the same DEIS school as Barbara, commented on having realistic expectations of parents. She noted that children's motor development is everybody's

responsibility and expressed discontent in relation to feeling overburdened by responsibility in her role as a teacher.

It's like everybody is responsible. I mean I hate this thing of that Teachers are always responsible for everything when of course it should come from parents, but that's not always realistic either. So ideally, you'd love it to be started early in the home and then progressed to preschool and then on into school, but I know in our area that's not a realistic expectation, so (Barbara, School A).

For Sarah (School B), teaching in a DEIS school, parents play a central role in their children's development.

Parents. I think anything to do with the children is to do...it's parental responsibility, and I am a parent myself, so it's up to them... (Sarah, School B).

She spoke about the accessibility of activities that promote motor development but countered this by commenting on the limited capacity of some parents to engage with extracurricular activities.

There are lots of activities that are free, it's just the children getting access to them, and being brought to them, I suppose that's an issue sometimes. And sometimes the parents are suffering themselves, so it's something that they can't help, but a lot of the time parents could help it and could get more engaged (Sarah, School B).

When prompted to comment further on why parents' might have limited capacity to engage in activities with their children that would aid their development, Sarah referred to a lack of education or knowledge in relation to handwriting and general literacy learning.

I'm a trained teacher and I didn't have the knowledge about...like, I knew that activities were important, but I didn't have, I suppose, the knowledge of the basics, the very basics that leads into their reading, or writing I should say (Barbara, School B).

6.5.2 Teachers' perceptions of the influence of preschools on children's motor development

In relation to environmental influences on motor development, participants spoke also about the role of preschools. Vivienne (School F) spoke about a decline in communication with preschool as a result of GDPR. She mentioned a lack of feedback from preschools and a lack of guidance in relation to where the children were at developmentally when they started school.

I think the playschool teachers could have a little feedback to schools. I'd love to see that happening a bit more but I know with GDPR it seems to have gone backwards. So, we used to be able to ring them, now we have to look for permission. A lot of that's actually stopped now, that information gap. It didn't help that situation. So, I just felt that you could get a better start with them if you had a kind of report or you had a guide where to put them at. Where they were leaving playschool and I knew kind of where they were on the checklist, I could differentiate it straight away and it would have helped a bit more (Vivienne, School F).

Eleanor (School A) spoke of not having high expectations in relation to children's preschool experience.

Well I know well enough now not to have huge expectations... Eleanor, School A).

She also commented however, on the potential for preschools to develop children's motor skills. She mentioned that formal letter formation should be left until junior infants but that pre-writing skills could be addressed in preschool.

I mean in terms of a lot of elements could be in preschool too. You know the gross motor, the fine motor, the visual perception, all those things. In terms of letter formation, I think Junior Infants, but any of the pre-writing stuff, definitely in preschool as well if possible, yeah (Eleanor, School A).

Barbara (School A) on the other hand, spoke of having had high expectation of children's preschool experiences but how that had changed since she has been teaching in the school she was in.

I would have assumed that they did a lot of it in preschool. I know kind of I even heard some children would come in with their Jolly Phonics, so you'd assume that they would have done a lot of fine motor work before moving on to that...I would expect them to come in with more developed skills (Barbara, School A).

She spoke about the struggles children experienced upon entry in to junior infants and expressed her surprise at many children not being able to recognise their names.

I would have a lot of children at the start of the year would have been kind of just scribbling lines in zigzags kind of just making shapes, so they're still at the pre-writing stage. A lot of them kind of didn't know their name even, like just to recognise it, something that you'd think they'd done at home like, so this is your name, sit down with mam do a bit of chalk work, something like that, no I was very surprised... (Barbara, School A).

Susie (School B) echoed those views, commenting on the significantly different levels of motor development and in particular life skills, among her cohort of children upon entry into school in September.

Well, there was massive differentiation even at the beginning. One could come in and write her own name...she was advanced from day one.

Even tying their shoes... They all have different abilities. One of them can actually tie up hair and things whereas the rest of them can't (Susie, School B).

When asked about why she thought this was the case, Susie (School B) spoke about her expectation and assumptions about what children had previously experienced in Montessori.

But that is part of Montessori...I thought they should have been used to it from play school. I thought they would have done loads in Montessori (Susie, School B).

Isla (School E) commented on the joint responsibility of preschools and primary schools to address children's motor development. She spoke about the need to spend time on all areas of children's development in junior infants and did not assume that children entered primary school 'ready' to write.

It would be great to see more focus on it in preschool, but I think Junior Infants are still developing all sides of their learning, do you know? So, I don't think it would be right to just expect them to hit the ground running without developing that further in Junior Infants. I wouldn't (Isla, School E).

Sarah (School B) reflected that she had not really thought about the role of preschools in relation to motor development previously. On doing so, she concluded that preschool do have some responsibility to prepare children developmentally for school.

I think there is a certain amount of responsibility there. It's a difficult one because I suppose they have their curriculum now, and I don't know, I've never thought about that actually. Yeah, there would be, I suppose, a lot of responsibility on them too, because they're supposed to be school ready, they're supposed to be ready to...like, we

wouldn't have our curriculum the way it is if it wasn't for the basics being already done
(Sarah, School B).

She went on to speak about assumptions that teachers make in relation to children being able to access the junior infant curriculum upon entry into primary school. She commented that she was almost following a preschool curriculum because the children in her class were not ready to access the curriculum.

It's assumed that they're done, so we're nearly doing more of a preschool curriculum, what I would have traditionally thought of as a preschool curriculum, than we have been in the past, we're going almost backwards in terms of what we're teaching, in order to move forwards (Sarah, School B).

Sarah (School B) spoke from her own experience as a parent and she wondered about the pedagogical practices that preschools engage in. She was unsure of how preschool prepared children for emergent handwriting skills to be developed but felt that they did have some responsibility to do so.

So yeah, I think there is...it's a quandary because I don't know what the preschools do, I don't know, I can only say from my own child's experience what they do, but there would have never been a pencil put in his hand, I don't think. Maybe colouring and crayons and all of that, but I don't think, like the pencil is for school, but I don't know what the preschools do, to be honest, but I would think that they would have a certain amount of responsibility for it too (Sarah, School B).

This chapter presented the qualitative findings of this research study, with particular reference to the sensorimotor handwriting programme, pedagogical approaches, teachers expertise and the participating children's learning. This chapter began with a visual representation (Figure 6.1) of the subthemes and the four overarching themes that emerged

from the process of thematic. Each overarching theme was presented with supporting material from the semi-structure interviews and field notes from the observation days to provide an insight into each participating teacher's experience. The next chapter will present an integrated discussion of the both the quantitative and qualitative findings of this research study.

CHAPTER SEVEN: AN INTEGRATED DISCUSSION OF THE FINDINGS

7.1 Introduction

The previous two chapters reported the quantitative and qualitative findings of this research study, supported by statistical data and excerpts from the interview transcripts and the researcher's field notes. This chapter provides an in-depth discussion of those findings. It aims to provide a clear summary of the overall findings across the themes and to contextualise findings in relation to the literature and with reference to the theoretical framework as presented in Chapter 2. How this research adds to, is consistent with, or extends or challenges what is already known about children's motor development and emergent handwriting skills will be discussed (Braun & Clarke, 2013).

The themes that emerged as a result of the thematic analysis applied to the qualitative data and reported in Chapter 6 have formed the basis of the structure for this discussion chapter: 1) the impact of the sensorimotor handwriting programme on children; 2) the impact of the professional development initiative and the sensorimotor handwriting programme on teachers; 3) the sensorimotor programme; and 4) the impact of environmental influences on children's motor development. Each of these themes will also be discussed in light of the quantitative findings where appropriate, again with reference to relevant literature in the area.

In effect, this discussion chapter aims to tell the stories of the research participants – both children and teachers – and with regard to the study's theoretical framework, to locate their stories in a wider societal and educational context.

7.2 The impact of the sensorimotor handwriting programme on children

The quantitative findings for this research study show that the mean standard score for motor proficiency of all of the participating children across the six schools improved post-

implementation of the programme. The mean standard score for all participating children across all six schools increased from 45.1718 pre-implementation of the programme to 47.7178 post-implementation of the programme. Qualitative findings support the statistical data, with all ten of the participating teachers reporting that children's motor skills and emergent handwriting skills had improved post-implementation of the programme. It is important to note however, that research in the field indicates that as well as being influenced by environmental factors, motor development is a continuous process that occurs as a result of the growth and maturation characteristics of the child (Goodway, Oznum & Gallahue, 2021).

All of the participating children scored higher in relation to their mean motor proficiency in May/June 2019 than they scored in September/October 2018, but they were also between 8 and 9 months older at that post-implementation of the programme testing phase. As outlined in Chapter 4, the BOT-2 is a standardised, norm-referenced measure of motor proficiency. In this way, the researcher attempted to counteract the above limitation regarding the natural maturation of motor skills over time. The mean standard scores of children recorded and presented for May/June 2019 are standard scores relevant to each child's age. Therefore, it appears reasonable to conclude that children's motor proficiency did improve overall, across all six schools, post-implementation of the sensorimotor handwriting programme.

The following sections will describe the impact of the sensorimotor handwriting programme on children under the following headings: 1) Competency; and 2) Confidence, Motivation and Enjoyment.

7.2.1 Competency

Handwriting is a complex process and the preparation for handwriting is dependent on a number of components of motor proficiency (McGlashan et al., 2017; Lepes et al., 2016; Santangelo & Graham, 2016; Suggate et al., 2016; Van der Fels et al., 2016; Bara et al., 2015;

Gaul & Issartel, 2015; Santangelo, 2015, Gaul, 2014). The short form of the BOT-2 standardised test of motor proficiency (Appendix L) includes 8 subtests used to test children's motor proficiency in regard to a number of components related to handwriting development. Those subtests include: 1) Fine Motor Precision (drawing lines through paths and folding paper); 2) Fine Motor Integration (copying a square and copying a star); 3) Manual Dexterity (transferring pennies); 4) Bilateral Coordination (jumping in place and tapping feet and fingers – both sides synchronised); 5) Balance (walking forward on a line and standing on one leg on a balance beam with eyes open); 6) Running Speed and Agility (one-legged stationary hop); 7) Upper-Limb Coordination (dropping and catching a ball using both hands and dribbling a ball using alternating hands); and 8) Strength (knee push-ups and sit-ups).

The statistical data outlined in Chapter 5 showed that all of the participating children across the six schools improved in the mean motor proficiency across all of the subtests, with the exception of subtest 4. The mean standard score for children in the three DEIS schools decreased post-implementation of the programme in the case of subtest 4. This section on *Competency* will describe children's proficiency in those individual subtests where the results were particularly significant, including the aforementioned subtest 4.

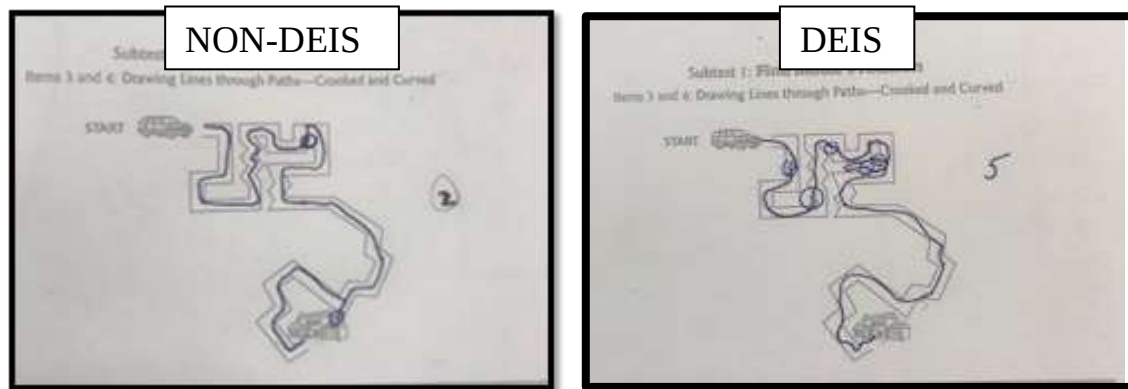
7.2.1.1 Subtest 1: Fine Motor Precision

One of the activities in subtest 1 involved drawing a line through a crooked path – a test of fine motor precision. The participating children in the three DEIS schools improved from a mean standard score of 2.04 pre-implementation to 3.77 post-implementation of the programme. Children in the three non-DEIS schools improved from a mean standard score of 3.51 to a score of 4.28. Figure 7.1 below illustrates a comparison of subtest 1 (drawing a line through a crooked path) between a child participant in a non-DEIS school and a child

participant in a non-DEIS school, pre-implementation of the sensorimotor handwriting programme.

Figure 7.1

A Sample Comparison of Subtest 1 Between DEIS and non-DEIS schools



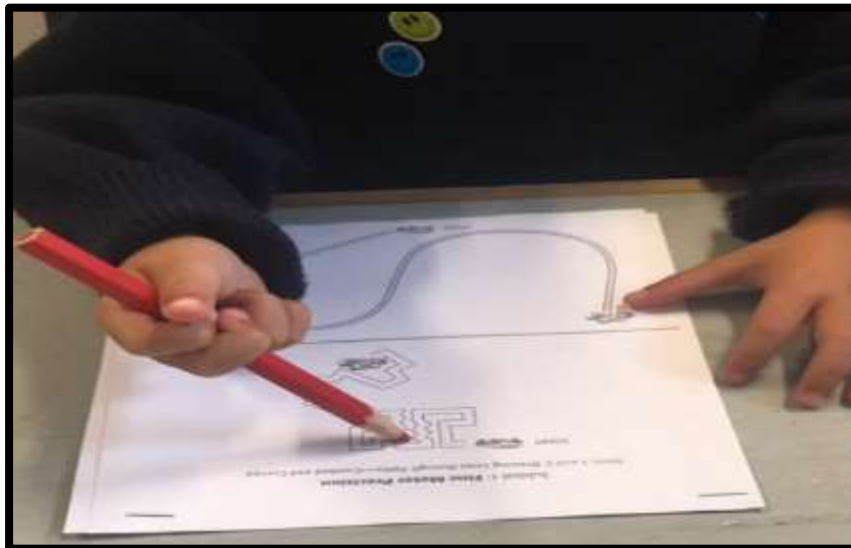
Fine motor precision is related to writing legibility, an important aspect of handwriting development for young children. Graham et al (2019) points out that until children can produce letters with reasonable legibility and speed, their “concentration and effort is consumed with letter production” (2019, p.3). Further research indicates that, as a consequence of poor legibility, readers may be biased in their evaluation about the ideas and quality of a text (Santangelo & Graham, 2016), and written text may be less accessible to others (Graham 1999). Good handwriting is still regarded by teachers as a sign of academic prowess (Santangelo & Graham, 2015), and a less legible version of a paper will be scored lower than a more legible one, according to research (Graham et al, 2019). It is therefore significant that the statistical analysis reported a significant improvement in the mean standard score of proficiency in this task, post-implementation of the sensorimotor handwriting programme.

The researcher observed a significant difference between DEIS and non-DEIS schools in relation to the pencil grasp of children during subtest 1. In general, the researcher noted (FN, 11.10.18) that most children in the non-DEIS schools had established a functional pencil grip upon entry into school. This is compared to the majority of children in the DEIS schools who

appeared to enter primary school with an immature pencil grasp. Figure 7.2 below illustrates the pencil grasp of a child in one of the DEIS schools at the beginning of junior infants

Figure 7.2

Sample pencil grasp of a child in a DEIS school



An analysis of the qualitative data revealed that teachers in the DEIS schools shared this view in relation to pencil grasp. Aoibheann (School C) referred to “how difficult it is for some children to hold pencils and crayons – even in first class they’d still be quite weak”. Susie (School B) also noted that at the beginning of the year, the children in her class appeared to be unfamiliar with holding a pencil. She noted that “they weren’t used to how to hold it, they were using the grip instead of holding it properly, they would be clutching the pencil”. Susie noted that by the end of the year, most children had mastered a functional grip and that she had seen “huge improvements”. She reflected that the fine motor activities such as using clothes pegs and the Theraputty were “brilliant” in helping to strengthen children’s hand and to improve pencil grip.

7.2.1.2 Subtest 4: Fine motor Integration

Subtest 4 tested for proficiency in the area of fine motor integration – copying a star. The ability to form letters with consistent size, proportions and spacing is dependent on visual-motor integration (O'Connor, 2012). The visual component of visual-motor integration enables children to discriminate letter shape in order to recognise each letter's specific characteristics and to identify the letter's orientation. The motor element allows the child to carry out the necessary sequence of movements to form the letter. Subtest 4 therefore, replicated the challenge of letter formation for children by requiring them to copy a star shape. It required the child to look at the shape carefully before attempting to make the shape on paper using a pencil.

A significant finding of this research is that children in the DEIS schools did not improve in the mean standard score of proficiency in subtest 4 post-implementation of the programme. The mean standard score decreased from .73 to .69 in the period between pre- and post-implementation of the programme. Children in the non-DEIS schools improved in the mean standard score from .90 to 1.60. An analysis of the qualitative data, including the semi-structured interviews and field notes gathered throughout the testing phase, suggests that one possible reason for the minor decline in the score for children in DEIS schools may be as a result of the participating teachers finding the visual integration activities challenging to implement.

Three out of six of the participating teachers in all three of the DEIS schools reported that they found the visual integration element of the sensorimotor handwriting programme difficult to implement (FN, 04.01.2019). Only one teacher from one of the non-DEIS schools reported that she found this element of the programme difficult to implement (FN 04.01.2019). The participating teachers in the DEIS schools reported that children struggled with the visual integration element of the programme. This was not the case in the non-DEIS schools. The

quantitative data supports this finding. The mean standard scores for proficiency in visual-integration were lower in the DEIS schools pre- and post-implementation of the programme.

Isla, teaching in a non-DEIS school (School E), commented that "...the visual perception I found that the kids in here could get that very quickly...I feel they were very able". Hannah, teaching in the same school echoed Isla's statement, claiming that the children in her class "flew through the visual perception" activities. Greta, also teaching in a non-DEIS (School F) school suggested that going forward she might "reduce the visual discrimination to two days". She didn't believe that the children in her class needed the visual integration work daily, with the exception of one child who had specific difficulties in this area and for whom the activities were of particular benefit. Greta stated that "...when we introduced the cursive writing one child in particular is finding it hard to remember the pattern of the cursive letter...she's finding it very hard to remember where she begins and what turn she takes...".

Aoibheann, teaching in a DEIS school (School C) reported that she believed that her school "was maybe lacking" in relation to the development of visual integration skills. She also concluded that the visual aspect of handwriting was "something we weren't as strong on". Eleanor, also teaching in a DEIS school (School A), reported that she did not enjoy teaching the visual integration element of the programme. She believed that "it was a *little* bit beyond *most* of their level". Eleanor believed that the children's struggle with this element of the programme led to her own aversion to it, suggesting "...you know you sort of feed off kids as well? Maybe it was their thing of like 'oh no, we're not doing this bit again'".

Sarah, also teaching in a DEIS school (School B), concurred with Eleanor's viewpoint that the children found this element of the programme particularly challenging, insisting that "they struggled so much at the beginning". However, in contrast to Eleanor's experience of not enjoying this element of the programme, Sarah stated that she found the visual integration

element of the programme the most effective and the one which she enjoyed teaching the most. She reported that she “loved” the visual integration activities. She was particularly struck by how some children who struggled initially made significant progress, “even the children who find writing...or reading very difficult...to see them develop...there was one child in particular, and I was very, very concerned about her reading and her writing, and to see her progress so well and manage them so well at the end was absolutely amazing”. Sarah added that she believed that the visual integration activities the children engaged in as part of the programme benefited not only their writing, but their reading also. She felt this was “because they’re looking so closely at the letters and they’re looking closely where the lines are going”.

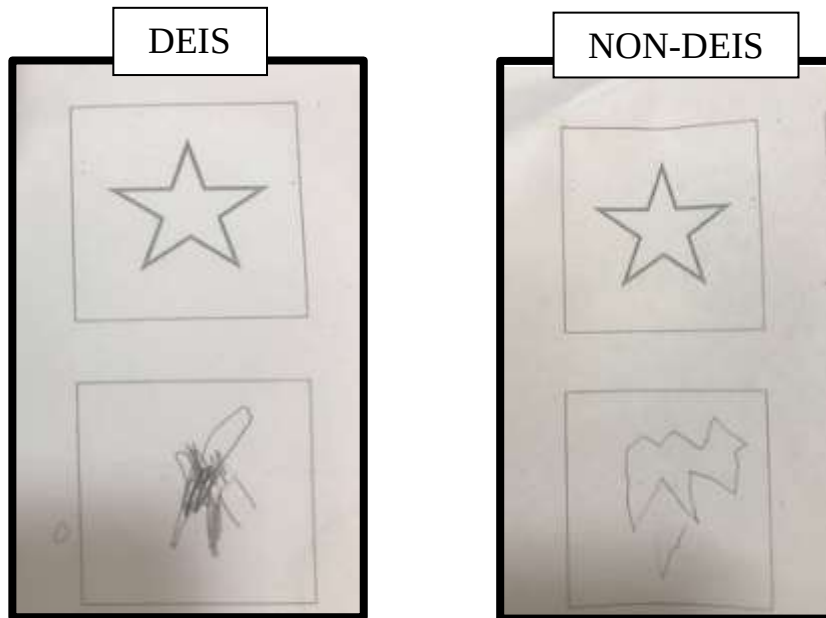
Sarah’s observation that visual integration is associated with children’s development in reading is supported by research in the area. Some children with dyspraxia for example, may experience perceptual problems, particularly in the visual modality, which are associated with difficulties in motor coordination (Barrett, 2008). Research has found that the number of co-occurring disorders present with DCD, for example reading difficulties or writing difficulties, is linked to the severity of the visual perceptual dysfunction (Barrett, 2008).

Susie, teaching in a DEIS school (School B) reported that “even towards the end of the programme there were some not able to do the visual perception”. Susie’s statement supports the quantitative findings of the research that indicate that children in the DEIS schools did not improve in relation to the fine motor integration activities.

Throughout the testing phase pre-implementation of the programme, the researcher also noted (FN, 19.09.2018) a significant difference in the ability of children in the DEIS schools to attempt this task compared to those children in the non-DEIS schools. Figure 7.3 below illustrates the difference between two children pre-implementation of the programme – one child from a DEIS school (School C) and one child from a non-DEIS school (School E).

Figure 7.3

Figure 7.3: Sample Comparison of Subtest 2 Between DEIS and non-DEIS schools (pre-implementation of the programme)



The images above demonstrate the significant difference in children's ability to integrate visual information. While the child in the non-DEIS school has not yet mastered the task, there is evidence of being able to discriminate the specific characteristics of the shape and orientation compared to the child in the DEIS school. Studies have found visual-motor integration to be one of the most significant predictors of handwriting performance, with strong correlations documented between visual-motor integration and writing legibility (Pfeiffer, Moskowitz, Paoletti, Brusilovskiy, Eckberg Zylstra & Murray, 2015). The qualitative and quantitative findings from this research therefore suggest that poor visual integration skills may be a possible cause of handwriting difficulties in young children.

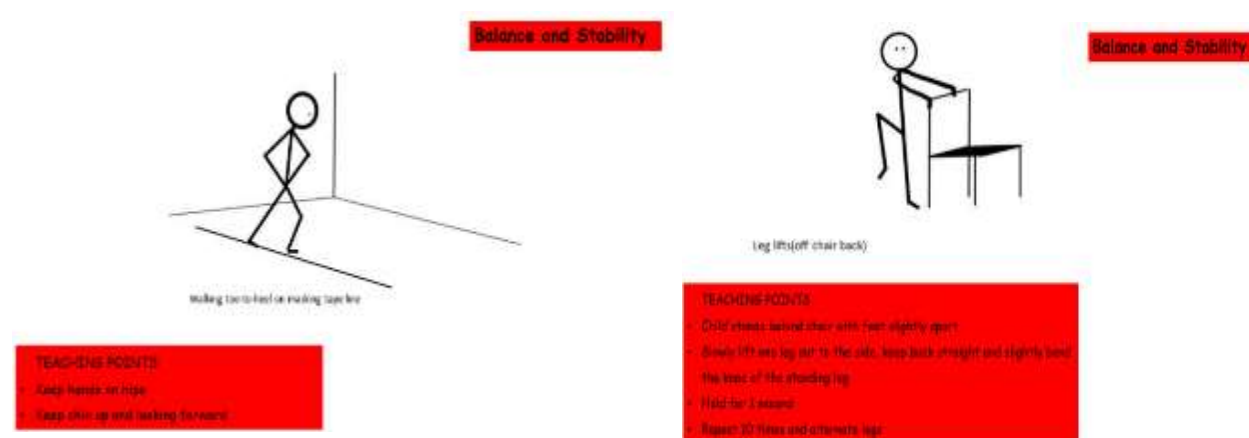
7.2.1.3 Subtest 5: Balance

The mean scores for motor proficiency across all of the subtests relating to gross motor development (Balance, Running Speed & Agility, Upper-Limb Coordination, Strength) improved in the period of time between pre- and post-implementation of the programme. This section discusses the findings in relation to subtest 5 which tests the balance component of motor proficiency. Balance is a key motor skill in maintaining good posture for handwriting (McAllen, 2008). Pre-implementation of the programme, the mean standard score of participating children in the DEIS schools for subtest 5 was 2.83 compared to 3.31 for children in the non-DEIS schools. Post-implementation of the programme, the mean standard score for children in DEIS schools was 3.33 compared to 3.64 in the non-DEIS schools. A significant improvement occurred for all children in the period of time between pre- and post-implementation of the programme.

Balance activities formed part of the sensorimotor handwriting programme under the ‘Gross Motor’ warm-up element of the programme. Overall, children improved in all of the subtests relating to gross motor development (Balance, Running Speed & Agility, Upper-Limb Coordination, Strength) across all six schools pre- and post-implementation of the programme. Figure 7.4 below illustrates a number of the activities that children engaged in to help to develop the balance component of gross motor development throughout the 16-week implementation of the programme.

Figure 7.4

A sample of 'Balance Activities' that formed part of the sensorimotor handwriting programme



Analysis of the qualitative data confirmed the statistical data – that children’s motor proficiency in the area of balance improved over the course of the 16-week programme. Teachers reported that the children were “really awkward to start with” (Sarah, School B), but that significant progress was made over the course of the 16 weeks. Eleanor reported that children really enjoyed this element of the programme, recalling how the children in her class “used to be laughing and joking doing the gross motor...it was all really enjoyable”. Sarah too reported that she “was delighted” with the gross motor element of the programme and that she “loved” it. Niamh (School E) stated that going forward she would “definitely” continue with the gross motor element of the programme while Vivienne in School D reported that “the gross motor exercises were really good”. She too concluded that it was “amazing” to observe the progress that children made, having struggled with the exercises at the start of the programme. Perhaps it was the enjoyment that both the teachers and children found in undertaking the types of gross motor activities that the programme prescribed, that led to the significant progress achieved in the scores across all schools.

7.2.2 *Motivation, Enjoyment and Confidence*

The overall improvement in the mean standard scores in motor proficiency for participating children across all six schools was a significant finding of this research. Also of note was that the participating teachers reported that children's motivation, enjoyment and confidence in relation to handwriting was significantly improved post-implementation of the programme. While the quantitative analysis did not measure children's motivation, enjoyment or confidence, the qualitative data were strongly indicative of positive changes in relation to these three aspects of handwriting development.

All of the participating teachers in the study reported that children's motivation, enjoyment and confidence significantly improved as a result of engagement with the sensorimotor handwriting programme. Bronfenbrenner's (1989) PPCT model as outlined in Chapter two, views the individual child as an active participant in his or her own development, not as a passive recipient of experiences within processes and contexts. Children's active engagement with the sensorimotor programme therefore, appeared to impact of the biopsychological characteristics of motivation, enjoyment and confidence in this case. Research in the area of motivation and writing largely focuses on motivating children to engage in the cognitive processes of writing (Boscolo & Gelati, 2019; Bruning & Kauffmann, 2016; Kaplan & Patrick, 2016), rather than on the mechanical process of handwriting. This research study adds to current research in that it highlights specific elements of the sensorimotor handwriting programme detailed below, that teachers believed improved children's motivation to engage in handwriting tasks and subsequently their enjoyment and their confidence in relation to handwriting.

7.2.2.1 Resources and materials

In particular, teachers referred to the variety of materials and the types of activities, believing that these were influencing factors on children's motivation, enjoyment and confidence. Participating teachers (Isla and Hannah, School E) reported that children "cheered" when it was time for the handwriting session and that handwriting was "now their favourite thing".

It emerged from the qualitative data that using a variety of new and novel writing tools was a contributing factor to children's motivation and enjoyment in relation to handwriting sessions. Making handwriting time a 'discreet time' with 'discreet materials' appeared to have added to children's enjoyment of the sessions. During the professional development days, teachers were issued with a box of handwriting materials (Appendix L) and asked to use the box only during the handwriting sessions, rather than making it available to children throughout the day or for free play time. This appeared to be an additional contributing factor in children's enjoyment of the sessions, with Susie (School B) reporting that "they are always asking when they are using Ms. Lambe's stuff".

A further significant finding in relation to children's improved confidence was the inclusion of blank pages for practice writing as part of the programme. All of the participating teachers reported that the children loved using blank pages to mark make. Teachers stated that they had not previously used blank pages, rather they had used copybooks from the beginning of the year and throughout the year. The 'Guided Practice' step of the programme encouraged children to explore blank space using a variety of materials, before moving to the next step (Semi-independent Practice), which was to write the letters into their copies using their pencils. The purpose of the Guided Practice step was to provide an opportunity for children to explore and play with mark making, in a manner which was free from expectation. Research supports

the idea of invitation versus expectation and allowing children some freedom to create. The blank page “presents children with an invitation to make meaning” as opposed to an expectation (Trehearne, 2011, p.26). A number of teachers reported that they would continue to use blank pages for those children who were not developmentally ready to move to copybooks and that this was helpful in providing those children with opportunities to succeed rather than fail.

7.2.2.2 Play-based versus instructional teaching and learning

The participating teachers also referred to the range and type of activities as a contributing factor to children’s enjoyment and motivation. Isla (School E) stated that “I *definitely* don’t think the interest would have been as high...without all the different activities”. The activities and tasks that formed the programme (Appendix C) were largely play-based activities that included an instructional element. It appeared from an analysis of the qualitative data that the activities being both play-based and instructional was a key contributing factor to the success of the programme. Aoibheann (School C) made an interesting point about her perceptions of play-based learning in the past. She suggested that she would feel “almost like a guilt” in allowing children to play with playdough for a prolonged period of time. The programme however added focus and structure to what she would have regarded as ‘free-play’ with the playdough. She gained a new awareness of how to integrate direct instruction into play-based activities, and how to scaffold development by being more aware of the specific components of motor development while observing children playing with the playdough. She noted which children were able to roll and to pinch the playdough and how they were seated during the activity and was enabled to extend and develop learning by providing feedback and offering prompts. This finding is significant in that it illustrates a potential misconception about play-based learning and the role of the teacher during play.

Research suggests that skilled adults play a critical role in supporting children to explore their environments and to engage in developmentally appropriate playful activities (French, 2019). Much debate surrounds the role of the teacher in play-based learning, and diverse perspectives about intervening in children's play have emerged in the research (French, 2019; Bubikova, Hjetland, & Wollscheid, 2019; Pyle & Danniels, 2017; Pyle & Bigelow, 2014; Pramling & Johansson, 2006). One viewpoint posits that play should be purely child-led (Pramling & Johansson, 2006), whereby the adult should avoid intervening in the play, or even 'hijacking' the play as described by Pyle and Danniels (2019). An alternative perspective suggests that the role of the adult is to scaffold and extend learning through adult involvement and guidance (Pyle & Bigelow, 2014). The latter type of approach aims to sustain children's engagement levels while "implementing some teacher-directed elements" (Pyle & Danniels, 2017, p. 276).

The sensorimotor handwriting programme that the participating teachers implemented as part of this research study employs a combination of the play-based and teacher-directed teaching and learning approaches. The programme involves largely play-based activities that aim to engage children actively, as well as guided instruction and direct instruction. Bronfenbrenner's PPCT model (1989) and the element of 'process' provides a lens through which to view this approach to teaching and learning. As outlined in Chapter two, process refers to forms of interaction between individuals and the environment, called 'proximal processes'. Human development occurs through processes of complex reciprocal interaction between an organism and its immediate environment. Within an educational context, it is the meaningful interactions between the teacher and the child that occur during both play-based learning and teacher-directed learning that promotes development.

Research supports the approaches adopted by the sensorimotor handwriting programme – to combine play-based activities with adult guided, explicit teaching approaches. Research

(Danniels & Pyle, 2018) strongly supports the benefits of play for children's learning and development, while an approach to teaching and learning that is purely based on direct instruction is viewed as detrimental to children's development (Miller & Almon, 2009). The change in perception of play-based learning as an opportunity to support children's learning using a playful, adult-guided approach as reported above by Aoibheann, is significant. It suggests that teachers in infant classes would not need to reduce the amount of time children spend on play, in favour of the explicit teaching of prescribed curricular objectives. Schickedanz (as cited in Trehearne, 2011) summarises this point astutely in stating that "we will not have done our best for young children if we deny them the path they seek to learn through play. But we will also not have done our best if we fail to provide instruction" (p. 46).

7.2.2.3 Developmental Appropriateness

The participating teachers also reported that children's confidence in relation to handwriting improved throughout the course of the 16-week programme. One of the contributing factors reported by teachers was the developmental appropriateness of the programme, with Vivenne (School D) suggesting in regard to one of the children in her class that "it was just more pitched at his level". Aoibheann (School C) reported that she believed the children's ability to successfully manipulate smaller, more complex pieces of Lego was as a result of the children practicing first with big Duplo blocks as part of the sensorimotor handwriting programme. She also spoke of how going forward she would set this as a developmentally appropriate goal for children – to move from Duplo to Lego as the children demonstrated capacity to do so.

Taking into account Bronfenbrenner's (1989) PPCT model, the developmental appropriateness of the programme can be viewed through the lens of 'time'. Time within Bronfenbrenner's model relates to the form, content and direction of proximal processes as

being impacted by the “social continuities and changes occurring over time through the life course and the historical period during which the person has lived” (p.798). The researcher addressed the element of time, and took into account the impact of historical experiences, by viewing each child’s individual motor development as unique to their own context, by establishing a baseline measurement of motor proficiency for each child prior to designing the programme.

The motor proficiency baseline measures outlined children’s areas of need prior to implementation of the programme and informed the programme in relation to the inclusion of visual integration activities in particular. Taking into account Piaget’s (1970) cognitivist approach to sensorimotor development and Ayres’s (1964, 1972a, 1972b, 1974) information approach, the programme aimed to set developmentally appropriate goals for the participating children. Secondly, current research in the area of handwriting development was reviewed and informed the inclusion of particular activities and tasks that were deemed developmentally appropriate.

Research supports the idea that for a programme to be successful, it should be developmentally appropriate (Trehearne, 2011). A developmentally appropriate programme requires that the goals and expectations for young children are challenging but achievable, with sufficient adult support. An activity is developmentally appropriate if the task is effective in moving the child towards a particular goal (Trehearne, 2011). Analysis of the qualitative data indicated that the programme was developmentally appropriate in relation to both of the above statements. Teachers reported that children experienced success at the activities in the programme with the support of the teacher, with Sarah (School B) commenting that “at the end (of the programme) it was just ‘yep, I’m doing this’ instead of ‘I can’t do it, I can’t do it’”. Teachers also reported that the programme was successful in moving children towards a particular goal – to improve emergent handwriting skills and motor skills. The quantitative data

also supports the developmental appropriateness of the programme, with the mean standard score for all children across all schools improving in the period of time between pre- and post-implementation of the sensorimotor handwriting programme.

7.3 The impact of the professional development initiative and the sensorimotor handwriting programme on teachers

Analysis of the qualitative data indicated that the professional development initiative and the sensorimotor handwriting programme had a significant impact on teachers in a number of ways: 1) new knowledge, understanding and awareness of the relationship between gross motor development and handwriting development; 2) new teaching approaches; and 3) recognition of gaps in relation to initial teacher preparation.

7.3.1 Knowledge, understanding and awareness of the relationship between gross motor development and handwriting development

All of the participating teachers in the study reported that they had developed new knowledge, understanding and awareness of the relationship between gross motor development and handwriting development. An analysis of the qualitative data indicated that prior to taking part in this study, teachers associated handwriting development with fine motor skills only. A review of the handwriting support material (NCCA, 2018) for teachers supports this finding. The support material for teachers focuses on the cognitive and creative processes of handwriting, and on the lower level processes or mechanical processes involved in handwriting. Support material emphasises the importance of developing fine motor skills and pencil grip, while the explicit development of gross motor skills is not evident. The emphasis on fine motor skills and handwriting development is further evident in a report on literacy learning in Irish primary schools (Government of Ireland, 2016). The report states that “while it is important to teach children that writing is a form of meaningful communication, the

technical aspects of writing also need to be taught. If a child has underdeveloped fine motor skills, then writing instruction must begin with fine motor skill development” (p. 65).

Teachers in the study reported that while they had previous knowledge, understanding and awareness of fine motor development, they were not previously aware of the connection between gross motor development and handwriting development. Vivienne (School D) summarised what all of the teachers reported at different stages throughout their interviews and throughout the professional learning days. She stated that she now understood that “you’re not just strengthening their hands, you’re actually strengthening their core, their arms...and how all that has implications on their development”. Vivienne went on to recall that prior to taking part in the programme, she would have focused largely on the development of fine motor skills. She reflected that in the past she had probably “started handwriting way too soon with children...kind of like getting them to walk before they could run”.

Sarah (School B) stated that “it makes so much sense now”. She talked about not having given much thought to the role of gross motor skills in handwriting development before she took part in the research study. Eleanor (School A) echoed Sarah’s statements, agreeing that she would not have thought about the relationship between gross motor skills and handwriting in the past. She spoke about addressing fine motor, gross motor and handwriting development separately and that she would never have “*really* thought about the connection with the gross motor and the fine motor in that sense”. Greta (School F) too reported that she would “have done a handwriting lesson (separately), and then gross motor development would have been movement breaks, PE, but it wouldn’t have necessarily been the bridge to build their handwriting skills”.

The idea that gross motor skills should precede the development of fine motor skills is supported by research (Goodway, Oznum, & Gallahue, 2021; Clarke & Metcalfe, 2002). The

‘Mountain of Motor Development’ describes the “progressive building and refinement” of motor skills, that leads to children being able to master fine motor manipulative skills such as writing (Clarke & Metcalfe, 2002, p. 17). The findings from this research illustrate a gap in the knowledge, understanding and awareness of the participating teachers in relation to gross motor development and handwriting development.

A further significant finding that emerged was in relation to how teachers’ awareness and understanding of the purpose of gross motor activities across the curriculum changed over the course of the programme. The gross motor activities that formed part of the programme were not necessarily ‘new’ to the participating teachers. All of the teachers reported that they were already familiar with the gross motor activities from teaching the PE curriculum. A review of the PE curriculum supports this finding, with physical and motor development explicitly named as a key objective of the PE curriculum (NCCA, 2009).

What emerged from the data however, was that teachers developed new knowledge, understanding and awareness of how children executed the gross motor activities, and how their competency in this area impacted their handwriting development. Prior to taking part in this research study, teachers reported doing “a lot of movement breaks” (Hannah, School E) like ‘Go Noodle’ for example. They viewed movement breaks as a useful transition tool and motor development as part of the PE curriculum. They did not recognise movement breaks or PE as opportunities to develop handwriting skills prior to implementing the sensorimotor handwriting programme. After taking part in the research, teachers were more aware of how children were executing the gross motor activities during PE or during a movement break – “it’s not just a transition, but it’s actually really important...to develop those skills” (Hannah, School E).

Another significant finding was in relation to teachers' new awareness in relation to gross motor development and the impact on children's posture while sitting to attend to written tasks. Greta (School F) described how children in her class in the past might have been lying across the tables or falling off their chairs. She noted that in the past she may have interpreted such behaviour as children being "distracted". Post-implementation of the sensorimotor handwriting programme however, Greta reported new knowledge, understanding and awareness in relation to the role that core strength plays in enabling children to sit at their tables to attend to handwriting tasks. Greta believed that the gross motor exercises played a key role in helping to develop that core strength.

Aoibheann too described new knowledge, understanding and awareness of the role that gross motor development plays in handwriting development. During her semi-structured interview, she referred back to a conversation that happened during one of the professional learning days – "I think one of the days that really stood out for me when you were chatting about a child who was slumping down on a table, and to change your attitude about that, to adjust - like that child mightn't necessarily be able to sit up straight yet, and for that to be okay". Aoibheann, like Greta, viewed posture in a new light post-implementation of the programme. The teachers now saw posture, core strength and balance as key areas of handwriting development and that they had a responsibility to attend to this by providing developmentally appropriate activities to enable children to develop the necessary skills.

Research in the area supports the findings from teachers in relation to their misconceptions about children being 'distracted'. The vestibular and proprioceptive systems provide the body with muscle tone required to keep the body in an upright position. Often the child with sensorimotor difficulties might have poor posture and low muscle tone and struggle to maintain a seated position (Crater, 2008).

7.3.2 Increased knowledge of teaching approaches and learning experiences that promote motor development and emergent handwriting development

Analysis of the qualitative data suggested that teachers acquired new knowledge of teaching approaches and learning experiences that promote motor development and emergent handwriting skills. The most significant change for teachers in relation to their approach to teaching handwriting appeared to be the structure or the ‘sequence’ of the sensorimotor programme. Teachers spoke about having taught all of the elements ‘separately’ prior to taking part in the research study. While the elements of the programme were not ‘new’ to teachers, the structure was. The structure of the programme appeared to enable teachers to relate all of the individual elements (gross motor, fine motor, visual integration) to the development of handwriting and to understand the *purpose* of what they were doing. Vivienne (School D) made an interesting observation in relation to how the programme gave her a really helpful structure and a tool with which to respond to children who were struggling with handwriting. She stated that “instead of saying ‘he’s really weak at handwriting’...they were on the road to getting somewhere”. Vivienne (School D) also reported that in the past “I didn’t really know why I was doing the marching or all those kind of things. I didn’t really know it had benefits in that way. I just thought it was part of PE and didn’t see the links there”.

Barbara (School A) also commented on a new awareness of how different materials and tools could be used to support children’s motor development. She spoke about how previously in the morning time she would have “just handed out fine motor activities in the morning and just assumed the children could do it”. After taking part in the research study however, Barbara reported that she was more focused on making sure the children were “using their pincer grip with a peg or different things like that”. Interestingly, she reflected that she was using similar resources as she had done in the past, but that now she was more aware of “how” and “why” she was using them.

This new learning in relation to the ‘why’ of what teachers were doing is significant. Research in the area confirms the key role of reflective practice in ensuring that teachers analyse and improve their practice for all children (DuFour, 2004). It is notable that the format of the professional learning community appeared to facilitate this type of reflection that led to teachers’ increased awareness and understanding of their practices in relation to handwriting instruction.

All of the ten participating teachers in the study reported that the professional learning days were very effective in acquiring new knowledge in relation to teaching approaches and learning experiences that promote motor development and emergent handwriting development. The factors that were identified by the participating teachers that contributed to the success and efficacy of the professional learning largely concurred with DuFour’s (2004) key principles of professional learning communities: 1) a focus on results; 2) a culture of collaboration; and 3) ensuring that all children learn. What teachers also identified as being key, and what adds to current research (Cochran-Smith & Lytle, 2009; DuFour, 2004; Hargreaves & Fullan, 1992; Grossmann, Wineburg, & Woolworth, 2001) in the area is that: 1) the set-up of the environment was key in supporting effective communication; and 2) having teachers from both DEIS and non-DEIS contexts was effective in learning from others’ experiences.

Susie (School B) reflected that “it was great to be with other teachers from different schools and to learn from them and see what it was like for them to implement in their school”. She also noted that hearing the different experiences that teachers in different schools had was of benefit to her own learning. Sarah reflected on the set-up of the room for the professional learning day. She spoke about the effectiveness even of the table around which the discussion was facilitated, “even just the set-up, that we were around one big table, and we got to have a chat beforehand”. The importance of all of the learners and the facilitator being able to share the space and share in the space together emerged as significant. The participants did not take

part in this research study merely to be taught, but rather to engage in the learning opportunity that the professional learning days provided. While the information presented was important, and the engagement of the participants was excellent, the sharing of experience and insight among the participants also added to the richness of the professional learning days.

7.3.3 *Gaps in Initial Teacher Education*

Analysis of the qualitative data revealed that all ten of the participating teachers reported that they were unable to recall receiving teacher education in the area of sensorimotor development as part of their undergraduate or postgraduate degrees. Specifically, teachers reported not having previous knowledge or awareness of the relationship between motor development and handwriting. A review of a Bachelor in Education prospectus of a teacher education college in Dublin supports this finding (Marino Institute of Education, 2018). It is evident that sensorimotor development and handwriting development is not *explicitly* addressed in the English language or PE modules over the 4-year period. Under the English Methods and Irish Methods modules (p. 37, 67, 92) presented over a 4-year period, objectives relating to the teaching of English language are outlined – based around the three strands: oral language, reading and writing.

Teaching objectives relating to the writing strand specifically include (p.38):

- *describe appropriate teaching methodologies for the teaching of oral language, reading and writing as appropriate to the middle classes in primary school*
- *describe and illustrate the literacy-related knowledge, skills and attitudes that children will need to draw on in order to meet the oral language, reading and writing demands of the English language curriculum from 2nd – 4th class.*

The Physical Education (PE) and Social Personal and Health Education (SPHE) module (p. 45,

69) outcomes focus on lesson planning, methodologies and organisation of lessons and include (p. 69):

- *design, implement and assess the units of work and longer term plans in PE and SPHE*
- *differentiate activities for children with Special Educational and other needs in PE and SPHE*
- *perform active learning methodologies central to the organisation and management of PE and SPHE lessons.*

While motor development and handwriting are addressed separately within the respective module outcomes, limited time within the modules to *explicitly* address the relationship between the two may be a contributing factor as to why teachers reported not having made the connection during their initial teacher education.

Another possible reason for teachers not being able to recall training in this area appears related to whether or not teachers received initial training in relation to the Aistear Framework which was introduced in 2009 (NCCA, 2009). Specific objectives in relation to the teaching of motor skills in line with the Aistear Framework are outlined in the Early Childhood Education Module (Marino Institute of Education, 2018, p. 87). The Aistear Framework was introduced in 2009 (NCCA, 2009), but research indicates that the roll out in primary schools and implementation of the framework has been slow (Murphy, 2015). The Aistear Tutor initiative (Uí Chadhlá, Forster, & Hough, 2014, as cited in Murphy, 2015) reflects this gap in relation to initial training. The initiative sought to train experienced infant teachers as tutors to support other teachers in implementing playful pedagogies in the infant classroom. Significant numbers of teachers are also partaking in online webinars and summer courses on Aistear in an effort to upskill themselves in this area (Education Centre Tralee, 2021).

Seven out of ten of the participating teachers in this study had been qualified for between 6 and 16 years at the time of data collection (2018/2019). Three of those teachers who qualified between 2004 and 2007 would definitely not have received initial training in relation to Aistear. Four of the teachers qualified between 2010 and 2012, suggesting that they may have received some initial training in Aistear during the very early stages of the roll-out. It appears therefore that gaps in initial teacher education relate to two main factors: 1) the relationship between motor development and handwriting development not being made explicit; and 2) not all of the participating teachers received training in relation to the Aistear Framework (NCCA, 2009) which highlights the role of motor development in the early years.

7.4 The Sensorimotor Handwriting Programme

An analysis of the qualitative data showed that overall the programme was very positively received, rated and regarded by all of the participating teachers. All of the teachers reported that they would continue to implement the programme with their infant classes going forward. Further evidence indicating that the programme was positively received was that the researcher was invited back to three of the participating schools to provide a professional learning day for the infant teachers in September 2019, post-implementation of the programme. Furthermore, a school that did not participate in the programme invited the researcher to speak to the staff about the programme in September 2020. A teacher in one of the participating schools (School B) had observed the researcher during the testing period and had since moved schools. She was interested in learning more about the research study and the sensorimotor programme. The researcher subsequently held a Zoom call with all of the staff in that school and the infant teachers implemented the programme over the past year (2020-2021).

The researcher presented an online summer course during July and August in 2020, with over 700 teachers enrolling on the course. The sensorimotor handwriting programme formed one of the modules on the course. This module was particularly commended in the

report from the DES following an evaluation of the course content and of the forum discussions (Appendix O). The researcher went on to present six online webinars in the area of Handwriting Development and Aistear with the Tralee Education Centre in 2021. The feedback from all of these webinars was very positive, in particular in relation to the sensorimotor handwriting programme. A number of requests from teachers have been received through the Tralee Education Centre and by email to the researcher in relation to the sensorimotor handwriting programme. There appears to be an appetite for more professional development in the area as well as a number of requests in relation to accessing the support materials (the Sensorimotor Handwriting Programme manual, the PowerPoint and the list of equipment).

Analysis of the qualitative data shed light on a number of key factors relating to the design of the programme: 1) The renewal of resources; 2) how the programme fitted in with the curriculum; and 3) fidelity to the programme. These three factors will be discussed in detail below.

7.4.1 *The renewal of resources*

All of the participating teachers identified the variety and types of the resources as being key to the success of the programme. They reported that the children really enjoyed the range of new and novel resources such as highlighters, shaving foam, pearl clay and Theraputty. Teachers also reported increased awareness and knowledge of the huge variety of resources available to promote motor development. While in the past, teachers may have used only Play-doh to develop fine motor skills, they now had an awareness of a range of other resources that enabled children to practice the same skills in different ways. Nicola (School C) reflected that going forward she would “change my shopping whereas before I would go out and buy the usual Play-doh or Marla and that kind of thing. Whereas I want to go and actually buy Theraputty, like fresh pearl clay, fresh kind of slime, fresh clay...whereas I would have just thought Play-doh at the start”. This learning in relation to doing the same thing but using

different materials is significant. It enables children to practice repetitive skills but to stay engaged, interested and motivated. Research supports this finding in relation to the importance of the types of resources, with Friedach (p. 43, as cited in Graham et al., 2019) reporting that “effective writing classrooms need to be rich in a variety of resources and tools”.

The availability and cost of the resources had implications on whether or not teachers believed they could replicate the programme in their classrooms and schools going forward. Nine out of ten of the participating teachers felt that it would be feasible to replicate the resources that had been provided, while the tenth believed that it might be too costly for their school. There was no significant correlation between perceptions about the cost of materials and school contexts (DEIS and non-DEIS). Nicola, teaching in a DEIS school stated that “I do think in a school like this you can...we can replicate those types of things and like it can go towards the programme”. She did not appear to view cost as a barrier to implementation of the programme. Sarah, also teaching in a DEIS school however, did view the cost of resources as a barrier. She reported that “some of it we wouldn’t have, like those droppers, the shaving foam, now that’s cheap obviously, the putty...tongs...yeah there were a few things that we mightn’t have”. When asked did she view this as a barrier to implementing the programme, Sarah reported that she did. She noted that she would have to look for funding for it as it would be too expensive to purchase all of the materials herself.

Post-implementation of the programme (September 2019), the researcher was invited back to School D to facilitate a professional learning day for all of the infant teachers in relation to the programme. It was notable that all five of the infant teachers had been provided with a box of resources that was identical to the resources provided for the participating teacher in September 2018. The researcher enquired in relation to whether it was costly to purchase all of the equipment for each teacher. The participating teacher responded that it was not a problem

and that the school was very happy to have acquired new knowledge in relation to the variety of resources available.

It appears therefore, from this finding that the cost of resources is not a barrier to implementation of a programme of this nature. Teachers found it beneficial to their own practice and to children's development to learn about the wide range of resources that can be used to support motor and handwriting development. One teacher suggested that a list of the equipment and where to purchase it would be helpful going forward. This was subsequently provided for all of the participating teachers by email (Appendix M). In relation to current research in the area, this finding indicates that 1) the variety of resources is an important contributing factor to the efficacy of a programme; 2) the cost of resources does not appear to be a barrier; and 3) a lack of knowledge in relation to the availability of resources may impact on the efficacy of a programme.

7.4.2 *The conflict between fidelity and time constraints*

An analysis of the qualitative data suggested that some of the participating teachers felt conflicted between maintaining fidelity to the programme, while continuing to meet all of the 'normal' curriculum demands. The term *fidelity* is used in this context to describe whether the sensorimotor handwriting programme was implemented uniformly by all of the participating teachers across all of the participating schools. This was a critical factor in contributing to the validity of the results of this study.

It emerged from the analysis of the data that almost all of the participating teachers reported that they implemented the sensorimotor handwriting programme over the 16-week period while maintaining fidelity. Some minor amendments to implementation were reported that appeared as a consequence of whole-school disruptions, such as a half day for the October midterm break. In this instance, teachers reported that they did not implement the programme

or they reduced the timeframe for it. No changes to the individual components of the programme were reported except in the case of one participant. Vivienne (School D), reported that she had adjusted the sensorimotor programme to fit in with her typical daily routine and practices. The researcher observed some of those changes during the observation day in the classroom, which included the use of a YouTube dance video to replace the Gross Motor PowerPoint. It was evident during the observation that other elements of the programme had been amended, and that fidelity to the programme was impacted in this case. It is important to note this limitation of the research in light of the findings. Research in the area (Parham et al., 2007) indicates that researchers rarely question the potential of fidelity to breach results and that adherence to the fidelity of sensory-based programmes often fails to be documented in a methodical and thorough manner.

A further significant finding that emerged in relation to fidelity was in relation to how teachers would amend the programme going forward to ‘fit in’ with daily curricular demands. While the majority of the teachers (9 out of 10) reported that they maintained fidelity to the programme throughout the 16-week period, a number of suggestions as to how teachers would amend the programme going forward emerged. All of the teachers reported that the time allocated to the programme was the biggest challenge that they faced in relation to maintaining fidelity. The time allocated to the programme emerged therefore as the main aspect that teachers indicated might be amended going forward.

All of the teachers reported that they believed each component of the programme was beneficial to the children’s handwriting development. However, three of the teachers (out of five) in the non-DEIS schools reported that they would not need to spend as much time on the visual integration element of the programme going forward. Hannah, teaching in a non-DEIS school (School E) reported that the children “flew through” the visual integration activities, with Isla (also School E) supporting that statement, “I found the kids in here could get through

that very quickly. So, an idea would be let's do it for the first maybe four weeks and then see". Sarah, teaching in a DEIS school however reported that she would continue to invest time in the visual integration activities as she thought they were "brilliant" in meeting the needs of the children in her class. An analysis of the quantitative data supports this finding, with children in DEIS schools scoring significantly lower on the visual integration subtest than those children in non-DEIS schools.

This is an interesting finding in relation to how one programme cannot provide a 'one size fits all' solution, and cannot meet the individual learning needs of each child. Research suggests that "individuals think and learn in different ways" (Willingham, Hughes, & Dobolyi, 2015). It appeared that flexibility within the programme was required to meet the specific needs of individual learners and individual groups. Hannah (School E), reported that it would be beneficial to her practice to have "a certain amount of freedom next year". She noted that as a result of being a participant in the study, she felt she had a responsibility to adhere to the programme. Going forward however, Hannah and the other initial participants should undoubtedly use their professional judgement to nuance the programme as they see fit. Indeed, current developments in regard to the revised Primary Curriculum (NCCA, 2016) as outlined in Chapter Three appear to support that view. The aim of the new time allocation model is to provide teachers with greater flexibility in relation to how time is used to best meet the needs of children and the school community (p. 42). All of the participating teachers echoed this need for greater flexibility in relation to the use of time across the curriculum. Teachers reported planning for the programme in the areas of English, PE and Maths with Aoibheann reporting that "there's a lot of overlap...there are plenty of opportunities to integrate it". The introduction of the flexible time allocation model, designed to allow for cross-curriculum teaching and learning, should offer just such an opportunity.

7.5 The impact of environmental influences on children's motor development

This research aimed to explore the interplay between young children's motor development and their emergent handwriting skills. The research also looked at the contextual factors and environmental influences that might impact on motor development. Chapter Two described Bronfenbrenner's ecological theory, that supports an understanding of the multiple and reciprocal influences on children's motor development, (Bronfenbrenner, 1979, 1988, 1992; Bronfenbrenner & Evans, 2000; Bronfenbrenner, 2005; Bronfenbrenner & Morris, 2006). Bronfenbrenner's model provided a framework from within which the researcher was enabled to attempt to view and to understand children's motor development in a wider sociocultural context and to highlight the sociocultural aspect of motor development.

Two of the pertinent research questions concerned with establishing the impact of contextual and environmental influences on children's motor development were: 1) What is the baseline measure of motor proficiency skills of a sample of junior infant children in DEIS and non-DEIS schools? and 2) Is there a significant difference in children's motor proficiency upon entry into school in DEIS schools and non-DEIS schools?

Analysis of the quantitative data showed that overall 59% of the 178 participating children across the six schools scored average in relation to their motor proficiency, relative to their age at the time of testing, pre-implementation of the programme. A comparison of the standard scores of children in the three DEIS and the three non-DEIS schools however, showed that just 42% of children in DEIS schools scored average for motor proficiency for their age, compared to 75% of children in non-DEIS schools. A total of 49% (almost half), of children in DEIS schools scored below or well below average for motor proficiency compared to just 15% of children in non-DEIS schools. The mean standard score for children in DEIS schools was

42 compared to 51 in non-DEIS schools. The difference in the mean scores of motor proficiency between DEIS and non-DEIS schools was therefore significant.

This statistical analysis suggests that contextual and environmental influences are significant in relation to children's motor development, with literature in the area supporting this finding. Initial studies of motor development, led by Gesell (1928) and McGraw (1969) contended that motor development was mainly attributed to maturation (Atun-Einy, Oudgenoeg-Paz & van Schaik, 2017). However, there is growing recognition that motor development is influenced by environmental opportunities or limitations for movement (Goodway, Ozmun & Gallahue, 2021; Malina, 2004). In particular, existing literature supports the finding that socio-economic status has a significant impact on motor development in the early years (Lepes et al., 2016; Draper, 2012; Ferguson et al., 2013; Kambas & Venetsanou, 2009; Berger et al., 2007; Adolph, 2002; Leitschuh & Dunn, 2001; Davis et al., 1998; Reed & Bril, 1996).

Research, as outlined in Chapter Three, points to a number of environmental influences that impact on young children's motor development (Lepes et al., 2016; Draper, 2012). A number of these influences have been confirmed in this research study. Parental or caregiver support, access to resources in the community and the quality of early learning and care settings emerged from the qualitative analysis as influencing factors on motor development. Analysis of the qualitative and quantitative data in relation to these environmental influences on children's motor development will be discussed in the sections below.

7.5.1 Parental or Caregiver Support

Parental involvement is recognised as a significant contributing factor to children's educational success (Lyche, 2010). The element of 'process' within Bronfenbrenners PPCT model (1989) provides a lens within which to view parental involvement – with process

referring to any meaningful interaction that occurs frequently between the parent and the child. The practices of parents in relation to motor development therefore, can influence children's motor development in the early years (Atun-Einy et al., 2017). The children of parents or caregivers who have lower levels of educational attainment, poorer health and fewer financial resources are more likely to experience challenges in relation to motor development (Lepes et al., 2016). Parental involvement is therefore “deeply embedded in socio-demographic positionality and people's resultant life experiences” (Doyle & Keane, 2019, p. 74).

Findings from this research in relation to parental influences on motor development showed that: 1) the research positively impacted on parental involvement in relation to children's motor development in the home; and 2) there were significant differences in parental involvement across DEIS and non-DEIS schools.

Nicola, teaching in a DEIS school, reported that she believed that the caregivers of children in her class had little understanding of the kinds of activities that they could do to support motor development. She suggested that going forward, she would invite all caregivers into the school for an information session on the sensorimotor handwriting programme at the beginning of the school year. In doing so, she hoped to highlight the kinds of activities that parents could do at home to support motor development and emergent handwriting skills. Nicola took it upon herself to create a Gross Motor homework activity. She photocopied the Gross Motor PowerPoint slides (Appendix G) and sent home a copy with each child. She encouraged the children to choose one or two gross motor activities to practice every day at home with their caregivers or siblings. She reported that this type of homework had been positively received by both caregivers and children, “...so we sent home like a folder and the parents did it at home but the parents actually said that was lovely, like part of homework that they could do together”. Involving parents in their children's education at an early stage is recognised as being a critical contributing factor to children's academic engagement and

success (Lyche, 2010). Nicola's initiative to involve the caregivers of the children in her class in the sensorimotor handwriting programme was a hugely positive outcome of the research therefore. This parental involvement element will be incorporated into the final iteration of the sensorimotor handwriting programme.

Prior to commencing the data collection phase in each school, the researcher was asked to facilitate an information session for parents and caregivers in the DEIS schools. The teachers in all three of the non-DEIS schools felt that it was important to verbally communicate the purpose of the research and the sensorimotor handwriting programme, and provide a space for parents to ask questions or to share any concerns about the research or their children's motor development or handwriting. It was important to the researcher to endeavor to involve the parents of the participating children in the research process, particularly in light of Hanafin and Lynch's research (2002) that notes that "the voices of parents of educationally disadvantaged pupils are unheard" (p. 36).

A significant difference in parental involvement and interest across the DEIS and the non-DEIS schools was observed while the researcher was onsite in schools during the testing phase (September-October, 2018). The researcher was available and visible in the morning time and at home collection time in all of the schools to meet incidentally with parents, should they want to talk about the research study. Just one parent in one of the three DEIS schools (School A), sought further information about the purpose of the study and requested to see a copy of the BOT-2 test and record sheet. No other parent approached the researcher throughout the testing period onsite in these three schools.

In rather stark contrast, during the testing period in School E a non-DEIS school, a number of parents approached the researcher either during the morning drop-off period or the home-time collection period each day. They enquired about the test that was being used and

how their children were performing. Some parents asked about activities to promote motor development in specific areas of motor competency (balance, for example), and others shared insights into what kinds of motor activities their children engaged in outside of school (FN, 03.10.18). In addition, Hannah and Isla, both teaching in School E, reported that parents of the participating children had shown a keen interest in the research study and wanted to find out more about how they could incorporate motor development activities into their children's day.

The differences observed in parental involvement between the DEIS and non-DEIS schools is supported by literature in the area, with research indicating that parents from lower socio-economic groups are more disposed to being less involved or less engaged in their children's education than middle class parents (Doyle & Keane, 2019). Counter research posits however, that what might be perceived as less involved or less interested on the part of parents may actually be as a result of a "lack of confidence and previous negative experiences of their schooling of their own" (Doyle & Keane, 2019). Those parents or caregivers who were early school leavers would perhaps have lacked the confidence to get involved in or to show interest in their children's education.

Eleanor, teaching in a DEIS school in the North Inner City, noted that ideally motor development would begin early in a child's life in the home but that "in our area that's not a realistic expectation". When the researcher probed further as to what was meant by this comment, Eleanor clarified that she was referring to the fact that many of the parents and caregivers of the children in her class were limited in their capacity to attend to children's developmental needs. She noted that many parents were attempting to parent without the support of a partner, and many were experiencing homelessness, addiction problems and financial difficulties. Eleanor's apparent low expectations of the parents or caregivers of the children in her class are reflected in current research that indicates that parental expectations

are shaped (lowered) by teachers' or professionals' viewpoints and expectations (Doyle & Keane, 2019).

In School D, another of the non-DEIS schools, the experience of the researcher was somewhat different to School E (non-DEIS) and to school A (DEIS) as described above. In the morning time, parents or caregivers did not come into the school, so there was no communication possible at this time, despite the researcher being available. At home-time, only a small number of parents came to collect the children, and none of those parents initiated communication with the researcher throughout the testing period. The researcher noted (FN, 25.09.18), that a significant number of the children in the class lined up separately to be collected by after-school clubs rather than by their parents. The researcher spoke with the class teacher about this (FN, 25.09.18). The class teacher explained that many of the children were collected either by grandparents or after-school clubs because generally both parents were working outside of the home. This was an interesting finding, and one that counters the assumption that parents from areas that are more 'advantaged' in terms of economic resources are more involved in their children's education. Parental involvement requires a range of resources, including times and unpaid time off work, that many parents working outside of the home in School D did not have access to (Doyle & Keane, 2019).

Therefore, it is important to note that limited capacity to attend to children's motor development is not confined to parents in DEIS schools, but also to parents in non-DEIS schools. The main difference appeared to be in the *resources* that limited parents' capacity. While the teachers in the DEIS schools perceived emotional energy, time and financial resources to be the main limiting factors, teachers in the non-DEIS schools only alluded to time as being a limiting factor.

In school F, the last of the three non-DEIS schools, the researcher had no contact with parents throughout the testing period, as they were not onsite either in the morning or at home time. The fact that in all three of the DEIS schools, parents were onsite and very much present in the classrooms and the school at both morning and home time was in itself an interesting finding. Only in school E of the non-DEIS schools were parents present in the classroom and in the school at those times.

7.5.2 Access to resources in the community that promote motor development

Physical play is a critical part of early childhood in developing children's cognitive and motor skills (Government of Ireland, 2016). Engagement with the natural physical environment provides opportunities for young children to physically play and enables children to test their limits and capabilities and to develop key gross motor skills (Sandseter, 2009). The availability and access to resources in the community that promote motor development are also key in providing young children with opportunities to develop motor skills in their early years (Gabbard & Krebs, 2012). Within Bronfenbrenner's (1989) theoretical framework as outlined in Chapter two, the element of 'context' within the PPCT model provides a lens through which to consider this particular finding. Context refers to the environmental conditions that the individual experiences that ultimately decide whether the person can achieve his or her full potential. Qualitative findings from this research indicated that there was a significant difference between DEIS and non-DEIS schools in relation to access to resources in the community that support motor development.

The researcher was particularly struck by the significant difference in the range and the types of sporting activities that children had been exposed to and had access to in DEIS and non-DEIS schools. The same statement and question was employed with all children prior to beginning the BOT-2 test: "Today we are going to play some games and do some exercise, do

you play any sports?’. The researcher recorded the activities that children reported having experienced.

School E (non-DEIS) in particular reported a wide and varied range of sporting activities. They were: Rugby-Tots, sailing, GAA, hockey, rowing, cycling, running, tennis, gymnastics, soccer, basketball and swimming. The researcher noted a particularly active culture in School E, the only school in the study with a purpose built bicycle rack that was designed to encourage children and their families to engage in active transport. School F, also a non-DEIS school reported a wide range of sporting activities: Rugby, GAA, cycling, tennis, gymnastics, taekwondo, Irish Dancing and swimming while children in school G (non-DEIS) reported: Rugby, GAA, cycling, gymnastics, swimming and tennis. This was in comparison to the children in the DEIS schools who appeared to have very little experience of sports activities or clubs outside of school. Children in School A reported playing just football. Children in School B reported having experienced football, gymnastics and dance and children in school C reported having experienced dance, gymnastics, football and swimming.

Sarah, teaching in a DEIS school (School B), spoke about parents having limited access to resources outside of the home that would help to support children’s motor development. She believed that while there may be an availability of resources in the community that are “free” (of charge), parents nonetheless were limited in their capacity to utilise and access those resources. Literature in the area however, suggests that gaps have been observed in relation to differential access to neighbourhood resources between areas of lower socio-economic status and areas that are more ‘advantaged’ (Macintyre MacDonald & Ellaway, 2008). Urbanisation plays a significant role in reducing opportunities for children to engage in physical play and states that children from low income families, traveller children, children from ethnic minority groups, children living in emergency accommodation, children from refugee families and

children living in urban areas are at particular risk of exclusion from accessing outdoor play (Kilkelly, Lynch, & Moore, 2016). All three of the DEIS schools in this study are located in highly urbanised areas in North Dublin.

Physical play and extra-curricular activities like those reported by the participating children (rugby, tennis, GAA, dance, swimming) provide opportunities for children to develop key motor skills in the early years (Coulter, McGrane, & Woods, 2020). Gross motor skills in early childhood generally refer to locomotor skills, object control skills and balance (Gallahue & Ozum, 2006; Draper, 2012). Locomotor skills involve the movement of the body through space and include running, jumping, skipping and hopping. Object control skills refer to the manipulation of objects and include throwing, catching, bouncing, striking and rolling (Bardid et al., 2013). Locomotor and object control skills develop proprioception, spatial awareness, bilateral coordination, crossing the mid-line, and balance and stability, all of which are key components in the development of handwriting (Feder & Majnemer, 2007; Ayres, 1964, 1972a, 1972b, 1974). As described earlier, four of the subtests of the BOT-2 tested the motor proficiency of children in those key areas of gross motor development: 1) Balance; 2) Running Speed and Agility; 3) Upper-Limb Coordination; and 4) Strength.

It is significant therefore that the mean score of proficiency for children in the DEIS schools was lower than the mean score for children in the non-DEIS schools on those subtests concerned with gross motor development. For example, pre-implementation of the programme, the mean score for children in DEIS schools for Subtest 5: Walking Forward on a Line (Balance) was 2.83 compared to 3.31 for children in non-DEIS schools. For subtest 6: One Legged Hop, the mean score for children in DEIS schools was 1.66 compared to 2.60 for children in non-DEIS schools. Subtest 7 tested dropping and catching a ball with both hands and dribbling a ball using alternating hands. The researcher was particularly struck by the

significant difference in children's ability to attempt this task. A recent presentation at the ESAI Conference (05.04.2020) by the researcher showed a video from this research study illustrating the difference in attempts between children in DEIS schools and non-DEIS schools (Appendix N). Children in DEIS schools had a mean score of 1.45 compared to 2.95 for children in non-DEIS school for dropping and catching a ball. Dribbling a ball with alternating hands was a challenging task for all of the children at this initial stage of junior infants, but still, the difference between DEIS and non-DEIS was notable with children in DEIS schools scoring .31 compared to .92 for children in non-DEIS schools.

Aoibheann (School C) made an interesting observation in relation to children's activity levels. She reported observing a significant improvement in children's motor development after she recommended to parents to bring their child to the playground every day for a period of time to help develop their gross motor skills. She also stated that she saw an improvement in the gross motor development of children who attended afterschool clubs, noting that "if there's a child who's in the afterschool for an hour, five days a week, then they're playing with a ball five days a week". This observation presents a further possible modification to the final iteration of the programme relating to daily outdoor activity.

Literature in the area supports this finding, with studies showing that motor proficiency is linked to the amount of physical activity that children engage in (Britton, 2020; Ericsson, 2011). Participation in physical activities provides opportunities for young children to develop essential gross motor skills (Duff et al., 2019). It appears from the findings of this research, that children who had more access to extra-curricular physical activities scored higher in relation to the gross motor components of motor proficiency than those children who had less access to extra-curricular physical activities in the community.

7.5.3 *The quality Early Learning and Care systems*

The quality of children's early learning and care was noted by the participating teachers as having an impact on children's motor development in the early years. Children typically attend preschool between the ages of 3 to 5 years. Within an Irish context, 96% of children participate in some form of early learning care provision before starting school (Government of Ireland, 2019). As a result, children are spending more hours of their day in childcare settings which subsequently means that the development of their motor skills is highly dependent on the provision and quality of that childcare (Ferguson et al., 2013).

Research shows that the preschool years represent a critical period of time or a "window of opportunity", for children to develop key motor skills (Duff et al., 2019, p. 355). Qualitative findings from this research study reflected current research, with all of the participating teachers in this research study perceiving the role of early learning and care services as key in developing children's motor skills from an early age.

The reality of what the participating teachers experienced in relation to children's motor skill development upon entry into school differed however. Sarah, teaching in a DEIS school (School B), noted that she felt as if she was teaching a preschool curriculum in September, that "we're going almost backwards in terms of what we're teaching, in order to move forwards". She wondered about the pedagogical practices that preschools engaged in and noted that some children appeared never to have held a pencil or crayon before.

Other teachers spoke about the focus of preschool perhaps being misplaced – with the emphasis being on beginning formal literacy (Jolly Phonics, letter formation) rather than on fundamental motor development. Eleanor believed that pre-writing development should be addressed in preschool, with Barbara echoing those views – "I would expect them to come in with more developed skills". Susie referred to children's struggles in being able to master daily

life tasks, such as tying their laces and tying up their hair. She was “surprised” by the challenges children encountered in negotiating the environment upon entry into school. Teacher’s perceptions that formal literacy learning would be better delayed until children reach school-age, is largely supported by research in the area. A vast range of literature (Bubikova et al., 2019; French, 2019; Pyle & Danniels, 2017) proposes that the focus of early years learning and care should be on playful pedagogy that promotes the development of key motor skills, as opposed to formal literacy instruction.

Aoibheann (School C) reported that there are significant differences in the practices between individual preschools that impact on children’s motor development. She commented that the children who have attended preschools using the Highscope curriculum “have excellent skills”. Other children she noticed, could not hold a scissors and had very poor motor skills upon entry into school. Aoibheann reflected that she was teaching children “from that point (developmentally)” and that she believed it would be beneficial for children to engage in further motor development activities in preschool. She spoke about children’s poorly developed motor skills as being a “barrier” when they start junior infants, as so much time was spent trying to develop their strength. She proposed that preschool teachers could benefit from “knowing more” about how to progress children’s motor development and wondered about “the level of understanding” in relation to handwriting development.

Vivienne noted a decline in communication between primary schools and preschools. She believed that in the past, the possibility of being able to make a phone call to the preschool had proved effective in sharing critical information about children’s development. She felt that as a result of new GDPR guidelines, she could no longer do that. Vivienne’s sense that this lack of communication is detrimental to children’s development and to the practices of both preschools and primary schools is supported by the literature (O’Kane & Hayes, 2013). Communication between both parties is deemed critical in terms of supporting the continuation

of pedagogical practices which would lead to optimal learning conditions for children (O’Kane & Hayes, 2013). The limited transfer of data across educational settings contributes to the risk of children’s development regressing (DES, 2011). Therefore, while literature in the area focuses on the importance of the transfer of information between preschool and primary schools, it does not focus specifically on the transfer of information relating to children’s motor development.

This chapter presented an integrated, in-depth discussion of the findings that emerged from an analysis of the results of the BOT-2 test of motor proficiency, and from the qualitative data that emerged from the semi-structured interviews. The four themes that emerged as a result of the thematic analysis formed the basis of the structure for this discussion chapter: 1) the impact of the sensorimotor handwriting programme on children; 2) the impact of the professional development initiative and the sensorimotor handwriting programme on teachers; 3) the sensorimotor programme; and 4) the impact of environmental influences on children’s motor development. The discussion of findings was contextualized by reference to the literature and to the theoretical framework that underpins this research study. The following and final chapter of this thesis will present the conclusion and recommendation that have emerged from the findings of the study, and limitations of the study will be revisited and acknowledged.

CHAPTER EIGHT: CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction: Beginning with a Blank Page

By way of conclusion, this chapter begins with an image that emerged from the research findings – the image of a blank page. This thesis began as a blank page, ready to explore the interplay between motor development and handwriting development in young children. When I began this research journey, my experience of teaching infants in a DEIS school meant that I had observed children beginning junior infants with poor motor skills, which subsequently impacted on their emergent handwriting development. I had a sense that the children in my class were in some way ‘disadvantaged’ by their environment in relation to motor development. I knew that a number of the children in my class were living in homeless accommodation, with limited space to move, to crawl and to play. I knew that the parents of those children did not like bringing their children to the playground because of the anti-social behaviour they experienced there. And I knew about the significant lack of sporting clubs and activities available in the area for children aged between 0-5 years. What I did not know was if what I was observing was specific to my own context or whether this was a widespread issue relating to motor development. The findings that emerged from the research showed that motor development is influenced by contextual factors, that the motor proficiency of children entering DEIS schools is significantly lower than those children entering non-DEIS schools. What had previously been based on my own experiences and on anecdotal evidence, has now become grounded in research.

The following sections of this chapter will revisit the limitations of this research study before presenting a summary of the key findings and outlining the conclusions and recommendations that have emerged from those findings. Recommendations relating to further research will be addressed and finally, the chapter will end with some concluding remarks to bring this thesis to a close.

8.2 Limitations

While every effort was made to counter the limitations (described in Chapter 4) relating to this research study and in particular to the recruitment of participants, and the collection of data using semi-structured interviews, it is nonetheless pertinent to revisit and to acknowledge the limitations of this study, prior to presenting the summary of key findings and the resultant conclusion and recommendations for this research study. The key limitations identified by the researcher are as follows:

1. The participating schools in this research study all agreed to be involved. Therefore, teachers were most likely willing to learn, to participate and to try out the ideas presented to them by the researcher. This potentially contributed to the more positive outcomes of this research study. In the case that teachers did not willingly volunteer to participate, they may not have been particularly interested in sensorimotor development and teaching handwriting and the outcomes may not have been as favourable.

2. It is possible, based on some of the participants' admissions during the interview phase, that the 'halo' effect. The halo effect is defined as "suffusing ratings of special features with a halo belonging to the individual as a whole" (Thorndike, 1920, p.25). In relation to this research the study, the halo effect relates to how ratings of the programme by the participating teachers may have been effected by a number of factors. Based on some of the admissions by some of the participating teachers during the interviews, some may have felt a sense of responsibility that they had to stick with the programme as a result of the researcher being known to them. In addition, the programme was implemented over a 16-week period, whereby at the beginning, all of the resources and activities were novel and new to the participating teachers and children. It is possible that some of the participating teachers might have formed a general impression of the programme, and their subsequent judgments about the programme may be significantly

influenced by this first impression. Some of the teachers may have stopped observing how the children engaged with the programme, while others may have made subsequent ratings of the programme consistent with their initial impressions (Bechger, Maris, & Ping Hsiao, 2010). While this limitation was impossible to totally eliminate (Darby, 2007), it is nonetheless important that is acknowledged and considered in light of the findings.

3. The findings of this study relate to only six schools in one region in one province so there can be no claims of generalisability. In order to counteract this limitation, the researcher provided sufficient detail about school contexts and the key themes to provide support for transferability, enabling the reader to transfer findings as relevant to their own setting.

8.3 Summary of Key Findings

Evident from the findings as outlined in Chapters 5 and 6 is: 1) The motor proficiency of children in junior infants in DEIS schools is significantly lower than that of children in non-DEIS schools; 2) The mean standard score for motor proficiency for all children improved post-implementation of the sensorimotor handwriting programme; 3) The sensorimotor handwriting programme impacted positively on children's confidence, motivation and enjoyment of handwriting; 4) The variety of resources and the types of activities that formed the basis for the programme were identified as key to its efficacy and; 5) the professional development initiative and the sensorimotor handwriting programme added to teachers' awareness and knowledge in relation to motor development and emergent handwriting skill.

8.4 Conclusions

In relation to the research questions, firstly, it was clear that there was a significant difference between the motor proficiency of children in DEIS schools and those in non-DEIS schools. The baseline measures showed that children in the three non-DEIS schools entering school were lower levels of motor proficiency than children in DEIS schools. Children in the

DEIS schools appeared to have limited exposure to activities that promote motor development outside the home and school. This was compared to children in the non-DEIS schools who appeared to have experienced a rich and varied array of sporting activities in their local communities. Parental involvement and interest in the research study appeared higher in the non-DEIS schools, but an initiative taken to involve parents in one DEIS school proved effective. Teachers viewed the role of the early learning and care systems as key in facilitating children's motor development prior to entering school.

The sensorimotor programme was positively received by teachers and children's motor proficiency improved post implementation of the programme. The participating teachers reported that children's enjoyment, motivation and confidence had improved as a result of the programme. Overall, the teachers enjoyed implementing the programme and found it beneficial to their own practice and to children's handwriting development. Teachers reported that children's fine and gross motor skills had improved, as well as their pencil grasp. All of the participating teachers reported that they would continue to implement the sensorimotor handwriting programme going forward.

The variety of materials and resources, and the types of activities included in the programme appeared to contribute to the success of the programme. Teachers reported new awareness in relation to the variety of materials and resources available to promote motor development. They perceived the new and novel resources to be instrumental in improving children's enjoyment, motivation and confidence in relation to handwriting. The structure of the programme appeared to be key in providing teachers with a framework within which to address fine motor, gross motor and visual integration skills. The structure of the programme and the types of activities allowed for a balanced approach to teaching handwriting which incorporated both playful pedagogies and explicit instruction. This combination of

instructional approaches, coupled with the variety of resources, appeared to be a key finding in relation to the success of the programme.

The participating teachers valued the professional development initiative that formed part of this research. They reported that they learned from listening to, and talking to others in the group. In particular, teachers noted that hearing from teachers who were teaching in contexts that differed from their own, presented a rich learning experience. The set-up of the environment emerged as a contributing factor to the success of the professional learning days, with teachers commenting on the use of the large table to facilitate discussion. The balance between informal chat and the presentation of information relation to the programme and to the research was noted by teachers as being important.

8.5 Recommendations

The findings that emerged from an analysis of the data substantiated the conclusions of this research study as outlined above. The following section with presents the recommendations that have resulted from those conclusions drawn and that have implications for both policy and practice in the area of children's motor development and emergent handwriting development.

8.5.1 Policy Recommendations

1. Resources in the community: The availability of resources in the community that promote physical play is a significant contributing factor to motor development in the early years. Children living in areas of lower socio-economic status appeared to have limited access to resources in the community that promote physical play and motor development. Children aged between 0-5 years would benefit in terms of motor development from having access to community based sports clubs and activities and to safe, green space to engage in physical play. The Dublin City Council Development Plan (2016-2022) outlines a number of specific goals and objectives and aims in relation to the improvement of green infrastructure, open space and recreation activities, including playgrounds, in the North Inner City area (Government of

Ireland, 2018, p. 29). It is important that progress is monitored in relation to the objectives of this document and that the document is reviewed and updated ahead of its expiration in 2022.

2. *Whole-school Approach:* A whole-school approach to developing motor skills for handwriting would be beneficial. Movement breaks with a specific focus on the gross motor skills associated with handwriting could be adopted by all classes. Movement breaks could also be integrated into Assembly time or at morning drop off and home collection. In this way, children would become increasingly aware of the role that their whole body plays in developing their handwriting skills. Informed by the findings of this research study, it is recommended that a whole-school approach to the development of motor skills for handwriting development should be incorporated into school policy. This would potentially further contribute to children's enjoyment and motivation of the programme and would help to share good practice across the whole school community.

3. *The Aistear Framework:* Findings from the research pointed towards a need to emphasise the critical role of play in developing motor skills and emergent handwriting skills in the early years. At present, it is not mandatory to implement the Aistear Framework either in early childhood education and care settings or in primary schools. It would appear beneficial to children's development that the implementation of a play-centred curriculum such as the Aistear Framework is made mandatory for teachers working with children between the ages of 0-6 years.

8.5.2 Practice Recommendations

4. *Structured communication systems* between preschools and primary schools would help to identify children with motor difficulties early on. Communication between preschool and primary schools would also facilitate sharing of good practice in relation to motor development in the early years.

The Mo Scéal initiative (NCCA, 2021) aims to support young children in the transition from preschool to primary school through sharing of information about children's learning and developing using a number of specially designed templates. Mo Scéal requires parental consent in relation to the sharing of information about children and in this way respects GDPR. It is important that the DES Early Years Inspectorate and the DES Primary School Inspectorate monitor the implementation of the Mo Scéal initiative and encourage preschools and primary schools to engage in the sharing of information about children in this structured and safe way. It would be beneficial also for the NCCA to provide further information and guidance to preschools and to schools as to how they can engage in the process and where the sharing templates can be located.

5. Parental involvement: Parents have a key role to play in children's motor development. Parents responded well to being invited to be involved in the sensorimotor handwriting programme and showed that there is scope for further parental involvement. It would be beneficial to hold an information session with all parents on the motor development and the role that it plays in handwriting development. Parents could be provided with ideas and/or resources that could help to support children's motor development throughout the day. Parents could be made aware of daily tasks, like washing dishes for example, that could be capitalised on to promote children's motor development. Parents could be invited into the classroom to work with small groups of children during the sensorimotor handwriting sessions. This would provide opportunities for working more intensively with particular groups of children and for increased differentiation to happen.

6. Video clips of programme in action: The addition of video clips illustrating each stage of the programme would be beneficial to teachers in implementing the programme. Video clips would clearly outline the teaching points for each stage, and help to draw teachers' attention to the specific motor skills that the programme aims to develop. The researcher aims to develop these

video clips over the next year as part of the sensorimotor handwriting programme, and they will be made available to teachers on a CD Rom as part of the whole programme package.

7. Sensorimotor Handwriting Programme: Teachers benefited from having a discreet list of activities and resources that promote motor development. Handwriting programmes should describe specific activities and resources that are easily replicable for teachers to implement in the classroom. Handwriting programmes should include a teachers' manual that shows an image of the activity and that outlines the key teaching points associated with the activity.

8. A Balanced Approach: An approach to teaching handwriting that incorporates playful pedagogy and explicit instruction is effective. A handwriting programme should address children's fine and gross motor skills and visual integration in a fun, enjoyable and playful manner. Children should be provided with opportunities to explore and to develop confidence in relation to emergent handwriting skills. The use of blank pages instead of copies is effective in motivating children in the early stages of mark-making. Children should also be provided with opportunities for formal writing in copybooks, with explicit instruction and feedback in relation to letter formation.

9. Wider Implementation of the Programme Across Schools: Informed by the findings of this research study, it is recommended that the final iteration of the sensorimotor handwriting programme should be implemented in the infant classroom in all schools. For this to happen, the programme would be finalised to include a Teachers' manual, a CD Rom with video clips to demonstrate the fine motor and gross motor activities and a pupil Visual Perceptual Skills workbook. The researcher would carry out a number of Webinars relating to the implementation of the programme through the Education Centres across the country. There is potential also to build a network of teachers whereby those who were involved in this research study could work with a cluster of teachers in their own geographical areas. To date, the researcher has revisited two of the participating research schools to work with the participating

teacher to upskill other teachers in the schools in relation to the implementation of the programme going forward.

8.1.1 8.5.3 Professional Learning and Development

10. Early Learning Education and Care Systems: Further emphasis on the key role of motor development in the early years is important. Training and upskilling for early years' teachers in the area of motor development would be helpful in addressing children's motor development at a critical stage of their development. This could happen through online webinars or courses that staff could attend as part of staff training days. Information on webinars and course for early years' teachers could be accessed through local education centres and communicated to all staff members. It is also important that motor development is addressed either as a discreet module or as part of an existing module on Early Childhood Education courses in third level institutions.

11. Initial Teacher Education: Cross-module teaching would benefit students in terms of making explicit the links between motor development and handwriting development. In particular, teacher educators in the areas of Physical Education and Literacy could collaborate to determine the aims, objectives and content of a module that could address this issue. Co-teaching could be considered to deliver the content in an integrated, effective manner and one which enables students to observe cross-curricular teaching and learning.

8.6 Further Research

This research study sought to explore the interplay between young children's sensorimotor development and their emergent handwriting skills. In particular, it focuses on how teachers employed a sensorimotor handwriting programme in the junior infant classroom to address the emergent handwriting needs of young children. This research also explores the contextual

factors that influence motor development in the early years. Stemming from this research, a number of areas for further research were identified:

1. Findings from this research indicate that children entering junior infants in DEIS schools have lower levels of motor proficiency than children in non-DEIS schools. The sample for this study was relatively small however, involving six schools confined to the Dublin area and 178 children. It would be beneficial for this study to be replicated with a larger sample of students across a range of contexts on a national level.
2. Findings from the research suggest that the sensorimotor programme was impactful in relation to children's enjoyment, motivation and confidence in relation to handwriting. The evidence for these findings was based on the participating teacher's perceptions of children's enjoyment, motivation and confidence. Further research focusing on the child's voice could be conducted in relation to the efficacy of the programme.
3. Findings from the research indicated that the role of preschools is critical in relation to children's motor development and handwriting development. Participating teachers suggested that early childhood education teachers might benefit from further training or upskilling in these areas. Further research would be beneficial in establishing the need for motor skills and handwriting development with early childhood educators. Further research could also explore the current knowledge, perceptions and practice of early childhood education teachers in relation to motor development and handwriting development.
4. Findings from the research suggest that the sensorimotor handwriting programme was effective in improving children's proficiency in the areas of motor development and handwriting development. While the BOT-2 was employed to support the qualitative findings in relation to children's motor proficiency, the BOT-2 did not provide evidence for improvements relating to children's handwriting. Further research that examines the

efficacy of the sensorimotor handwriting programme on handwriting using more scientific methods of data collection would be beneficial.

5. Findings from the research suggest that children living in areas of lower-socio economic status have limited access to sports clubs and activities that promote motor development. This finding is based on the participating children's reports of what sports activities they experienced outside of school. Further research would be beneficial is establishing the availability and accessibility to community resources that promote motor development in areas of lower-socio economic status.

8.7 Concluding with an Image

This thesis concludes with an image of Jayden (pseudonym), a junior infant in School A. The opportunity to take the photograph arose from Jayden calling over to me during the observation day in his classroom. He said "Sinéad, look at me, I'm balancing". Jayden epitomises what this research is all about. Finding out more about what educational approaches can help him to become a literate, life-long learner who remembers school as a place where he was happy, where he experienced success and where he learned. Jayden's confidence in himself, his pride in what he has mastered and his enjoyment of what he is doing is summed up in this photo. This research has highlighted the inequity that exists for children from areas of lower socio-economic status in terms of opportunities to develop motor skills. It has shown that before a child enters formal school, they may already be at risk of failure due to circumstances outside of their control. While the sensorimotor handwriting programme is promising in terms of helping to level the playing field, there continues the need to strive to deliver equal opportunities in schools for children so that they too can get off to a start like Jayden.



The final words of this thesis go to Dewey who said that:

Educational practice is “the beginning and the close” of all educational enquiry; that education is an art that can be informed by the outcomes of educational inquiry; and that the one and only purpose of educational inquiry is to make the actions of the educator more intelligent, and Dewey himself might add “more enlightened, more humane, more educational than it was before” (Dewey, 1929, p. 39).

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Appendix A Letter sent to Parents Seeking Consent for Their Child to Participate in the Research Study

Dear Parent,

I am a doctoral student completing research in Dublin City University. The research focuses on the motor development and emergent writing skills of young children in the Junior Infant mainstream class in primary school. In particular, its purpose is to understand the links between socio-economic factors, motor development and the emergent writing skills of young children.

As part of the research study, I will assess the fine and gross motor skills of 178 children from DEIS and non-DEIS schools in the Dublin area, using a standardised motor skills test. Based on the emerging motor skills needs of the children identified by this data, and informed by research, a sensorimotor handwriting programme will be adapted by the researcher. All children will be invited to take part in the sensorimotor handwriting programme. The programme will be implemented by the class teacher over a 16-week period on a daily basis. Each session will last approximately 20-25 minutes in duration. Photographs of the programme in action will be taken by the researcher and the class teacher for the purpose of this research study. If you do not wish your child to be included in those photographs, you can inform the class teacher at any stage throughout this process.

As a parent, you can access the assessment results for your child through the principal either verbally or written, at any stage throughout this process. You may also wish to discuss any element of the research process with the researcher who will be available to meet with you in the morning time and at home time throughout the testing period in your child's school.

If you agree for your child to participate in this research, please read and sign the attached letter of consent and return it to the principal who will forward it to me. All personal information and references to your child in the final report will be modified in ways that protect their identity.

You are free to withdraw your child from the study at any time. If you do, all information I have collected from you will be returned.

Thank you for your interest and co-operation,

Yours sincerely,

Sinead McCauley Lambe

Appendix B Parental Consent Form

Please complete the following by circling *Yes* or *No* to each question

Have you read the letter?	<i>Yes/No</i>
Is the information provided clear to you?	<i>Yes/No</i>
Have you had a chance to ask questions and discuss the research?	<i>Yes/No</i>
Are you happy with the answers you received?	<i>Yes/No</i>
Are you happy for your child to be included in photographs?	<i>Yes/No</i>

I, _____, have read the attached letter describing your research project and I agree for my child to participate. Any questions I had, have been answered by the researcher. It is clear to me that my child's will be protected and that I am free to withdraw from the research at any time.

Signature

Date

Contact telephone number: _____

Contact mobile number: _____

Appendix C Typical Sensorimotor Handwriting Session Format (Keller, 2001)

1. Gross Motor Warm-Up Activities (5 minutes)

- Weeks 1-4: Proprioception
- Weeks 4-8: Balance & stability
- Weeks 8-12: Hand-eye coordination
- Weeks 12-16: Bi-lateral coordination and crossing the midline

2. Fine motor Warm up- Activities (5-10 minutes)

- Weeks 1-4: Clay, therapy putty, silly putty, play-doh
- Weeks 4-8: Clothespin games, tongs, tweezers, chop sticks
- Weeks 8-12: Interlocking construction games, mega blocks, Lego, links
- Weeks 12-16: Squeezy toys and materials, pipettes, foam balls, rubber balls, popping bubble wrap

3. Visual Perception Work (5 minutes)

Complete one worksheet per session

- Weeks 1-4: Form and constancy
- Weeks 4-8: Visual discrimination
- Weeks 8-12: Visual Closure
- Weeks 12-16: Visual Sequencing

4. Letter Introduction (2-3 minutes)

- Teacher models writing the letter on the board and describes the steps (can use Jolly Phonics here)
- Children imitate by writing in the air using large arm movements and repeating the steps aloud
- Children continue to say the steps while writing on the table with pointer finger

5. Guided Practice (10 minutes)

- Write on board
- Write on another child's back and have him or her guess the letter
- Write on large, blank sheets using a range of materials: colour change markers, scented markers, battery operated pens, paint, chalk, finger paint, shaving foam.
- Write in sand, rice, lentils, glitter bags

6. Semi-independent practice (5-10 minutes)

- Write in handwriting copy or sheet with teacher providing feedback on pencil grasp and posture and formation

7. Independent Practice Homework

- (Dependent on school / class policy)

Appendix D Plain Language Statement and Consent Form for Children

Hello. My name is S. Your teacher or somebody at home may have told you about me. I want to learn about teaching and learning in your school. I'd especially like to find out about the best ways to help you to learn to write in school. To do this, I would have to play some games with you first to Figure out what kinds of games will work best to help you in your classroom when you are learning to write. I will also have to visit eight times when you're in Ms. X's class to find out if the games are fun and if you like them and if they help you.

If you don't want to play the games with me or to visit your class, that is OK. If you want me to stop visiting or to stop the games, that is OK too. Afterwards, I am going to write about what I have learned. I won't use your name when I'm writing and all the information about you will be private. Have you any questions for me?

Please circle  or  for each question

Did the researcher tell you about the study?



Do you understand what it is about?



Have you had a chance to ask questions and talk about it?



Are you happy with the answers you got?



Do you know you don't have to take part?



I agree to take part in this study:

Yes



No



Appendix E Letter sent to Teachers Seeking Participation in the Research Study

Dear Class Teacher,

I am a doctoral student completing research in Dublin City University. The research focuses on the motor development and emergent writing skills of young children in the Junior Infant mainstream class in primary school. In particular, its purpose is to understand the links between socio-economic factors, motor development and the emergent writing skills of young children.

As part of the research study, I aim to assess the fine and gross motor skills of 100 children from DEIS schools and 100 children from non-DEIS schools using a standardised motor skills test. Based on the emerging motor skills needs of the children identified by this data, and informed by research, a sensorimotor handwriting programme will be designed by the researcher. All children will be invited to take part in the sensorimotor handwriting programme. The programme will be implemented by you, the class teacher, in your infant classroom over a 16-week period on a daily basis. Each session will last approximately 20-25 minutes in duration.

The research aims to explore the impact of this programme on the motor development and emergent writing skills of young children. It also aims to gather information from you, the class teacher, relating to changes in practice, perceptions and knowledge relating to sensorimotor development. Your reflections regarding the implementation of this programme will also be gathered and included in the research findings. Research outcomes will be used to inform teacher education at initial, induction and in-career levels and to contribute to the development of educational policies.

The research will involve 5-6 Junior Infant class teachers across 5-6 DEIS and non-DEIS primary schools in the Dublin area. If you are willing to participate in this research project, here is what would happen next:

- 1) I would interview you individually, to talk about your perceptions, knowledge and current practice relating to sensorimotor development. The interview would take approximately one hour. I would like to tape out interview, which I will then transcribe, so that I can identify themes in your teaching experience. A summary of these themes will be made available to you and you will be invited to verify/comment on its contents. This would take place during the first school term. Tapes will be destroyed when the research is complete.
- 2) I would visit your classroom on two occasions to observe the pupils while they engage in with the sensorimotor handwriting programme and to have a brief follow-up dialogue with you. I would like to take written records, to confirm and identify themes relating to the implementation and impact of the sensorimotor handwriting programme. Again, a summary of these themes will be made available to you and you will be invited to verify/comment on its contents. This would take place during the latter part of the first school term and during the second school term.
- 3) I would interview you again, at the end of the 16-week period to talk about any changes to your perceptions, knowledge and current practice relating to sensorimotor development. Your reflections regarding the implementation of the programme would also be included in this interview. Again, the interview would take approximately one hour. I would like to tape our interview as before, which I will then transcribe, so that I can identify themes arising regarding changes to perceptions, knowledge and current practice. A summary of these themes will be made available to you and you will be invited to verify/comment on its contents. This interview would take place during the second school term. Tapes will be destroyed when the research is complete.

If you agree to participate in this research, please read and sign the attached letter of consent and return it to the principal who will forward it to me. Your name, all personal information and references to you, your colleagues and your pupils in the final report will be modified in ways that protect your identity and theirs. You are free to withdraw from the study at any time. If you do, all information I have collected from you will be returned.

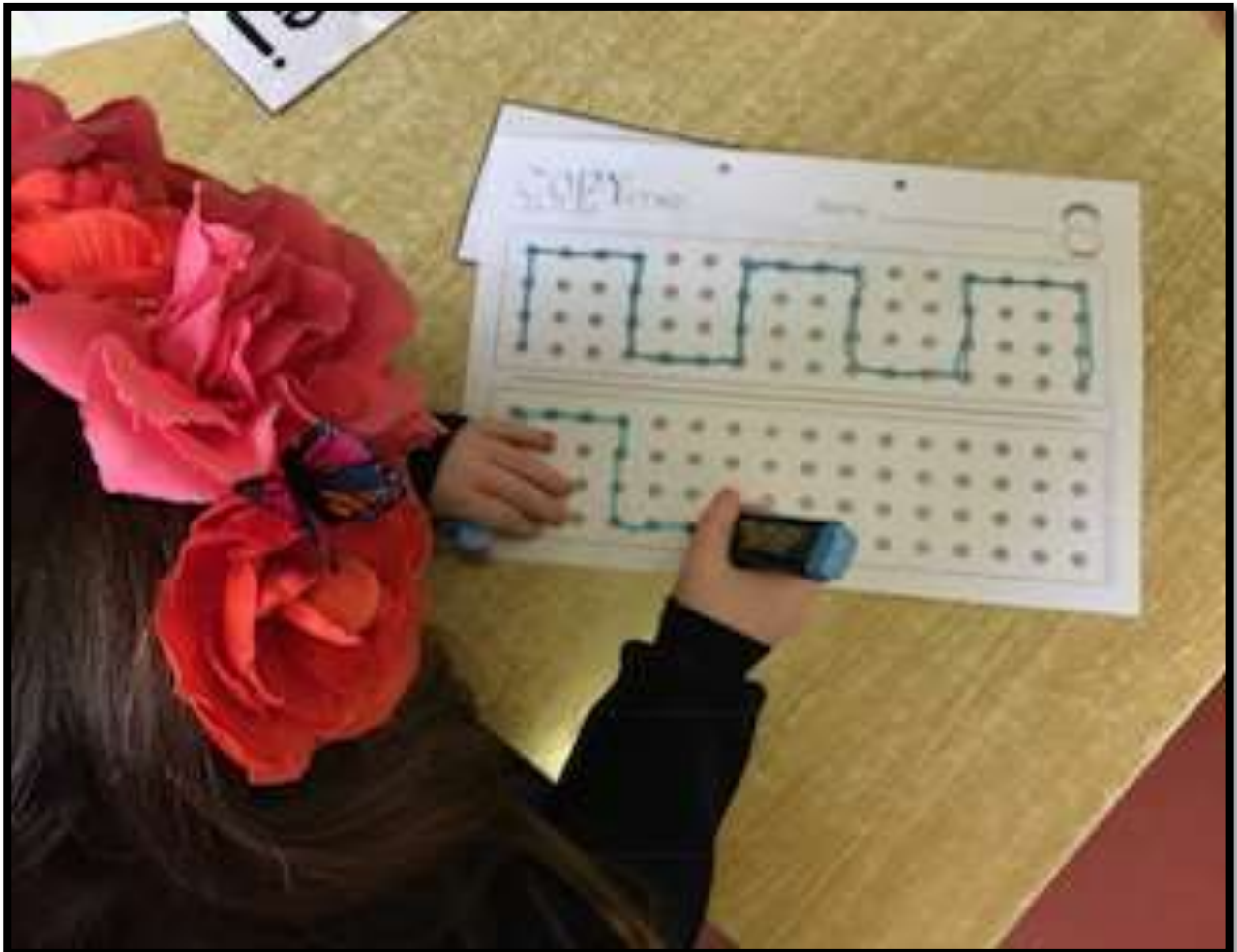
Thank you for your interest and cooperation,

Yours sincerely,

Sinead McCauley Lambe

**Appendix F Sample Teacher Manual: Sensorimotor Handwriting
Programme for Junior Infants**

Sensorimotor Handwriting Programme Teacher Manual



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Is Handwriting Really That Important?

The importance of handwriting is reflected in society, which continues to assign much significance to reading and writing, despite the recent increase in technological advances both in the home and in the classroom. Handwriting is "an extremely versatile tool used to accomplish a variety of goals" (Graham, 2018, p. 4), including personal, social and cognitive accomplishments in schools and in a wider societal context (O'Mahony et al., 2008). The importance of handwriting is perhaps more visible than ever in light of the Covid-19 pandemic, when writing became a key mechanism for maintaining connection with family, friends and colleagues. The psychological and physiological benefits from writing have been documented (Smyth, 1998 as cited in Graham, 2018), with writing recognised as a tool to "combat loneliness" (p. 4).

What are the Skills Involved in Handwriting?

There are many skills involved in handwriting including visual perceptual skills, eye-hand coordination, muscle memory, posture, gross motor skills, fine motor skills, pencil grasp and letter formation. Pre-writing skills are essential in enabling children to be able to develop the ability to hold and move a pencil fluently and effectively, and to produce legible writing. When children enter school with underdeveloped motor skills, and they are tasked with demanding writing activities, they can become frustrated by feeling like they cannot succeed.

Problems with the mechanical aspects of handwriting can negatively influence the writing and academic performance of students in a number of ways in the classroom. Firstly, poor motor control will affect a child's ability to write legibly and result in incorrect size or placement of letters, inadequate pencil grip and

slow handwriting speed (McGlashan et al., 2017). Research indicates that as a consequence of poor legibility, readers may be biased in their evaluation about the ideas and quality of a text (Santangelo & Graham, 2016) and written text may be less accessible to others (Graham, 1999). Good handwriting is still regarded by teachers as a sign of academic prowess (Santangelo & Graham, 2016) and a less legible version of a paper will be scored lower than a more legible one, according to research (Graham, 2018).

What are the building blocks necessary to develop emergent writing skills?

- **Hand and finger strength:** An ability to exert force using the hands and fingers that enables the controlled movement of a pencil.
- **Crossing the mid-line:** The ability to cross the imaginary line running from the nose to pelvis that divides the body into left and right sides.
- **Pencil grasp:** The efficiency of how the pencil is held
- **Hand-eye coordination:** The ability to process information received from the eyes to control, guide and direct the hands in the performance of a task such as handwriting.
- **Bilateral integration:** Using two hands together with one hand leading (e.g. holding and moving the pencil with the dominant hand while the other hand helps by holding the writing paper).
- **Upper body strength:** The strength and stability provided by the shoulder to allow controlled hand movement for good pencil control.
- **Object manipulation:** The ability to skilfully manipulate tools (including holding and moving pencils and scissors) and controlled use of everyday tools (such as a toothbrush, hairbrush, and cutlery).
- **Visual perception:** The ability to interpret and make sense of visual information, such as letters, shapes and numbers.

- **Hand dominance:** The consistent use of one (usually the same) hand for task performance, which allows refined skills to develop.
- **Hand division:** Using just the thumb, index and middle finger for manipulation, leaving the fourth and little finger tucked into the palm stabilizing the other fingers but not participating.

How can I tell if a child has problems with emergent writing skills?

If a child has difficulties with emergent writing skills, they might:

- Display a non-functional pencil grasp.
- Have difficulty controlling a pencil for colouring, drawing or writing.
- Show a tendency to use their whole hand to manipulate objects rather than just a few fingers.
- Have poor endurance for pencil-based activities.
- Display messy and/or slow handwriting.
- Have difficulty staying within the lines when colouring.
- Apply inappropriate pressure to the paper for pencil based activities (either too heavy and frequently breaks the pencil, or too light and 'spidery').
- Have poor upper limb strength (weak shoulders).
- Have difficulty coordinating both hands together for two-handed tasks.
- Have poor hand-eye coordination.

- Be verbally skilled but has difficulty showing this on paper (i.e. writing, drawing or colouring).
- Not meet the pre-writing expectations outlined on the following page.

Age / Pre-writing expectation

1 -2 years

- Randomly scribbles
- Spontaneously scribbles in vertical/horizontal and/or circular direction
- Imitates a horizontal/vertical/circular direction

2 - 3 years

- Imitates a horizontal line
- Imitates a vertical line
- Imitates a circle

3 - 4 years

- Copies a horizontal line
- Copies a vertical line
- Copies a circle
- Imitates +
- Imitates / and \
- Imitates a square

4 -5 years

- Copies a +
- Traces a line
- Copies a square
- Copies a / and \
- Imitates X
- Imitates Δ
- Grasps pencil in writing position

5 -6 years

- Copies X
- Copies Δ
- Recognises between a big and small line or curve

Why are Gross Motor Skills Important for Handwriting?

Below are four key areas of Gross Motor development that contribute to handwriting readiness.

1. Proprioception & Spatial Awareness

Proprioception is the sense of knowing where your body is in space and has a direct connection with knowing how much pressure to place through an item. In relation to handwriting, proprioception impacts on pencil grasp. A child that needs a higher amount of proprioceptive input, may not recognize how much pressure to place through their writing utensil. They may use too much force (snap the nip of the pencil!), or too little force (you can barely see marks on the page!).

Spatial Awareness involves a child's ability to process information in relation to where their body is in space, its orientation and its position. It may involve the ability to understand directional language concepts such as up/down, next to, left/right, over/under, etc. In handwriting, difficulties with spatial relationships may also affect letter formation (as described in visual discrimination later in this section), as children have difficulty relating the position of lines in relation to other parts of a letter. Children may also demonstrate difficulty with writing on a line and/or making appropriate spaces between letters or words.

Children with spatial awareness difficulties benefit from a range of strategies that can assist with visual perceptual skills. These may include gross motor activities and postural control activities to encourage body awareness as well as shape positioning games such as Tangrams. They may also benefit from copying patterns made with blocks, LEGO models and beads before attempting to copy patterns on paper. Further strategies may include using speciality writing paper

(coloured lines), grid paper, highlighting the writing line, placing a ruler on the writing line and the use of a 'spacer' between words.

2. Balance & Stability / Posture & Positioning

Sitting with poor posture can put stress on children's muscles, joints and ligaments. When children have unstable posture, they end up using excess energy to maintain their stability and balance. This can affect how they function and decrease their ability to complete fine motor tasks, schoolwork and even to listen. Sitting with good posture for writing increases stability, provides a sturdy foundation for written output, and can increase attention and focus. Poor core strength is often overlooked when addressing printing issues but it has a large impact on a child's fine motor skills and abilities.

Some signs of poor core strength include:

- Slouching in the chair
- Having the non-dominant hand hold the chair or hang beside the body
- Appearing tired or complaining of fatigue
- Resting the head in the non-dominant hand, or laying the head and arm on the table
- Leaning forward or close to the paper
- Moving around, shifting from side to side or turning the body

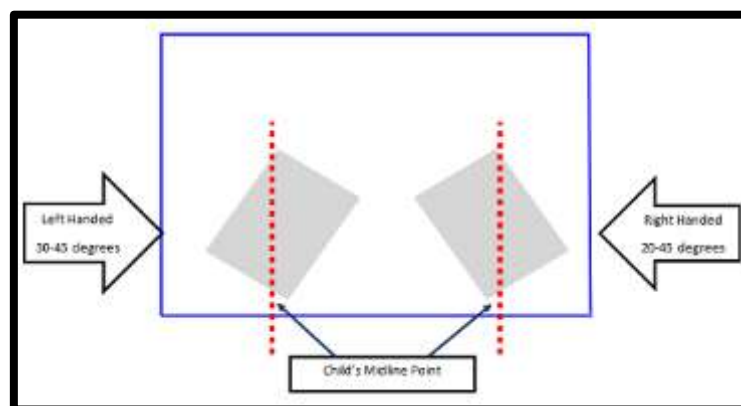
A child's posture at their table or desk should follow the **90-90-90 angle rule**:

- The feet should rest flat with a 90-degree angle at their ankles
- The knees should be bent at a 90-degree angle and about 1-2 inches away from the seat of the chair
- The hips should be at the back of their chair and positioned at a 90-degree angle

- If the child's chair is too high or too low, it is important to fix this. If the chair is too high, place a stool, book or box under their feet. If the child's chair is too low, place something on the seat of the chair to make them higher like a book or a firm cushion.

Positioning describes how the child is set up at the table. Once the seat and desk are set up to follow the 90-90-90 angle rule it is important to consider what good positioning for handwriting looks like.

- The child's body should be facing the table with their elbows in line with the desktop at 90 degrees
- They should be seated with their back hinged at the hips slightly forward towards the desk
- Their paper should be stabilised with their non-dominant hand
- Their arm and wrist should be resting on the table
- Their paper should be tilted up to the right if they are right handed and to the left if they are left handed
- Their paper should be angled between 30-45 degrees for left handed writers and between 20-45 degrees for right handed writers



For many who sit at a desk all day at work, comfort is everything. Now, more than ever, we are aware of ergonomic assessments of workstations and ergonomic

furniture. It is important to remember how often children have to sit in a desk too. It should be just as important to set up their desk appropriately to minimise discomfort, improve stability and in return increase productivity and work output. Ensure to give children plenty of feedback on their posture to help them to become more body aware, especially during written tasks. It is important that the children recognise that 'good' posture is part of 'good' handwriting, and that is not all about the pencil and the paper!

3. Hand-eye Coordination

Eye -hand coordination is the ability to coordinate eye movement with hand movements. It involves the ability to process visual information to guide hand function. When children are learning to control a pencil for handwriting, they will rely on visual information as they look at their hand and what the pencil is producing as they write.

The ability to copy a vertical line, circle, horizontal line, right oblique line, square, left oblique line and an oblique cross have been recognised by therapists as an indication of a child's readiness to integrate visual-motor skills to begin handwriting instruction. Beery & Beery (2010) recommend that formal pencil-paper instruction be postponed until a child can easily execute an oblique cross, as it requires crossing the midline, which is the source of many reversal problems. They also suggest that transfer of improved visual-motor skills does not automatically transfer to academic tasks and teaching letters, words and sentences are still required.

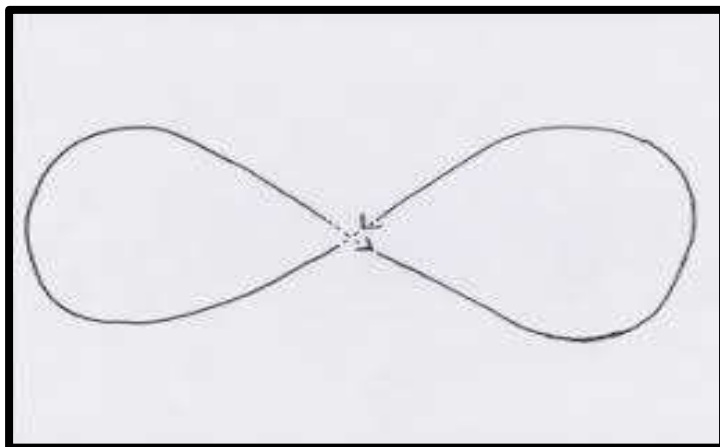
Typically, children are encouraged to control their pencils and practice eye-hand coordination with tracing various lines, then shapes and then letters. These lines may include bold dotted lines, faded dotted lines, bold unbroken lines, faded unbroken lines to trace. Children may also be provided with paths, roads or

outlines to draw between to produce lines, shapes or letters. Teachers may support children with eye-hand difficulties by contrasting the path to be drawn or by emphasizing the boundary line (with a raised surface).

Eye-hand coordination of fine and gross motor tasks may also be encouraged prior to handwriting instruction. This may emphasize large movements before moving to small movements. Children may be encouraged to develop eye-hand coordination of larger tools before using small tools for more accurate control (chubby crayon before ordinary crayon).

4. Bilateral Coordination and Crossing the Midline

Bilateral coordination is a key prewriting developmental skill. When we write, we need to easily coordinate both sides of the body for effective posture, holding the paper, moving the pencil, erasing, using margins, and filling in given spaces on worksheets. Forming letters requires pencil strokes that involve moving to the midline. Think about it this way: A new writer forms letters that are very large in size. As they develop coordination and motor skills, letter size decreases but those letter strokes continue to remain the same. A pencil still needs to move to the midline when crossing an uppercase T or adding the middle line to an uppercase A.



Why are Fine Motor Skills Important for Handwriting?

Fine Motor Skills are a powerhouse when it comes to handwriting. From pencil control to an efficient grasp, to endurance in writing, fine motor skills are required. Working on fine motor skills can be a huge help for many children who struggle with handwriting. It is important to remember also that fine motor skills not only affect handwriting, but also general classroom activities and skills. While handwriting tends to be where many notice a concern with fine motor skills, fine motor skills also affect many other classroom or home activities such as dressing, toileting, feeding, playing, and any activity that uses your hands (everything!). Children who present with decreased fine motor skills most likely will need to focus on these basic self-help skills, not just handwriting.

A very common issue that many parents or teachers notice with handwriting is an incorrect pencil grasp. It is commonly believed that a poor pencil grasp leads to poor legibility in handwriting. However, some research suggests that there may not be a significant effect. The most significant fine motor skill directly linked to poor handwriting skills is in-hand manipulation. This refers to the skill of picking up an item and being able to move it around in your hand, or manipulate it. In some studies, it appeared that in-hand manipulation skills had a significant effect on letter formation.

Fine motor skills involve the coordination of small muscles and movements of the hands, fingers, and eyes. Fine motor skills development starts with basic grasps like the palmar grasp and then the pincer grasp and eye-hand coordination.

What are the building blocks necessary to develop fine motor skills?

- Bilateral Integration: Using two hands together with one hand leading (e.g. opening a jar lid with hand while the other hand helps to by stabilising the jar).
- Shoulder and Postural (body) stability: Stabilization of the body in a functional position. Being able to maintain a good sitting position and hold the shoulder in a good stable position.
- Wrist stability and extension: It is easiest to use your finger movements when your wrist is slightly extended, and when your hand is stabilized and resting on the table.
- Crossing Mid-line: The ability to cross the imaginary line running from a child's nose to pelvis that divides the body into left and right sides.
- Hand and finger strength: An ability to exert force against resistance using the hands and fingers that allows the necessary muscle power for controlled movement.
- Hand eye coordination: The ability to process information received from the eyes to control, guide and direct the hands in the performance of a task such as handwriting.
- Hand Dominance: The consistent use of one (usually the same) hand for task performance, which allows refined skills to develop.
- Hand division: Using just the thumb, index and middle finger for manipulation, leaving the fourth and little finger tucked into the palm not participating but providing stability for the other 3 fingers.
- In-hand Manipulation: The ability to skilfully manipulate tools (such as the ability to hold and move pencils and scissors with control) and the controlled use of everyday tools such as a toothbrush, hairbrush, and cutlery.

- Proprioception: Information that the brain receives from our muscles and joints to make us aware of our body position and body movement, so we can accurately control our movements.

How can I tell if a child has problems with fine motor skills?

If a child has difficulties with fine motor skills, they might:

- Have an awkward or immature pencil grasp for their age.
- Have messy, slow or laborious drawing, colouring or writing skills.
- Fatigue quickly when typing or using a mouse on a computer.
- Have difficulty (or achieves a messy/choppy outcome) when using scissors.
- Have difficulty performing precise manipulation tasks (i.e. doing up buttons, threading, or tying shoelaces).
- Dislike precise hand and eye coordination tasks (e.g. construction).
- Have difficulty performing age appropriate self-care tasks independently.
- Have difficulty mastering new fine motor tasks.
- Tire easily when engaged in fine motor tasks.

What other problems can occur when a child has fine motor skill difficulties?

When a child has fine motor skill difficulties, they might also have difficulties with:

- Behaviour: They may avoid or refuse to participate in fine motor tasks.
- Frustration with precise eye and hand coordination tasks.
- Avoidance of these tasks: Preferring to get others to perform fine motor tasks for them under their direction, rather than actually doing themselves (e.g. "Daddy, draw me a house", or "build me a rocket", with refusal to do it themselves).

- Showing academic ability: Being verbally very skilled but having difficulty showing this on paper (i.e. writing, drawing or colouring).
- Self-esteem: when they compare their own skills to those of their same aged peers.
- Academic performance: The ease with which a student is able to complete academic tasks.

What can improve fine motor skills?

- Hand dominance: Determine which the dominant hand is and reinforce its more frequent use in precision task performance.
- Bilateral Integration: Practice using both hands to perform tasks, not just one (e.g. use the 'doing hand' to place the block and the 'helping' hand to hold the block construction steady).
- Finger Isolation: Practice tasks that use just one or two fingers - not all the fingers at once (e.g. 'poking' games).
- Hand and Finger Strength: Enhance finger strength by using pegs and/or clips in play.
- Experience: Encourage enjoyment in activity participation instead of focusing on a 'successful' outcome (e.g. rewarding pencil to paper attempts, not whether the drawing actually looks like a car or a house).

What activities can help improve fine motor skills?

- Threading and lacing: with a variety of sized laces and beads.
- Tongs or tea bag squeezers: to pick up objects (e.g. put marbles down a marble maze).
- Manipulation games: such as 'Connect 4'.

- Playdoh: Using the fingers, not the hands as whole; working with the Playdoh up in the air, not flat on the table.
- Construction: that requires pushing and pulling with fingers ('Mobilo', 'K'nex' or 'Lego').
- Storing construction materials in jars with screw lids that need to be opened and closed as the materials are needed and when packed away.
- Craft: Make things using old boxes, egg cartons, wool, paper and sticky or masking tape.

Why is it important to address the issue of poor fine motor skills?

Therapeutic intervention for a child with fine motor skills difficulties is important to:

- Improve their ability in, and persistence with, fine motor tasks that are required for academic, play and life skills.
- Increase school readiness and academic performance of: colouring, drawing, writing, cutting and pasting skills.
- Help the child to develop age appropriate mastery of self-care tasks, such as doing up buttons and zips, opening lunch boxes, tying shoe laces.
- Avoid the child becoming disengaged in an academic environment due to difficulties completing fine motor activities (e.g. writing, cutting, and drawing).
- Avoid frustrations experienced by parents, teachers and children when the child is struggling to remain engaged in academic activities.
- Help maintain and develop a positive sense of wellbeing that is related to school confidence as well as fine motor play skills with peers.
- Ensure that the child does not fall behind their peers in development of handwriting, as this is a common reason for academic under-performance.

What can difficulties might arise as a result of poor fine motor skills?

When a child has difficulties with fine motor skills, they might also have difficulties with:

- Meeting academic criteria due to poor handwriting skills and/or rapid physical fatigue.
- Mastering letter formation, which slows writing and reinforces dislike of the task.
- Excessive pressure and anxiety in a school-aged child due to difficulties 'keeping up' in class.
- Completing exams due to difficulty answering all written questions within the allocated time.
- Poor self-esteem when the child compares their abilities with their peers.
- Developing efficient typing skills.
- Manipulating items for construction (puzzles, Lego).
- Completing self-care tasks (e.g. doing up shoelaces, buttons, zips, using cutlery).

Why are Visual Perceptual Skills Important for Handwriting?

Handwriting is a complex skill. Handwriting involves the ability to form letters with consistent letter size, proportions and spacing, so that others can read words and sentences. Producing legible handwriting requires complex visual perceptual skills as well as an integration of motor skills with these visual perceptual skills. A deficiency in visual-motor integration may be evident when observing poor quality handwriting (Volman, van Schendel, & Jongmans, 2006).

Visual perception is the process where the brain extracts and organises information, giving meaning to what we see. Visual-motor integration is the degree to which visual perception and finger-hand movements are well coordinated (Beery & Beery, 2010). There are many components of visual processing which work together to assign meaning to what we see and include eye-hand coordination, visual discrimination, form constancy, visual memory and visual-sequential memory.

What are the building blocks necessary to develop visual perception?

- Sensory Processing: Accurate registration, interpretation and response to sensory stimulation in the environment and the child's own body.
- Visual Discrimination: The ability to determine differences or similarities in objects based on size, colour, shape.
- Visual Memory: The ability to recall visual traits of a form or object.
- Visual Spatial Relationships: Understanding the relationships of objects within the environment.

- Visual Sequential-Memory: The ability to recall a sequence of objects in the correct order.
- Figure Ground: The ability to locate something in a busy background and filter out unimportant background information.
- Form Constancy: The ability to know that a form or shape is the same, even if it has been made smaller/larger or has been turned around.
- Visual Closure: The ability to recognise a form or object when part of the picture is missing.

Eye-hand coordination as described above in the *Gross Motor* section is the ability to coordinate eye movement with hand movements and includes the ability to process visual information to guide hand function. When children are learning to control a pencil for handwriting, they will rely on visual information as they look at their hand and what the pencil is producing as they write.

The ability to copy a vertical line, circle, horizontal line, right oblique line, square, left oblique line and an oblique cross have been recognised by therapists as an indication of a child's readiness to integrate visual-motor skills to begin handwriting instruction. Beery & Beery (2010) recommend that formal pencil-paper instruction be postponed until a child can easily execute an oblique cross, as it requires crossing the midline, which is the source of many reversal problems. They also suggest that transfer of improved visual-motor skills does not automatically transfer to academic tasks and teaching letters, words and sentences are still required.

Typically, children are encouraged to practice **eye-hand coordination** by tracing various lines, then shapes and then letters. These lines may include bold dotted

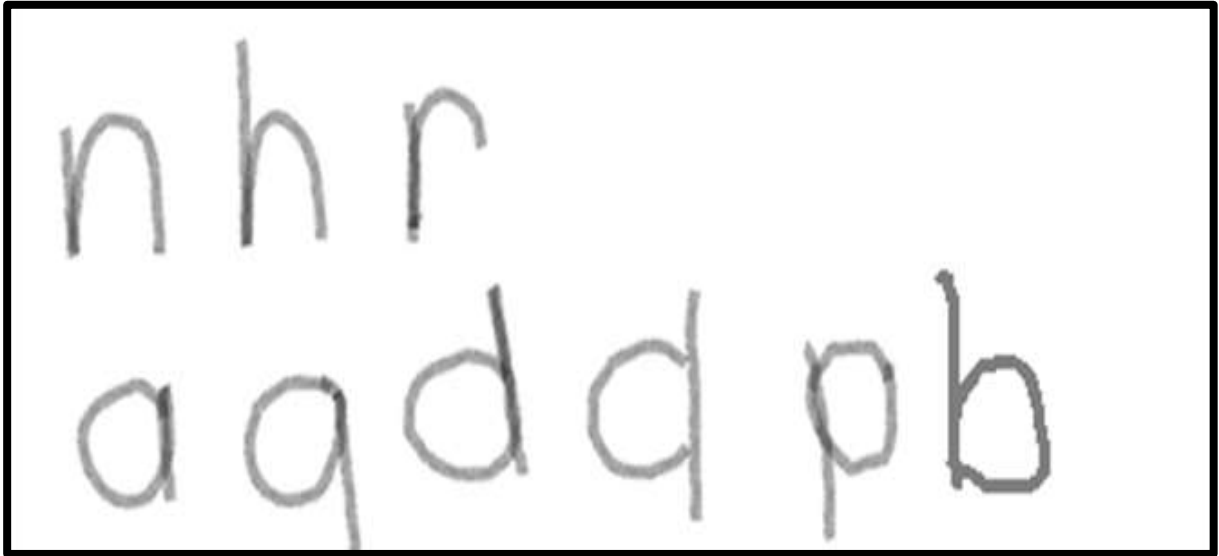
lines, faded dotted lines, bold unbroken lines, faded unbroken lines to trace. Children may also be provided with paths, roads or outlines to draw between to produce lines, shapes or letters. You can children with eye-hand difficulties by contrasting the path to be drawn or by emphasising the boundary line, for example by providing a raised surface (a piece of twine works well).

It is really important that fine and gross motor tasks that promote eye-hand coordination are promoted prior to moving towards more formal handwriting instruction. Choose tasks that emphasise large movements, before moving to small movements. Encourage to develop eye-hand coordination of larger tools before using small tools for more accurate control - by using a chubby crayon before an ordinary crayon for example.

Visual Discrimination is the ability to classify objects or shapes based on visual information such as colour, form, pattern, size or position. In handwriting, children need to be aware of common characteristics as well as subtle differences that distinguish letters and words. Children need to identify letters as well as the sequential order of letters to recognise words for reading, writing and spelling. Difficulties with **visual discrimination** may be seen with letter reversals, or lack of attention to detail in letter formation.

For example, when writing "n", if the initial line is drawn too long it appears as "h" or if the up and over section is too short it appears as "r". When writing "a", if the line is produced too long and below the circle it appears as "q", if the line is produced too long and above the circle it appears as "d", if the line is too long above and below the circle it is unrecognizable, if the line is too long and placed

to the left and below of the circle it appears as "p" or if it is placed to the left and above the circle it appears as "b".

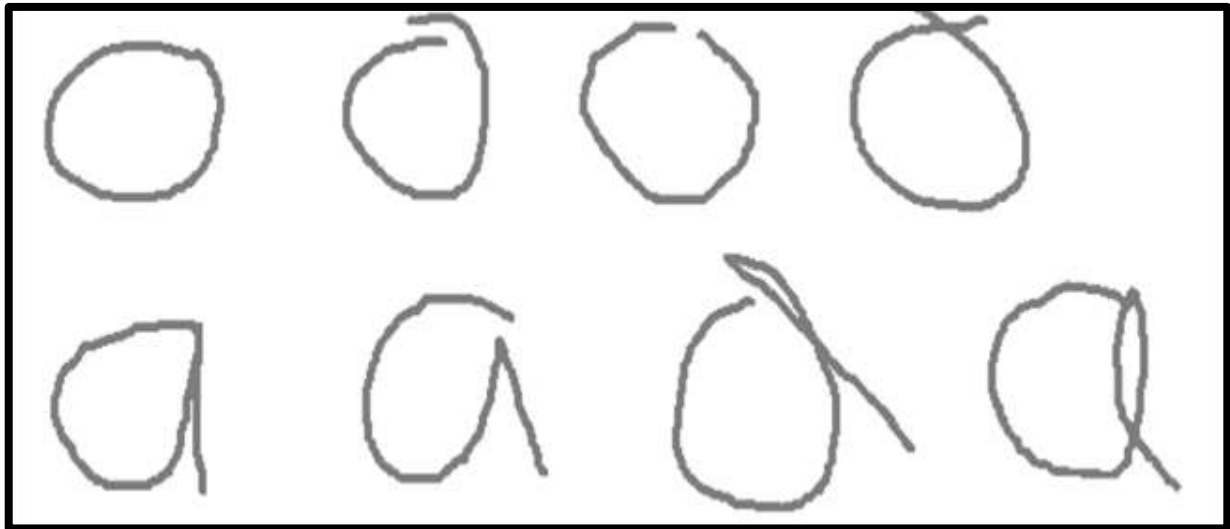


Visual discrimination in handwriting may also be seen with confusions with the use of lower and upper case letters. Children need to be able to firstly identify letters regardless of lower or upper case formation (classification), and then use these appropriately (capital letters used at the beginning of a sentence).

Children with visual discrimination difficulties may require additional strategies to classify letters. Providing a multisensory approach to learning (playdoh, rice, shaving foam, clay) is great for assisting with kinaesthetic learning and muscle memory.

Visual Closure is the ability to process visual information when the object or word is partially hidden. In handwriting, this may affect letter formation and spelling

words. Visual closure in letter formation is closely related to visual discrimination described earlier. Children may also demonstrate incomplete letter formation which affects handwriting legibility and neatness.



Form Constancy is the ability to identify an object, shape, letter, number, symbol when it is presented in a different way (larger, smaller, rotated, italics, bold, different font, sideways, upside down, different colour). In handwriting this may result in the child not realising when they are having difficulty with letter formation as they may interpret their formation as accurate. For example, they may see the visual closure examples above, and may consider the forms to be constant (form constancy), and are unable to identify the discriminating features (visual discrimination). Children who have difficulty with form constancy may also have difficulty transitioning from printing to cursive writing.

Children who experience with difficulty with form constancy may benefit from consistent use of the same writing font in the classroom, presentation of

information at the same orientation that it is expected to be reproduced (eg. flat on the table when writing at the table or vertical when writing on a whiteboard). Teaching letters and words using a multisensory approach can help children to become more aware of the properties of shapes and letters needed for handwriting.

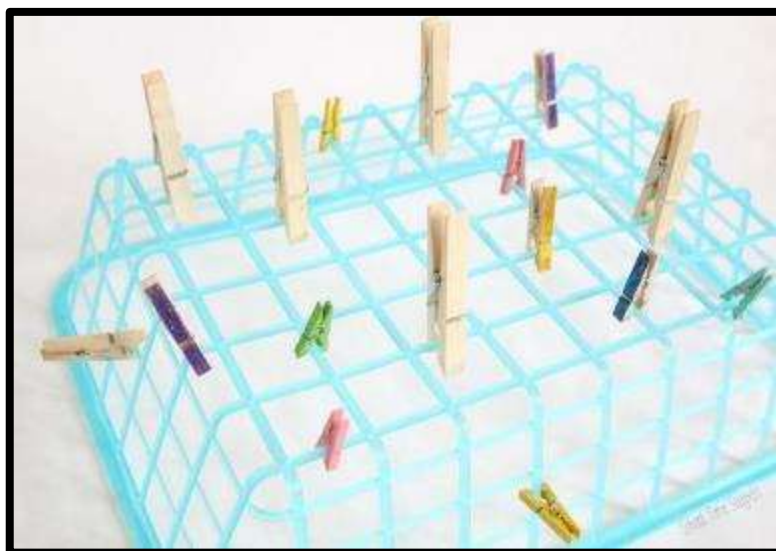
Visual memory is the ability to remember and recall objects, shapes, symbols or movements in short term memory. Visual memory requires visualisation of what to remember. This may affect a child's ability to recognize and name shapes, letters and words. They may have difficulty remembering what these 'look like' without a visual prompt. For example, children may be able to copy the letters of the alphabet when it is on a desk strip, however if you randomly ask them to write various letters of the alphabet they may not recall what it looks like. They may also have difficulty remembering all the letters of a word to copy and need to 'look up' to copy each letter even with familiar words.

Children with visual memory difficulties benefit from playing memory card games and chunking small amounts of information at a time for writing (word on a flash card rather than a whole sheet). They may require visual aids for longer than other children. These children might also benefit from multisensory learning, especially incorporating the use of verbal cues associated with motor movements. Children could make the letter 'h' for example, by walking on a chalk line, by using a skipping rope to make the shape, by tracing the letter in shaving cream, by writing it on a whiteboard, by using a ribbon to draw 'h' in the sky or by using a finger to write it on someone's back. Be as creative as you wish!

Visual sequential memory is the ability to remember and recall a sequence of objects, shapes, symbols or movements in a particular order. In handwriting, this may affect letter formation with more frequent letter reversals as children have difficulty remembering the order for letter formation as well as the spatial position of the next line. This may also affect a child's ability to write words which may have similar letters (on, no, one) or a sequence of words to make a sentence.

Children with visual sequential memory difficulties benefit from pairing verbal cues with motor skills as described in visual memory. Children may read and repeat letters for writing words, or read and repeat phrases and sentences for extended writing. These verbal cues may need to be said 'aloud before the child learns to internalise this and 'says it in their heads'. Simple sequential memory games using physical props such as beads, blocks, pom-poms may precede games using letters, numbers, shapes and words. These may be presented in increasingly large numbers and covered to be reproduced with shorter time frames over time as skills develop.

Pegs, Tongs and Tweezer Activities





The use of small tweezers and larger tongs provides opportunities for the development of prerequisite skills required for scissor use. Through the use of tong and tweezer tasks, the following will be encouraged:

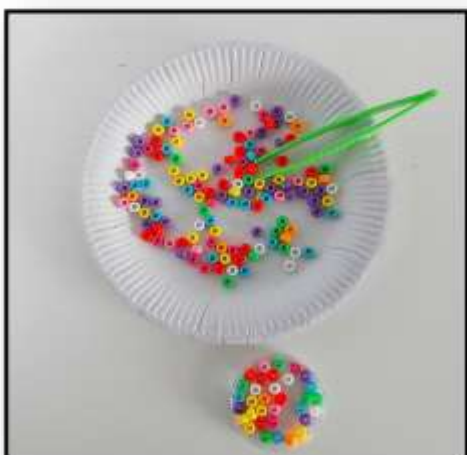
- Resistance and strengthening
- Development of the arches of the hand
- Skilled control of the radial fingers (thumb, index, and middle fingers)
- Stabilization of the ulnar fingers (ring and little fingers)

Rotate activities daily so that all children have an opportunity to experience all of the tasks.



Tongs and tweezers

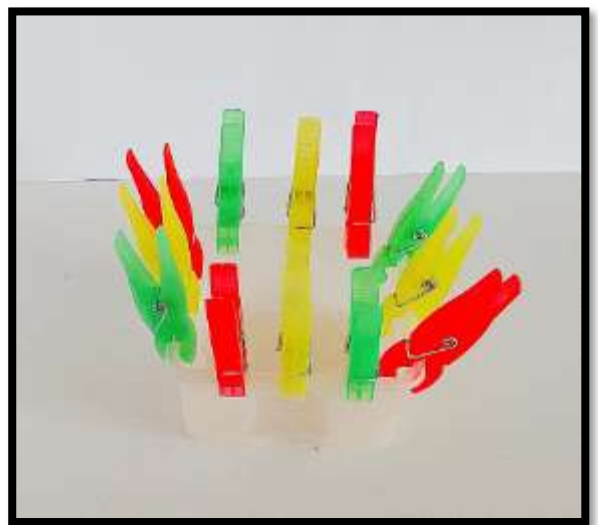
1. Pick up pom-poms, blocks, Lego, feathers, pipe cleaners or small beads and place them into a box or a sorting tray or small bowl or cup. Use or any small items that will encourage pinching, gripping and manipulating the fingers
2. Place bowl/tray/box on opposite side of the body to incorporate crossing the midline into the task.
3. Use a bottle to increase the challenge for those children who find the task too easy





Pegs

1. Pick up pom-poms, playdoh, feathers, pipe cleaner, small beads and place into a box or a sorting tray or small bowl or cup. Use or any small items that will encourage pinching, gripping and manipulating the fingers.
2. Place 10 pegs on a paper plate or piece of card. Time the activity to increase the challenge or add numbers or letters to the pegs and paper plate.
3. Place pegs around the rim of a bowl or a basket



Clay, Putty and Play-Doh Activities





Clay

Rotate clay activities so that all the children experience manipulating the clay with:

1. Their fingers and hands - the best tools!
2. A scissors
3. A pencil

The clay activities outlined below are helpful in promoting the following skills necessary for handwriting development:

- Shoulder and arm strengthening: Pushing, smashing, rolling, and pulling apart playdoh promote shoulder and arm strength that supports the development of fine motor skills.
- Pincer grasp: Pinching with thumb and index finger to develop a functional pencil grip.
- Finger isolation: Activating a single finger, for example the index finger for pointing and pushing.
- Thumb opposition: Coordinating the thumb with the other fingers to help with holding, squeezing, and strengthening the space between thumb and index finger.
- Tripod grasp: Holding and controlling a tool such as a pipe cleaner with the thumb and index finger while stabilizing it on the knuckle of the middle finger.
- Hand-eye coordination: Coordinating hand or motor movements based on what the information the eyes are processing. Also known as visual-motor integration.
- Bilateral coordination: Coordinating the use of two hands to carry out a task, such as one hand stabilising the page, while the other hand mark makes or writes.



HANDS



- Pinch small pieces from a large piece of clay
- Pinch the clay between the thumb and pointer finger
- Roll the clay into a long snake
- Pull or tear the clay apart
- Squeeze a ball of clay in both hands
- Squeeze a ball of clay in alternate hands
- Slap the clay!
- Hammer the clay to make it flat like a pancake
- Poke the clay with the pointer finger to work on finger isolation
- Press small items like beads or pom-poms or cubes into the clay
- Use tools to carve in the clay, pressing and drawing with the tools
- Press letters or numbers into clay
- Add water to make the clay softer or allow the clay to dry out for a more resistive texture



SCISSORS

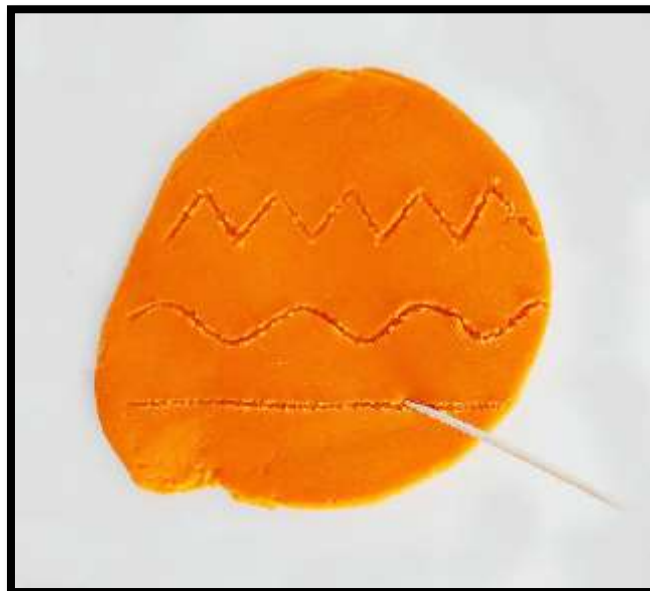


- Roll a long snake and use scissors to cut the snake into chunks!
- Roll a long snake of clay and use a pencil or plastic knife to mark lines. You could also try cutting along the lines that you draw!
- Smash, slap and pat the clay into a flat disk. Use scissors to cut across the clay. Then, mark lines with a pencil and plastic knife to cut along the lines.



PENCIL

- Create a flat disk with the clay. Use a pencil to write in the clay. Practice letter or shape formation.
- Roll the clay into a snake and poke a pencil into the clay, encouraging a tripod grasp on the pencil.
- Create a flat disk from the clay. Place a piece of paper on top of the paper. Practice writing on the paper, encouraging your child to write lightly enough not to poke the pencil point through the paper. This is an exercise in developing the sense of proprioception.





Therapy-Putty

- Retrieving Small Objects



- Making Confetti



- Rolling snakes & Making Shapes



- Squeezing- Deep Pressure Work



- Smoothing - into a contained surface





Play-Doh

Pounding and Squashing:

- Pounding and squashing are great bilateral activities if the child uses **both hands together**. They are also good for developing proprioception!
- Encourage the child to pound a ball of playdough to flatten it.
- Try an alternating rhythm or both hands at the same time (symmetrical and synchronised movements).





Rolling balls:

Break off chunks of playdough and roll them between two hands to make balls.

If the child needs some additional support, put your hands over the top and guide the movements.

Rolling sausages:

Use both hands to roll out a long piece of playdough. This can become sausages, worms, snakes, spaghetti etc. or make a coil pot!

Make a pinch pot:

- Take a ball of playdough, insert the thumb in the centre of a ball, and use the index and middle fingers to pinch the outside of the pot.



Rolling small balls:

Isolate the tripod fingers and then those 3 fingers work together to roll small balls. This can be very tricky for young children, so give them lots of encouragement and modelling. Maybe some visual aids would help too? Try rolling the balls yourself with your non-dominant hand and this will give you a sense of how demanding this task can be!

Find buried treasure

Digging for buried treasure is not only a great strengthening workout for the fingers and hands, but it also helps develop the sensory system responsible for helping children to identify what an object is just by using their sense of touch — the tactile system.





Use tongs

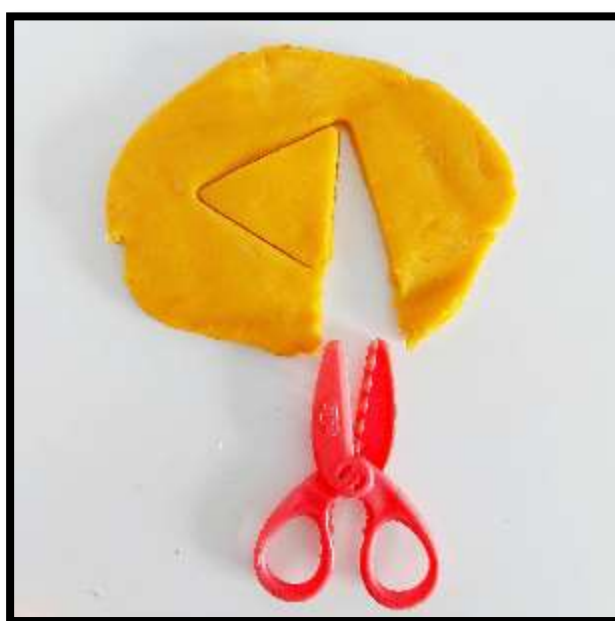
Incorporating tongs into children's play is a great way to exercise their hand muscles, as well as practice the motor pattern needed for operating scissors- close/open/close/open. Tong play also promotes hand-eye coordination. It is important to monitor the child's use of the tongs to make sure that they are controlling the tongs with their fingertips as much as they can, rather than pressing them into their palm and using more of a grasper approach. Encourage children to use their thumb, index, and middle fingers (the "worker fingers"), if you feel that they are able, but always ensure that the child is able to succeed at the task!





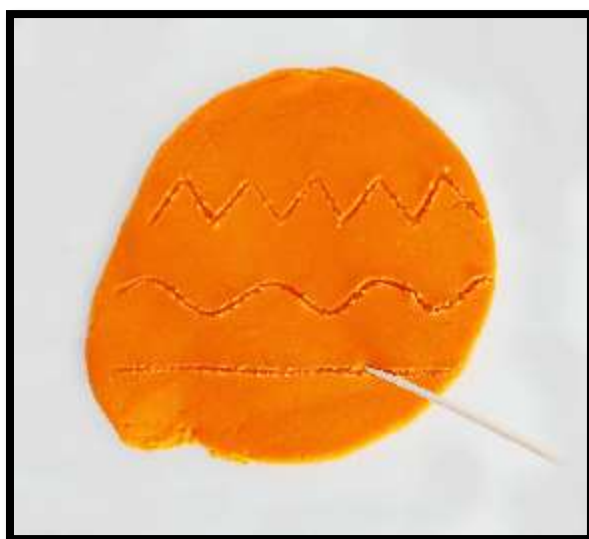
Use Scissors

Snip the playdoh with scissors and progress to cutting out lines and shapes in the playdoh.



Write letters

Write letters or draw lines and shapes in the playdoh with a pencil.



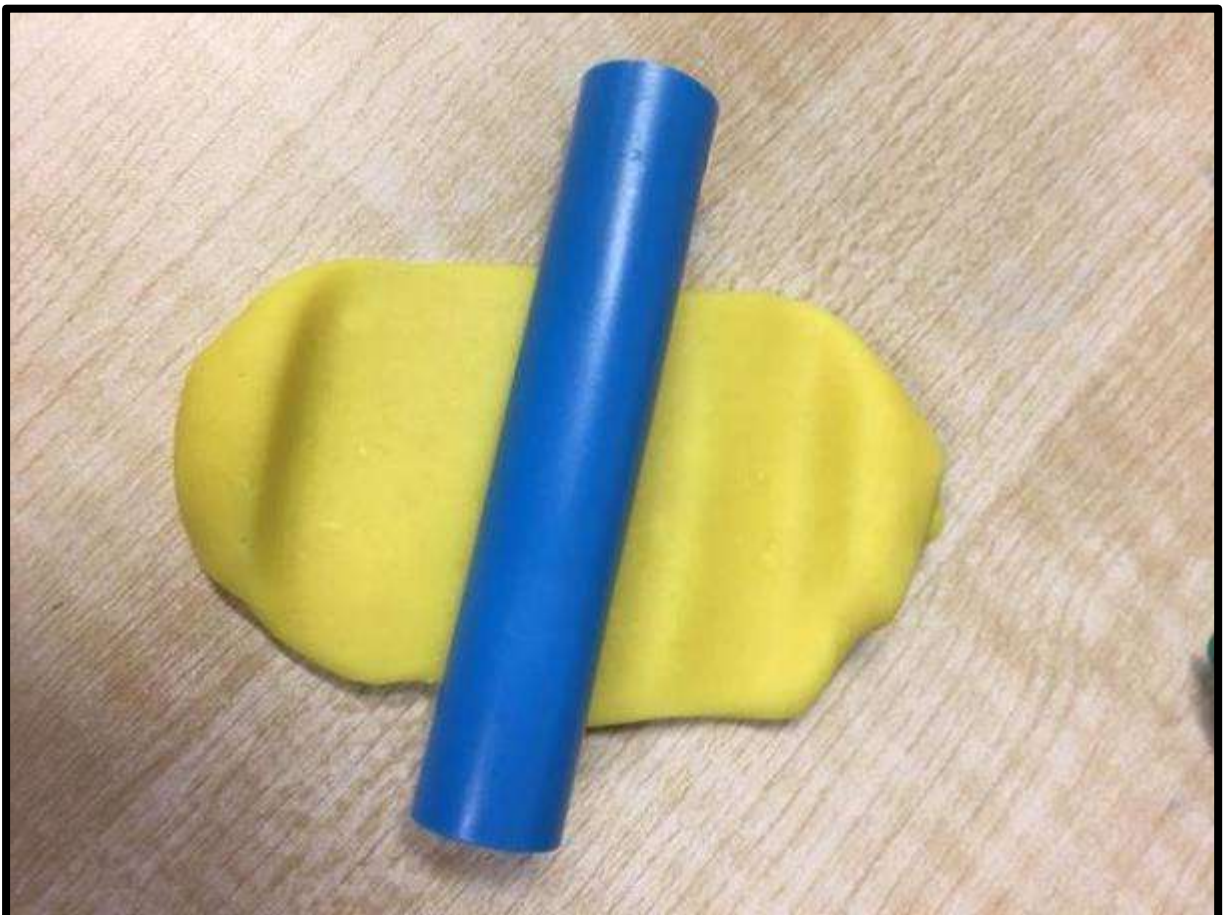
Notes

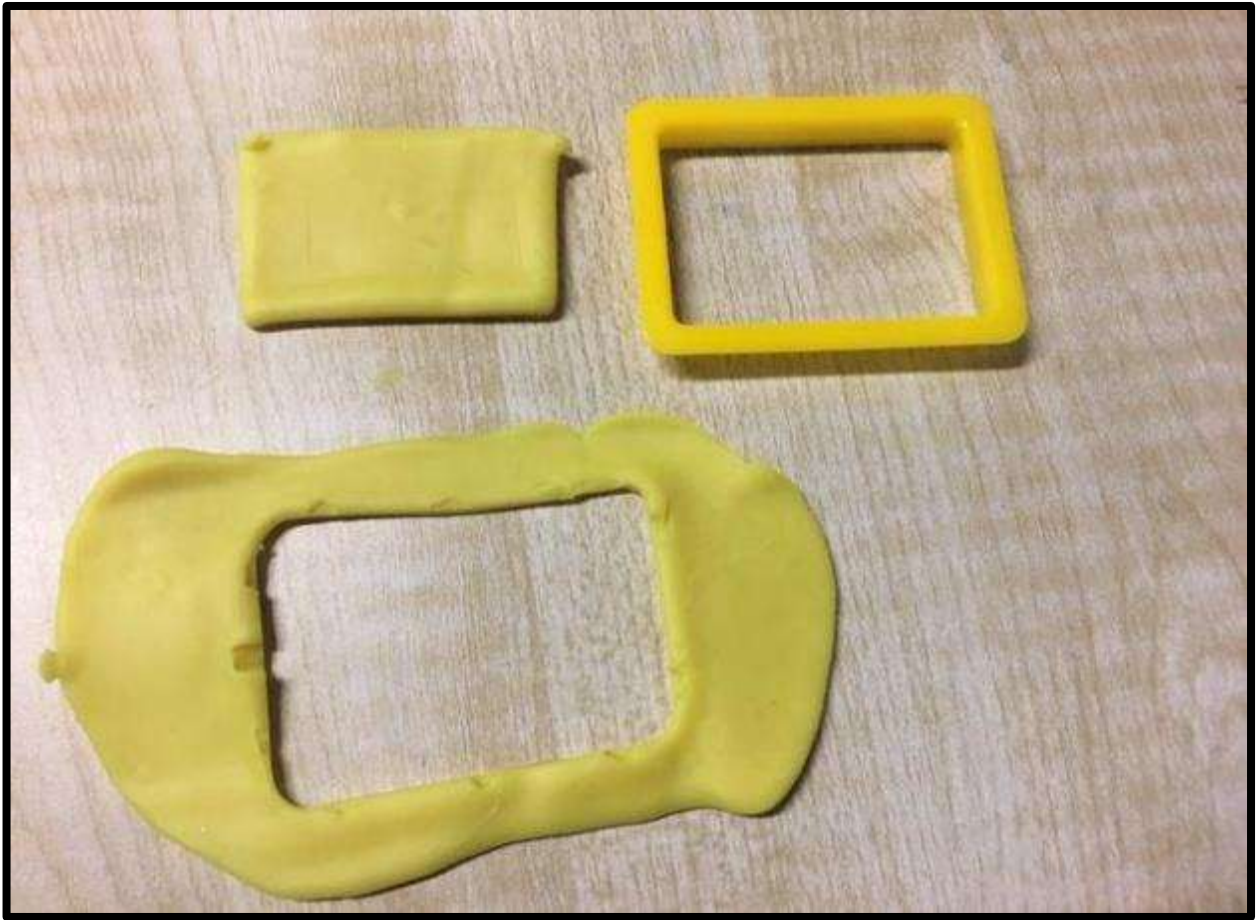
Visual Aids

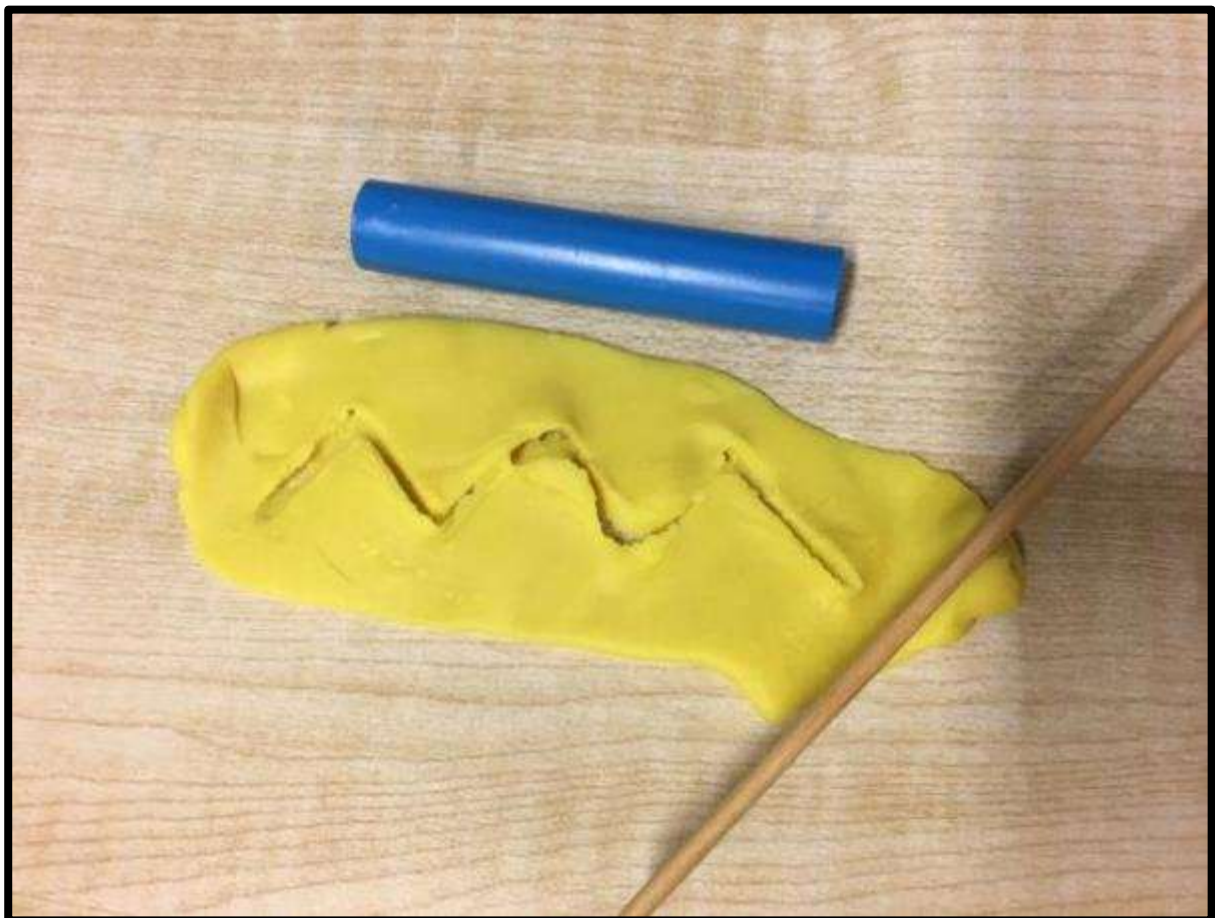
The following images could be printed and laminated and used as visual aids for children during the Play-Doh activities. Alternatively, you could show the images on the whiteboard to the whole class to give a visual representation for the task.

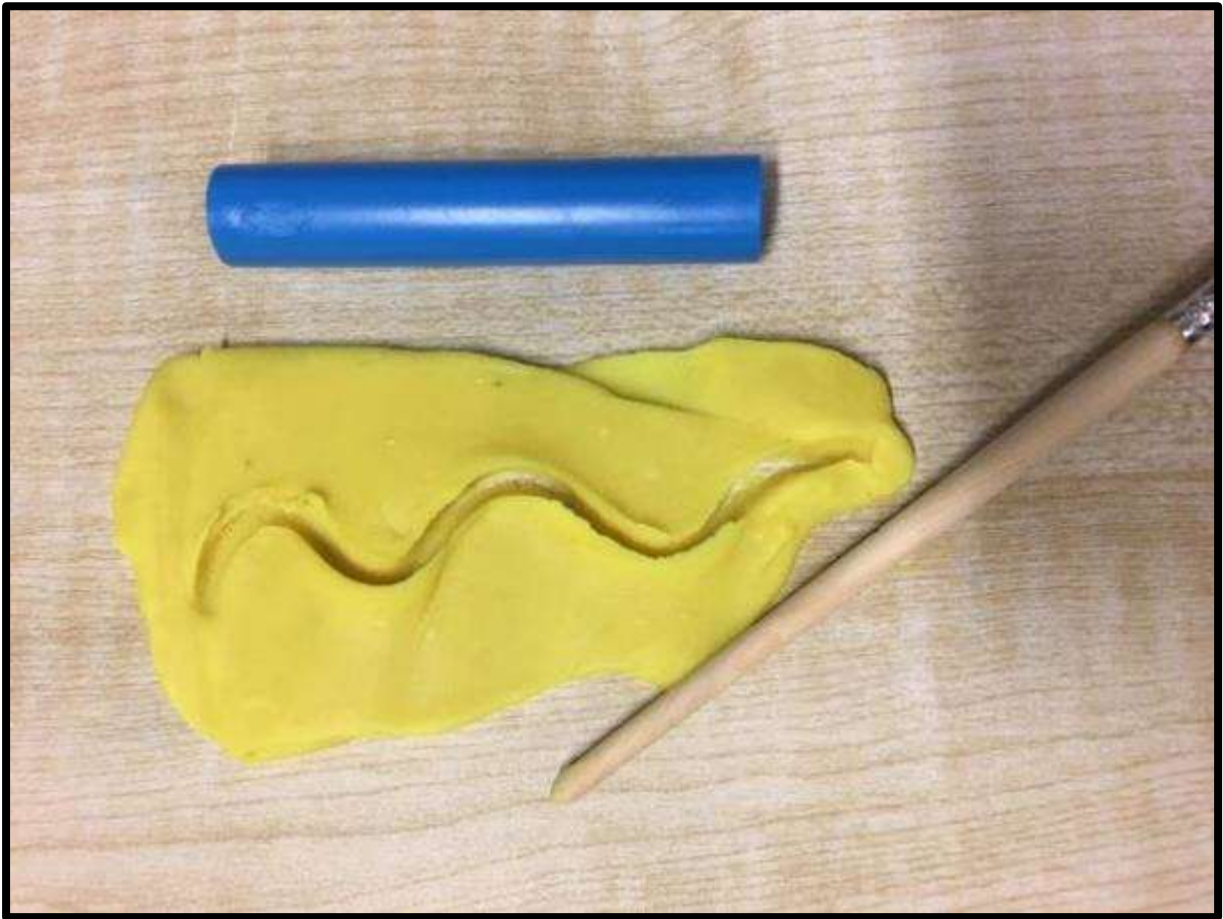














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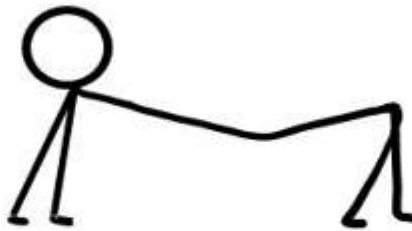
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Appendix G Examples of Gross Motor PowerPoint Presentation for Teachers

Proprioception



Crab walk

TEACHING POINTS

- Student sits on bottom
- Places hands on the floor behind bottom
- Push up using arms

Bi-lateral Coordination

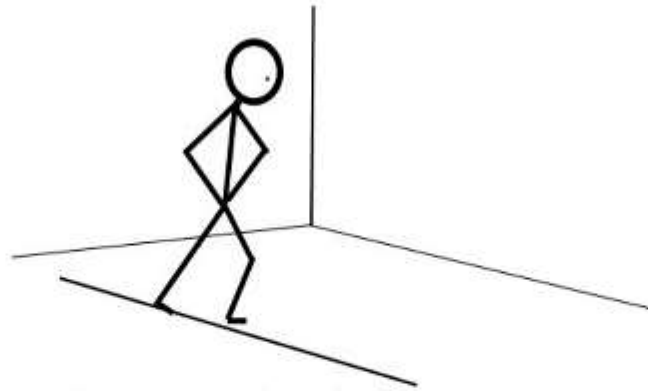


Marching to music

TEACHING POINTS

- Have children march to music using all the space in the room
- Encourage children to clap their hands at the same time

Balance and Stability



Walking toe-to-heel on masking tape line

TEACHING POINTS

- Keep hands on hips
- Keep chin up and looking forward



Holding up the wall

Proprioception

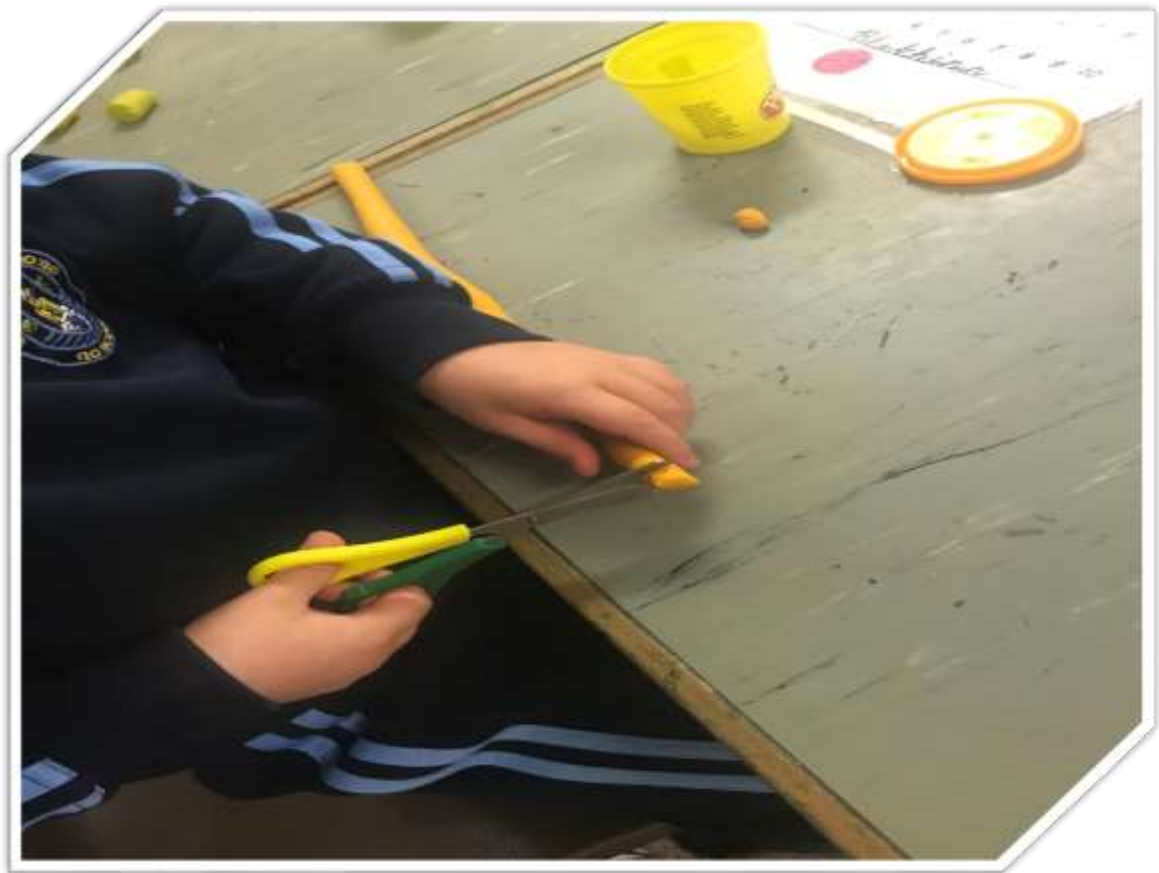
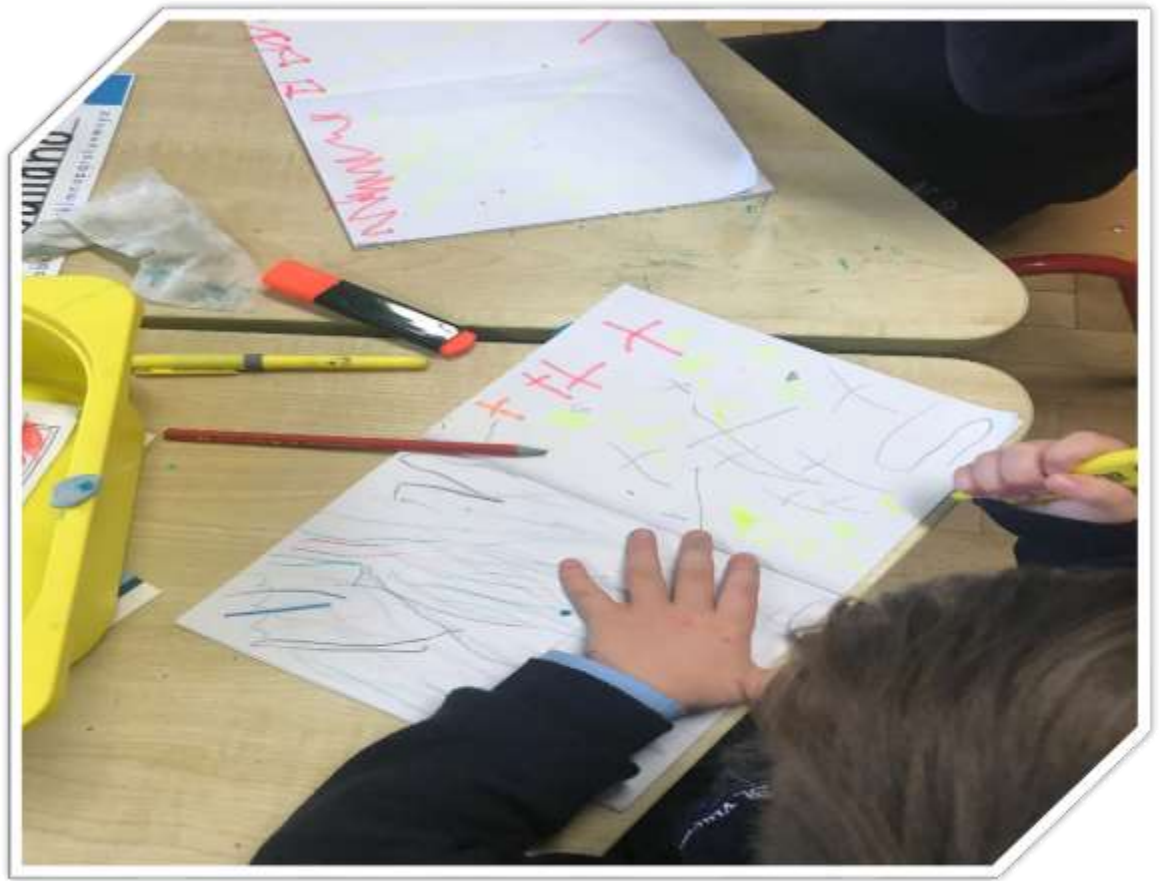
TEACHING POINTS

- Stand a little further than arms length away from the wall
- Feet shoulder width apart
- Lean against the wall, palms flat
- Bend elbows and lower the upper body toward the wall in a slow, controlled manner
- Hold for 1 second

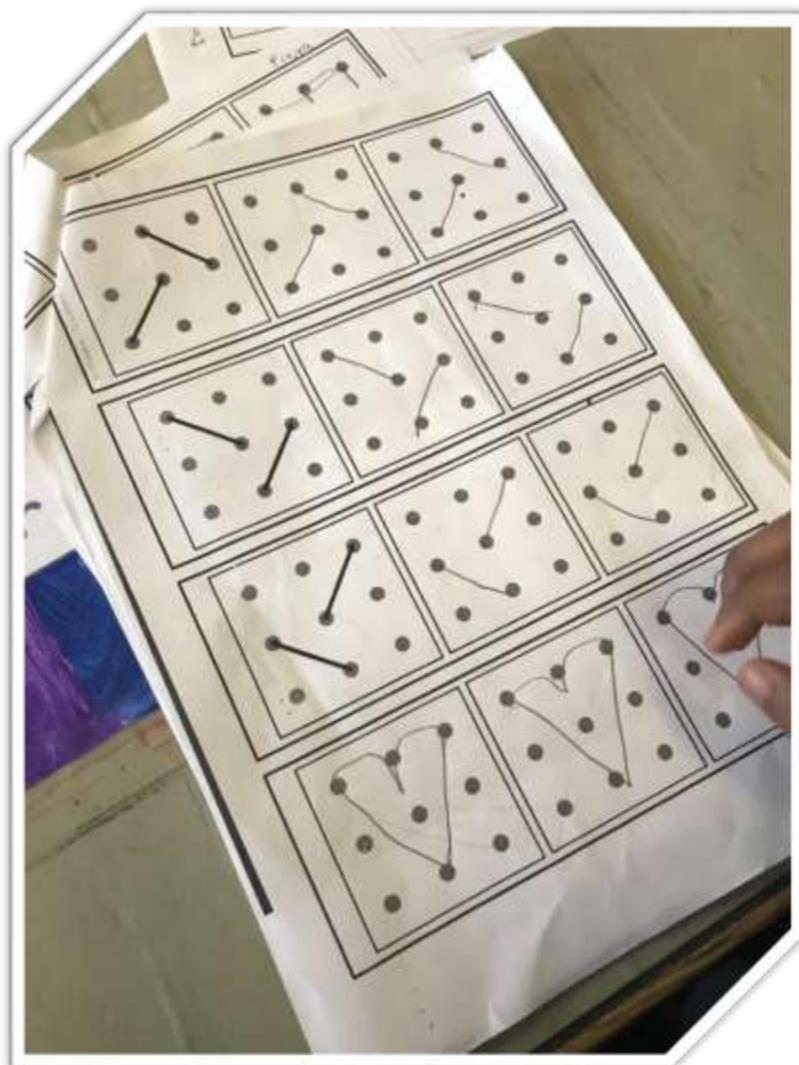
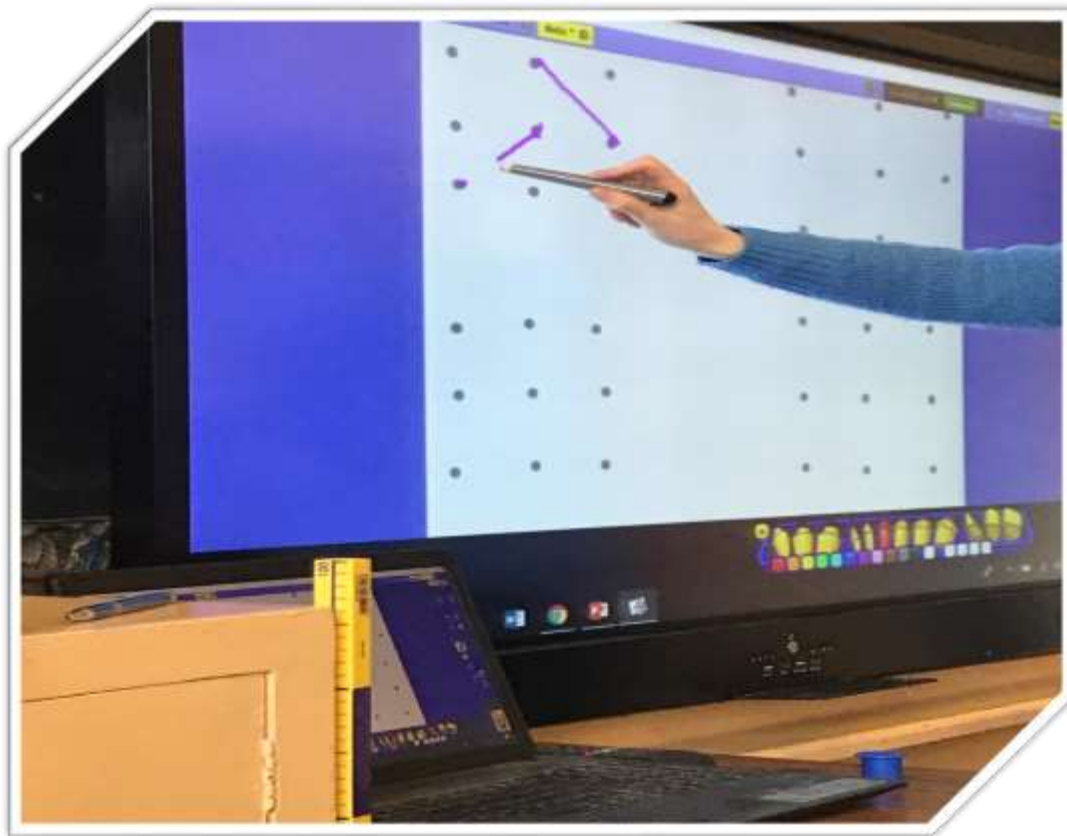
Appendix H Examples of Photographs from Observation Days

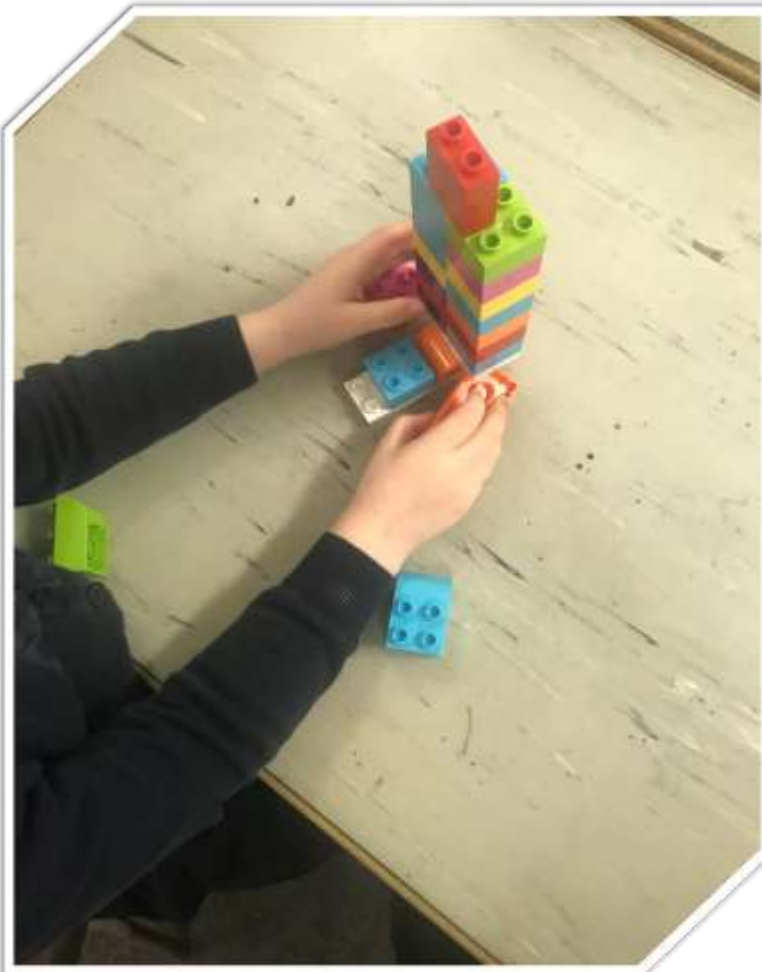
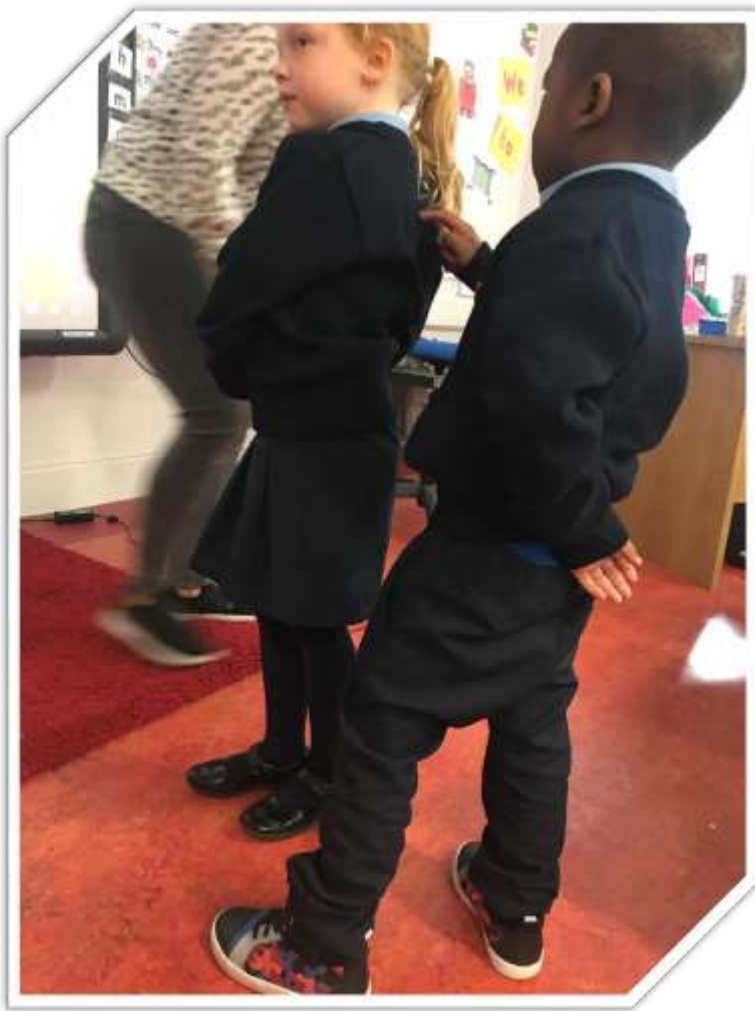












Appendix I Examples of Field Notes from Observation Days and Teacher Training Days

Ambleton
17/03/19.

① Start - FNU (Chorus) - 4 groups.
engaged, on task, engaged.

"give me permission to start down and focus on this for today and - I hope it all transfers to the next."

② Sweet Home - 1st ^{5m} engaged, on task and gave to me the words. Some didn't join in.

③ Visual Perception copy line (1st/2nd) Stood on board. Chose any words (1st) they loved this. All engaged on task they improved by focus, attention.

④ Handbrush in air - letter practice Song - up like 'H' 'P' Teacher instruction: formation Copy on floor and in air.

20/05/19 Colmallyn

→ "I don't just use the books anymore, I know their words more to it now so I do other things too."
Her

Has it changed for you Leah?
I've changed! I understand the importance of fine motor skills now and know this so much more than the book.

→ "What do I do next?"

→ Movement sounds on the PE board.

Teacher Training Day 1 - 02/04/19

* Leaders spoke about getting a balance between leadership, instruction and teacher writing, focusing the importance of routines and children's formation, rather than being able to relay these straight out when on paper...

* Spoke about being focused on the task outcome rather than the process.

* Spoke about pre-school overly focusing on teaching 'silly songs' songs and letter names without children having any concept of the letter sound being related to the shape.

* After an hour all about the concept of number - but children couldn't form the number,

then were dismissed and started as unengaged by the trainer. Focus is not on formation.

Q - Do we explicitly teach handwriting?
Yes in workbooks. No, only addressing gross motor movement.

* Review Story - Little Henry's words.
Good - consistent, written but lost to go back and teach writing.

* Need for explicit teaching - explicit programme - Leaders (2) wanted the programme very, well, high, exact.

* Talked about pre-school care of children as pre-school, parents both working so still less input than before.

Appendix J Interview Guide and Categorisation of Questions for Interview

Interview guide for class teachers including examples of descriptive, structural and contrast questions

Examples of descriptive questions

Examples of structural questions

Examples of contrast questions

Typical school day

To begin, would you like to describe what a typical school day would look like for a child in your class?

How much of the school day is given over to motor development?

Sensorimotor development

This research study concerns sensorimotor development. How would you define that? What is your understanding of the importance of sensorimotor development?

What kind of activities do you think promote or develop sensorimotor skills?

What are the basic fine and gross motor skills that you expect your junior infants to come into school with? Could you tell me a bit about that?

Class specifics / Children whom you teach

How many children have you in your class?

What is the breakdown in terms of girls / boys?

Have you any sense of particular needs relating to motor development with this particular group?

Are there any supports, in terms of resource hours, available to children with particular needs in the area of motor development?

Planning

How do you go about planning for sensorimotor development?

What sources of information do you draw on?

What resources are available to you in terms of planning for sensorimotor development?

Teaching and Learning

Where do you see sensorimotor development fitting into the curriculum?

What activities/games do you use to develop sensorimotor skills in your classroom?

Do you have any sense of the impact of sensorimotor development on children's learning?

Environment / Available resources and space

In what ways is your classroom environment suitable for the promotion of sensorimotor development?

What about the whole-school environment – indoors and outdoors?

Supports / Resources Available

In terms of supports / resources within school, what supports / resources do you see as being available to you for your work with the children relating to their sensorimotor development?

Are there any external supports or outside agencies available that you can draw on?

Teaching Priorities

Would you like to say something about your teaching priorities for your class?

In a normal year, where would sensorimotor development fit in?

Needs

What do you see as the priorities in terms of the needs of the children in your class in relation to sensorimotor development?

Responsibilities

Who is chiefly responsible for the development of children's sensorimotor skills, do you think?

What role does the classroom teacher have?

In-career development / pre-service preparation

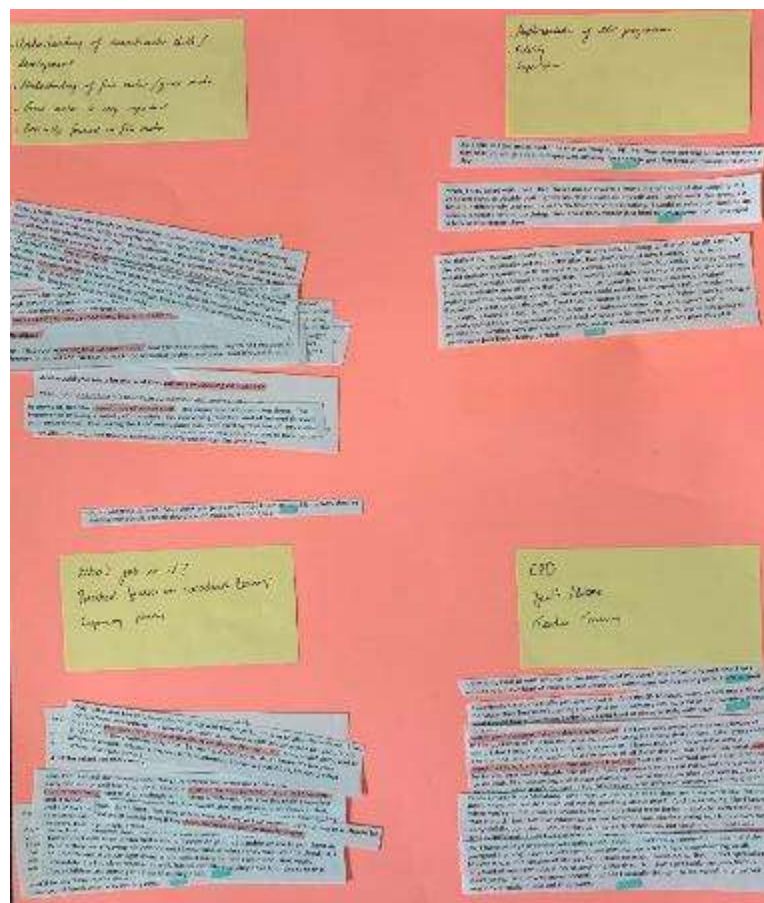
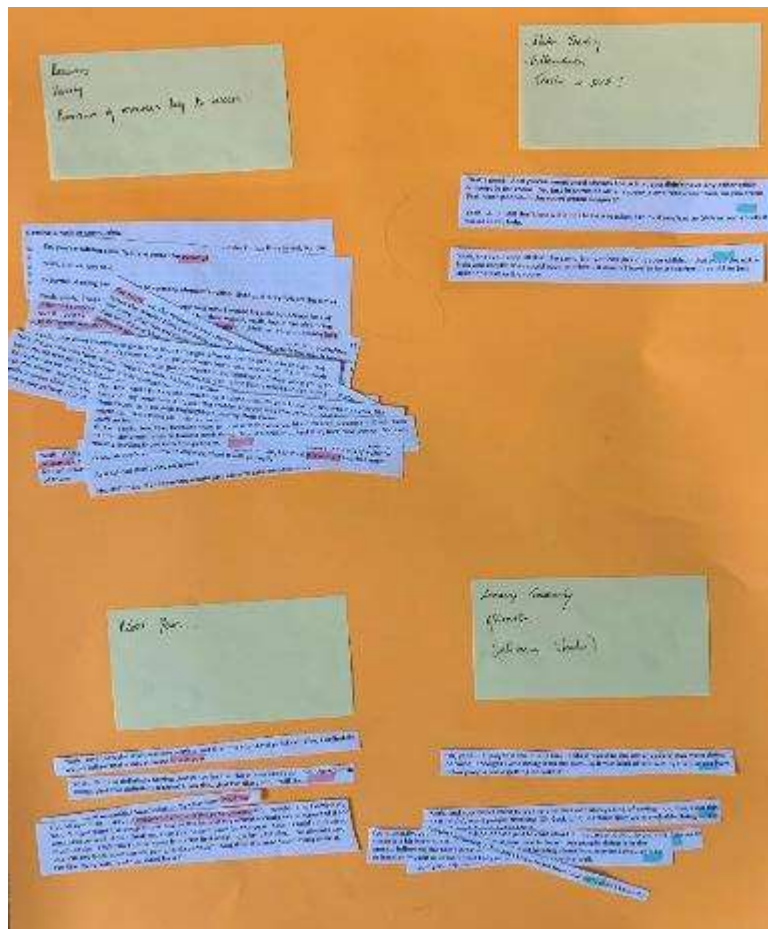
Would you like to say a word about your initial teacher education in the area of developing children's sensorimotor skills?

What kind of continuous professional development has been made available to you?

Concerns

Have you any concerns in relation to the teaching of sensorimotor development in your class?

Appendix K Manual Thematic Analysis of Qualitative Data



W. Hall's racing line straight
looking like an old night classroom
How Dear

4. 1941

4) King's College
with my children

1. *Agave*
 2. *Yucca*
 3. *Sp. 1*

Planning is a challenge to overcome.
- however, needed to be ready and
only available
- nothing as / organization.
Space

- Habitats
- Salinity
- Temperature
- Chlorophyll *Cyano*

Victor Tenny
William Tenny, clerk of court, London

Language

Appendix L BOT-2 Short Form

BOT 2

**Bruininks-Oseretsky Test
of Motor Proficiency, Second Edition**
Robert H. Bruininks, PhD, & Brett D. Bruininks

Year: _____ Month: _____ Day: _____

Test Date: _____

Birth Date: _____

Chronological Age: _____

Preferred Drawing Hand: Right _____ Left _____

Preferred Throwing Hand/Arm: Right _____ Left _____

Preferred Foot/Leg: Right _____ Left _____

☐ Dominant/Usual ☐ Ambile ☐ Mixed ☐ Unambidextrous

Examinee Name: _____

Sex: _____

Grade: _____

Examiner Name: _____

School/Clinic: _____

	Total Point Score	Scale Score Mean = 15, SD = 5 (Tables B.1-B.3)	Standard Score Mean = 50, SD = 10 (Tables B.4-B.7)	Confidence Interval: 90% or 95% (Tables C.1-C.4)		%ile Rank (Tables B.4-B.7)	Age Equiv. (Tables B.14-B.16)	Descriptive Category (Table C.13)
				Band	Interval			
1 Fine Motor Precision				+	-			
2 Fine Motor Integration				+	-			
Fine Manual Control	Sum			+	-			
3 Manual Dexterity				+	-			
7 Upper Limb Coordination				+	-			
Manual Coordination	Sum			+	-			
4 Bilateral Coordination				+	-			
5 Balance				+	-			
Body Coordination	Sum			+	-			
6 Running Speed and Agility				+	-			
8 Strength: Pushup: Knee Fall				+	-			
Strength and Agility	Sum			+	-			
Total Motor Composite	Sum			+	-			

Short Form

Push-up: Knee Fall

Total Point Score	Standard Score (Tables B.8-B.13)	Confidence Interval: 90% or 95% (Tables C.3, C.4)		%ile Rank (Tables B.8-B.13)	Descriptive Category (Table C.13)
		Band	Interval		
		+	-		

Complete Form

During the testing session, record the examinee's performance on each item.

After the testing session, convert each item raw score to a point score using the conversion table provided. For items needing two trials, convert the better of the two raw scores. Then, record the point score in the appropriate oval in the Point Score column.

For each subtest, add the item point scores, and record the total in the oval labeled Total Point Score and on the appropriate line on the cover page.

Short Form

During the testing session, record the examinee's performance on each Short Form item, listed on page 8.

After the testing session, convert each item raw score to a point score using the conversion table provided. For items needing two trials, convert the better of the two raw scores. Then, record the point score in the appropriate oval in the Point Score column.

Finally, add the item point scores for all 14 Short Form items, and record the total in the oval labeled Total Point Score and on the appropriate line on the cover page.

PEARSON

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PsychCorp

Short Form

Subtest 1: Fine Motor Precision		Raw Score										Point Score										
3	Drawing Lines through Paths—Crooked	errors	Raw	≥21	15-20	10-14	6-9	4-5	2-3	1	0	○										
			Point	0	1	2	3	4	5	6	7											
6	Folding Paper	points	Raw	0	1-2	3-4	5-6	7-8	9-10	11	12	○										
			Point	0	1	2	3	4	5	6	7											
Subtest 2: Fine Motor Integration		Basic Shape	Closure	Edges	Orientation	Overlap	Overall Size	Raw Score*														
2	Copying a Square	○	○	○	○	○	○	points	○													
7	Copying a Star	○	○	○	○	○	○	points	○													
Subtest 3: Manual Dexterity		Raw Score																				
		Trial 1	Trial 2																			
2	Transferring Pennies	pennies	pennies	Raw	0-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	○							
				Point	0	1	2	3	4	5	6	7	8	9								
Subtest 4: Bilateral Coordination		Raw Score																				
		Trial 1	Trial 2																			
3	Jumping in Place—Same Sides Synchronized	jumps	jumps	Raw	0	1	2-4	5												○		
				Point	0	1	2	3														
6	Tapping Feet and Fingers—Same Sides Synchronized	taps	taps	Raw	0	1	2-4	5-9	10												○	
				Point	0	1	2	3	4													
Subtest 5: Balance		Raw Score																				
		Trial 1	Trial 2																			
2	Walking Forward on a Line	steps	steps	Raw	0	1-2	3-4	5	6												○	
				Point	0	1	2	3	4													
7	Standing on One Leg on a Balance Beam—Eyes Open	seconds	seconds	Raw	0.0-0.9	1.0-2.9	3.0-5.9	6.0-9.9	10												○	
				Point	0	1	2	3	4													
Subtest 6: Running Speed and Agility		Raw Score																				
		Trial 1	Trial 2																			
3	One-Legged Stationary Hop	hops	hops	Raw	0	1-2	3-5	6-9	10-14	15-19	20-24	25-29	30-39	40-49	≥50	○						
				Point	0	1	2	3	4	5	6	7	8	9	10							
Subtest 7: Upper-Limb Coordination		Raw Score																				
		Trial 1	Trial 2																			
1	Dropping and Catching a Ball—Both Hands	catches		Raw	0	1	2	3	4	5												○
				Point	0	1	2	3	4	5												
6	Dribbling a Ball—Alternating Hands	dribbles	dribbles	Raw	0	1	2	3	4-5	6-7	8-9	10								○		
				Point	0	1	2	3	4	5	6	7										
Subtest 8: Strength		Raw Score																				
		Trial 1	Trial 2																			
2a	Knee Push-ups	push-ups	Raw	0	1-2	3-5	6-10	11-15	16-20	21-25	26-30	31-35	≥36	○								
OR (single one)	Full Push-ups		Point	0	1	2	3	4	5	6	7	8	9									
3	Sit-ups	sit-ups	Raw	0	1-2	3-5	6-10	11-15	16-20	21-25	26-30	31-35	≥36	○								
			Point	0	1	2	3	4	5	6	7	8	9									

Notes & Observations

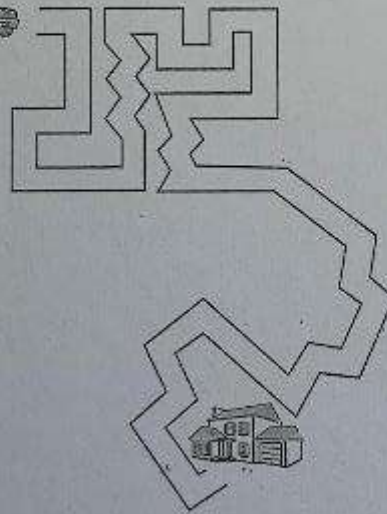
Total Point Score
Short Form

* Subtest 2: Fine Motor Integration: add the first score; record the sum in the Point column.

Subtest 1: Fine Motor Precision

Items 3 and 4: Drawing Lines through Paths—Crooked and Curved

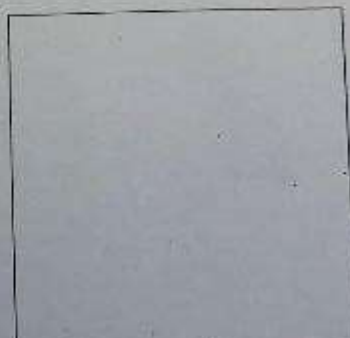
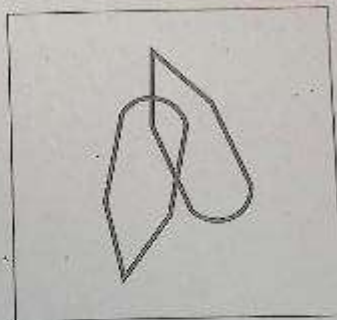
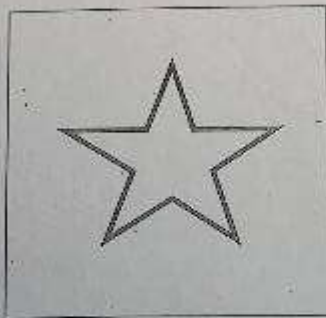
START



Subtest 2: Fine Motor Integration

Item 7: Copying a Star

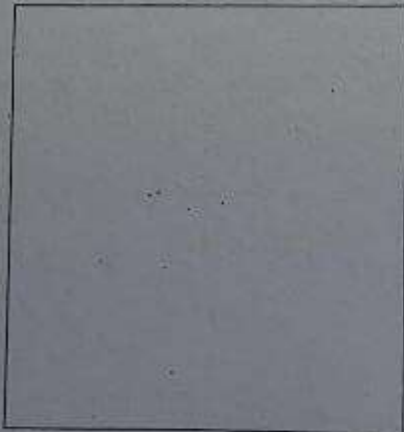
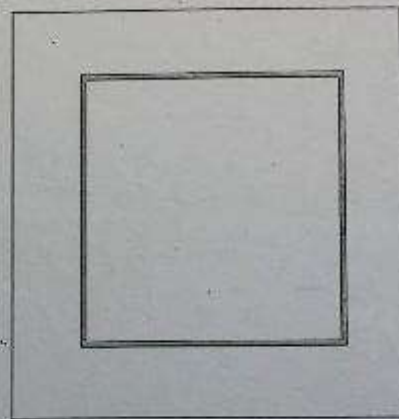
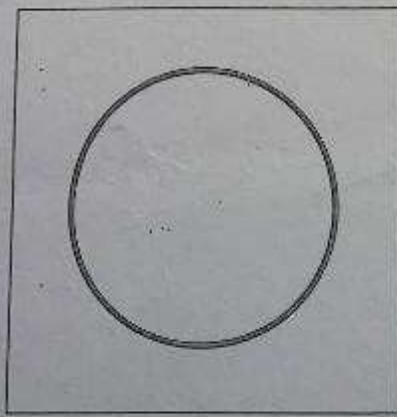
Item 8: Copying Overlapping Pencils



Subtest 2: **Fine Motor Integration**

Item 1: Copying a Circle

Item 2: Copying a Square



Appendix M List of Equipment for the Sensorimotor Handwriting Programme that was Emailed to Teachers

List of Equipment for the Sensorimotor Programme

- An array of writing materials (really important to vary and use things you wouldn't normally use!) – highlighters, scented markers, gel markers, markers, stampers, chalk, scented pencils, sharpies etc!
- A range of different coloured and sized paper and card as well as large sheets of white blank paper – the rolls of paper from IKEA are ideal.
- Good quality scissors – right and left handed! Great to include a range of different types and sizes of scissors to increase motivation.
- A range of putty type materials (try Tiger store) – foam putty, slime, silly putty, clay, play-doh (shop or homemade), Thera-putty (physio stores or special education equipment) – any type of soft, squishy dough basically!
- A range of different size tweezers and tongs and chopsticks– try places like B&Q, Home Store and More (or any homeware shops- kitchen section!). You can also buy specific children's plastic tweezers from the Art & Hobby store. Pipette's are great too for developing pincer grip and are great fun and can incorporate water play – I bought them in the Art and Hobby shop – they were called Twisty Droppers
- Construction toys –whatever you can afford to purchase, there are so many choice! I went for Octons and large Duplo blocks (important to start large before moving to small Lego pieces dependent on the child's ability) – interlocking construction materials are key. Try to choose toys that you don't have in the free play area / Aistear so that these ones are especially for handwriting time and are a bit different from the norm!



Appendix N ESAI 2020 Submission and Example of Slide from Conference Presentation

Abstract

(a) background/context

The focus of this paper is the interplay between sensorimotor development and the emergent handwriting skills of young children and the influence of sociocultural factors on motor development. The paper looks uniquely at the impact that a sensorimotor handwriting programme in the infant classroom has on the emergent handwriting skills of young children and on the practice, knowledge and perceptions of teachers in relation to sensorimotor development. This paper is significant because it hopes to highlight the socio-cultural aspect of sensorimotor development and its influence on the development of emergent handwriting skills.

(b) research aim/objectives

The over-arching research question for this paper is: What are the links between the environment, motor skill development and the emergent handwriting skills of young children? This paper seeks to address the following questions:

6. What is the current practice of teachers and preschool teachers in relation to the development of motor skills?
7. What are the current baseline measures of fine and gross motor skills of a sample of junior infant children in DEIS and non-DEIS schools?
8. What are the effects of a sensorimotor handwriting programme on the development of fine and gross motor skills and emergent handwriting skills of junior infant children?
9. Do sociocultural factors influence children's motor skill readiness in relation to emergent handwriting development in the infant classroom?

(c) methods and data sources, or equivalent for theoretical/conceptual papers

Phase one of this study sought to identify the baseline fine and gross motor skill competency of 200 children from DEIS and non-DEIS schools in Dublin using a standardised motor test - the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2; Bruininks & Bruininks, 2005). The fine manual control and gross manual control composites of the BOT-2 (Bruininks & Bruininks, 2005) were employed to measure fine motor and gross motor skills.

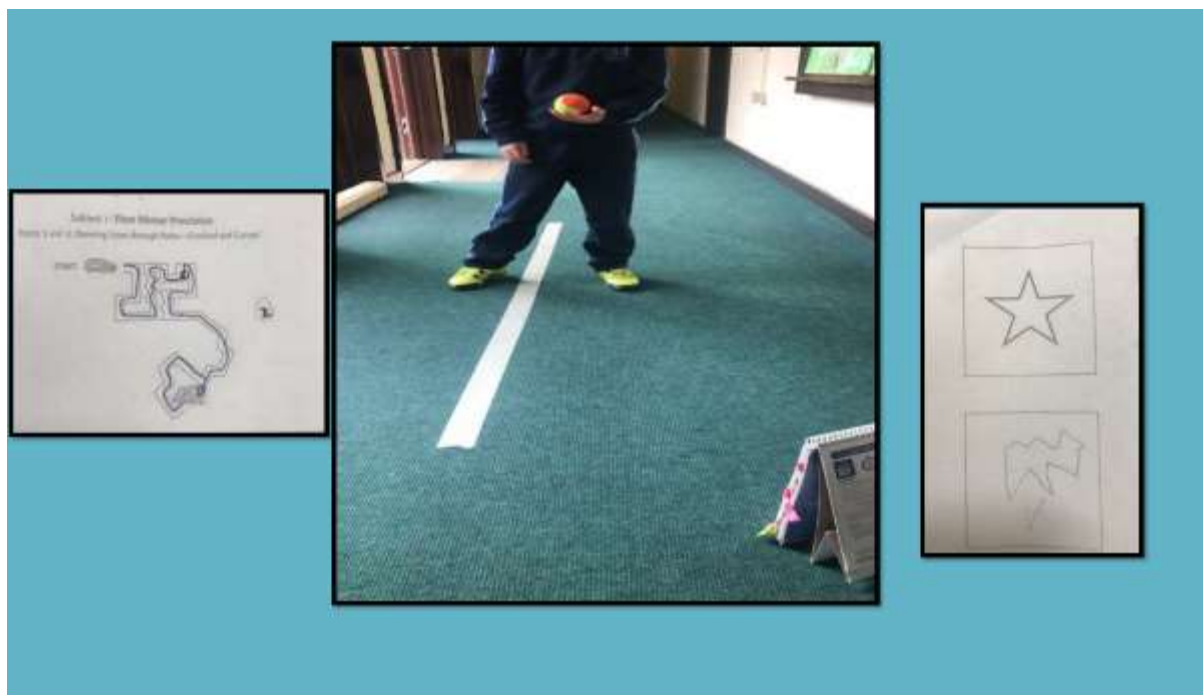
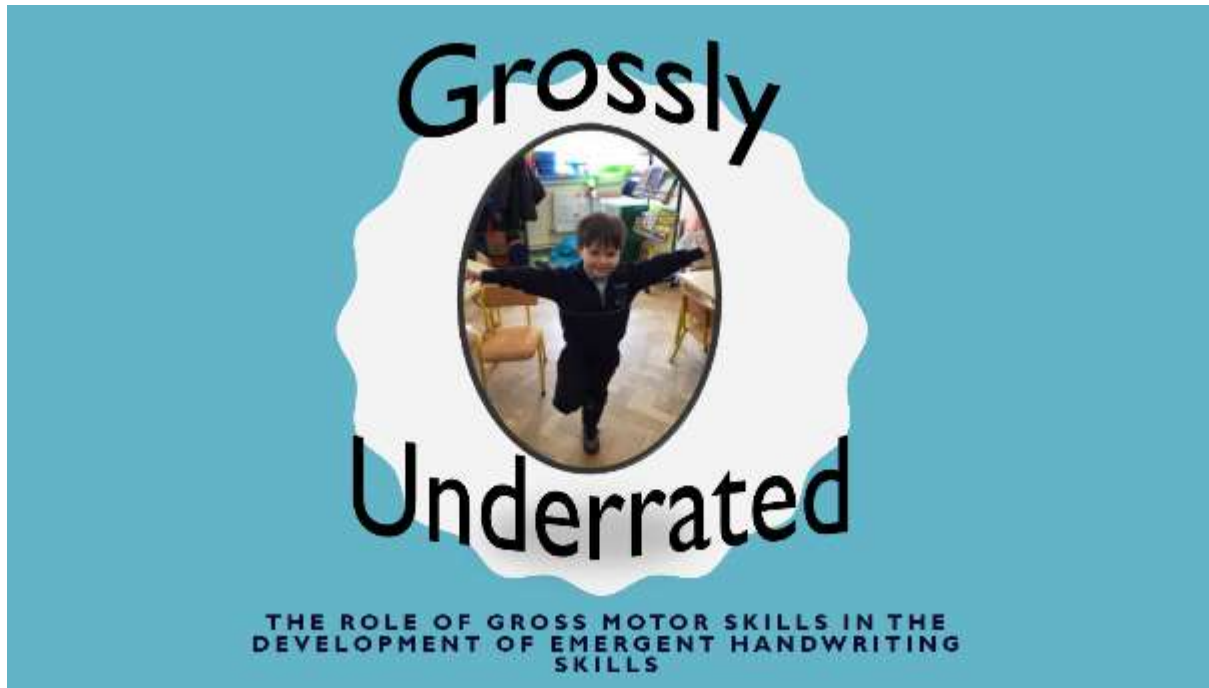
A sequential mixed methods strategy was employed during phase one. Information was gathered through the use of focus groups with preschool teachers. Surveys were used to gather the perceptions and practices of parents in relation to sensorimotor development during this initial phase also. The BOT-2 test results from this phase provided a rationale for the design and implementation of a sensorimotor handwriting programme in ten junior infant classrooms across the six participating schools.

In phase two of the study, data from Phase 1 was combined with the literature and the perceived needs of the subjects based on the standardised test results to design the sensorimotor handwriting programme that teachers implemented over a 16-week period (October 2018-March 2019). Post-implementation of the programme, children were retested using the standardised test and semi-structured interviews were employed with teachers to gather information relating to changes in perceptions, knowledge and practice in relation to motor development and emergent handwriting skills.

(d) key findings/takeaway points

1. Preliminary findings from phase one of this research show that over 50% of children in DEIS school scored below average on the BOT-2 test in comparison with 17% of children in non-DEIS schools
2. Preliminary findings indicate that all 10 teachers perceived the sensorimotor handwriting programme to improve the motor skills and emergent handwriting skills of the children in their classes
3. Preliminary findings indicate that the participating teachers will continue to embed sensorimotor strategies in their practice in relation to the teaching of handwriting

(EXAMPLE OF CONFERENCE PRESENTATION SLIDES)



Appendix O Examples of Responses from the Summer Course Discussion Forum on Module 3: Developing Emergent Writing Skills

Module 3 Discussion Forum I

Gross Motor Skills and Emergent Writing

⚙️ Settings

◀ Developing Emergent Writing skills

Gross Motor Skills ▶

Display replies in nested form ▼

Move this discussion to ... ▼

Move



Gross Motor Skills and Emergent Writing

by Deleted user - Tuesday, 3 August 2021, 8:38 PM

I found this module to be of outstanding quality in terms of educating me on how to approach the preparation of the child for writing. So much of the content resonated with me; the children I have encountered who had various difficulties with fine motor and writing activities and not being able to pinpoint the 'why' or the specific ways to help. It makes perfect sense that well-developed gross motor skills are a pre-requisite for acquiring fine motor skills but many of us teachers were not equipped to identify the physical deficits children have/present with that impact on their acquisition of fine motor skills- until now! Also, as was mentioned in the presentation, many of us have assumed that children have acquired skills and age-related milestones but we are now discovering this may not be the case for many. I also think that parents would benefit HUGELY from the information in this module as they would see, in a very concrete way, the impact that children's lifestyles are having on their ability to learn and acquire skills!

Module 3 Discussion Forum I

Gross Motor Skills

⚙️ Settings

◀ Gross Motor Development

Gross Motor Skills ▶

Display replies in nested form ▼

Move this discussion to ... ▼

Move



Gross Motor Skills

by Deleted user - Thursday, 22 July 2021, 2:59 PM

Before completing this module I hadn't taken much consideration for gross motor skills in relation to handwriting, but now I can see that it is a very important aspect of handwriting development. The examples given of the impact of gross motor development such as posture and spatial awareness when it comes to handwriting have really made me think about just how essential it is. I will be sure to spend more time on gross motor skills this year and try to incorporate gross motor movement breaks etc. I also like the layout of the handwriting lesson beginning with a gross motor activity and then progressing on to a fine motor activity and handwriting.

A combination of increased urbanization of areas and the increased popularity of video games and devices have led to the decline in children's motor development. We now need to be focusing on gross motor skills that in the past the majority of children would have developed through their own play outside of school.

Module 3 Discussion Forum 1

Gross Motor Skills

Settings

Module 3

Gross motor skills

Display replies in nested form

Move this discussion to ...

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Gross Motor Skills

by Deleted user - Monday, 26 July 2021, 9:30 AM

I have to be honest and say that I didn't see the connection between gross motor development and emergent writing skills. The module was extremely informative and has given me great scope for this school year. I had always focused on fine motor skills for writing development but never gross motor apart from PE lessons. Having completed the module I can now see the huge role that gross motor plays here. I can also now see that many children are not developmentally ready for the junior infant curriculum and there are definitely hurdles that need to be overcome first, more so now than ever due to Covid.

I absolutely feel that technology has a huge part to play in their readiness. I don't think children nowadays play like we did. I was always outside, the TV had 2 channels that everyone fought over to watch. Being outside was much more fun for us anyway, I don't ever remember using the word "bored" as a child. My favourite activity as a child was making obstacle courses with my sister which we would take part in ourselves and then train the dogs to do it!! We were always able to entertain ourselves.

When I started teaching (17 years ago) children were able to do a lot for themselves but in the last 5 years I can see that children are very immature coming to school despite being that little bit older. I'm constantly asked to put on a coat, tie a shoe lace (the mind boggles as to why parents buy them when they can't tie them), open a yogurt or a frubie, or clean up the mess when they spill it/burst it...the list is endless really. This all takes time out of the school day and I feel it puts more pressure on the already overworked and stressed teacher.

I'm really excited and looking forward to using the 16 week programme. It is so well structured and the resources needed are already in my room. Thank you for sharing this with us Sinead!

Module3 Forum 1

Settings

Group F - Response Thread: Module 3, Forum 1

Display replies in nested form

Move this discussion to ...

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Module3 Forum 1

by Deleted user - Tuesday, 6 July 2021, 9:37 PM

Although I was aware that gross motor skills had some influence on emergent handwriting skills in infant children I actually didn't realise the extent of it until this module. I suppose it is obvious when you really think about it that gross motor skills should be developed before focusing on the fine motor skills. Taking this into consideration and reflecting on my own experience I feel that children generally are not developmentally 'ready' to access the curriculum in Junior Infants. In my school there is definitely a bigger emphasis placed on fine motor skills in Junior Infants. The SET team do take groups of children for gross motor skills but these are the children that are on school support plus or have a physical disability. After completing this module I feel that all children need access to more gross motor skills especially in term 1 of Junior Infants otherwise it really is a case of putting 'the cart before the horse' by focusing on fine motor too much and too soon. I notice it is the little things that Teachers take for granted that the children tend to struggle with, for example at sports day this year when asked to skip instead of run many of the children hadn't a clue how to skip, the older children were given skipping ropes and again some children were puzzled as to what to do with them. Children just don't get the same opportunities to play anymore, life can be too busy. As a child I spent more time up a tree than in front of a screen and such activities are completely alien to many children today due to many different factors. I do think however that we can incorporate gross motor without even realising we are doing it for example in Maths when counting with Junior Infants I often use a large soft ball, I throw the ball to a child and they start off by saying 'one' they throw it to another child who shouts 'two' and so on. Jumping and sitting when counting also. Gross motor can be incorporated into the topic of well-being by using various meditation techniques/poses or in the socio-dramatic area by acting out a scene of a story...i.e. Going on a Bear Hunt. When you keep in mind the need to incorporate gross motor skills into your day there are many opportunities to do it in a meaningful way.

Appendix P Ethical Approval

Ollscoil Chathair Bhaile Átha Cliath
Dublin City University



Ms Sinéad Lambe
School of Human Development

2nd May 2018

REC Reference: DCUREC/2018/094
Proposal Title: An exploration of the motor development and emergent handwriting skills of young children
Applicant(s): Ms Sinéad Lambe, Dr Órla Ní Bhroin

Dear Sinéad,

Further to expedited review, the DCU Research Ethics Committee approves this research proposal.

Materials used to recruit participants should note that ethical approval for this project has been obtained from the Dublin City University Research Ethics Committee.

Should substantial modifications to the research protocol be required at a later stage, a further amendment submission should be made to the REC.

Yours sincerely,

A handwritten signature in blue ink that reads 'Dónal O'Gorman'.

Dr Dónal O'Gorman
Chairperson
DCU Research Ethics Committee



Taighde & Nuálaíocht Tacaíocht
Ollscoil Chathair Bhaile Átha Cliath,
Baile Átha Cliath, Éire

Research & Innovation Support
Dublin City University,
Dublin 9, Ireland
T +353 1 700 8000
F +353 1 700 8003
E research@dcu.ie
www.dcu.ie

