AN INVESTIGATION INTO HOW INTERVENTIONS CAN HELP SUPPORT YOUNG CHILDREN'S PHYSICAL DEVELOPMENT.

by

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Abstract

This thesis aims to investigate how tailored interventions within the Scheme of Work (SOW) can support young children's physical development (PD); through the creation of a bespoke SOW that enhances both fine motor skills (FMS) and gross motor skills (GMS), core strength, and coordination using movement-based MC interventions. These elements form the key pillars around which the SOW is built, with the goal of enabling children to meet the Early Years Foundation Stage (EYFS) developmental milestones and enhance their overall PD.

Conducted over three academic terms, totalling 19 weeks, the study involved a longitudinal case study design. Interventions within the SOW were implemented and evaluated at six points during this period to assess effectiveness and make adjustments. Data collection included qualitative observations focused on FMS and GMS development.

Statistically significant improvements were observed in various aspects of GMS and FMS following the implementation of motor competency interventions within the SOW. Notable improvements were seen in hopping, running, galloping, sliding, dribbling, rolling a ball, climbing, balancing, kicking, catching, and using scissors ($p < 0.05$). However, no significant improvements were found in the use of cutlery ($p > 0.05$).

The study underscores the importance of holistic approaches to PD, taking into account individual differences. It highlights the crucial role of educators in providing personalised support to facilitate each child's progression in PD. Early intervention in PD is emphasised as critical, aligning with researchers like Heckman, Stixrud, and Urzua (2006), who stress the early years as a key period for shaping long-term outcomes.

The findings advocate for strategically planned motor competency interventions, coupled with practitioner observations, to achieve longitudinal improvements in PD. The study recommends nationwide implementation of similar approaches to improve PD outcomes, ensuring children are equipped with the necessary skills to access the Key Stage 1 National Curriculum within the English educational system.

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List of abbreviations

AFPE	*Association for Physical Education*
DfE	*Department for Education*
ELGs	*Early Learning Goals*
ET#	*End of term #*
EYFS	*Early Years Foundation Stage*
FMS	*Fine motors skills*
GEE	*General estimating equations*
GMS	*Gross motor skills*
KS1	*Key Stage 1*
MC	*Motor competency*
PA	*Physical activity*
PD	*Physical development*
PE	*Physical education*
SC	*Success criteria*
SH	*School holidays*
SOW	*Scheme of work*
SR	*School readiness*
ST#	*Start of term #*
T#	*Term #*
WHO	*World Health Organisation*

1: Introduction

1.1 Myself as the researcher

I will refer to myself as the researcher throughout this thesis. I am a qualified primary school teacher who has been working in a small one form entry Church of England primary school as a year 3 class teacher and have since become Physical Education (PE) subject lead. This role has provided me with ample opportunities to support external school games and regional competitions, run sports clubs with a variety of year groups as well as assist with children's growth and development through listening to, understanding and acting upon their pupil voice. I have previously conducted research into what effect the pandemic has had on the physical development (PD) of reception age children, which was published in The Association of Physical Education, Physical Education Matters journal (Huggett and Howells, 2022) and later presented at the International Association of Physical Education in Higher Education (AIESEP) 2022 and 2023 conference.

1.2 Previous research; the impact of the pandemic on the physical development of young children

According to Kay (2021), there was a deficit of research on the impact of the COVID-19 pandemic on the PD of young children in the Early Years Foundation Stage (EYFS), as most studies tend to concentrate on the psychological well-being of the children. The EYFS is the statutory framework for early years education and care settings within England, which sets the standards for learning, development, and care of children up to the age of five years (Department for Education, nd) (DfE). My earlier study sought to disseminate the knowledge gained regarding the impact of the pandemic on young children's PD.

Thirteen of the twenty-seven children in the case study were four years old, and fourteen were five. The research was entirely based on observations, as is customary within this age group of children, and the observations were completed solely by the researcher. This research and completed structured observation sheets focusing on the aspects of fine motor skills (FMS) and gross motor skills (GMS) found within early learning goals (ELGs) (DfE, 2021).

Overall, the findings highlighted that children's developmental stages trailed behind those expected for their age and therefore a large number of young children were failing to meet age related PD expectations demarcated in ELGs within the EYFS (Huggett and Howells, 2022). Children failed to successfully negotiate space (n = 10) and appeared clumsy when moving (n = 7). Their poor hand and eye coordination was evident in their inability to display FMS, such as correctly holding a pencil (n = 18) or using cutlery to stab food (n = 9). This may be due to be attributable to a major decline in child participation levels in PA as a result of nationwide lockdowns and school closures during the COVID-19 pandemic. Huggett and Howells (2022) emphasised the necessity for a tailored support plan which strives to develop both FMS and GMS to upskill the children to meet developmental targets. To do this, Huggett and Howells (2022) further stressed that educators required both guidance and assistance on how to best involve children in a wide range of captivating activities that further develop PD in impacted areas.

1.3 Current research

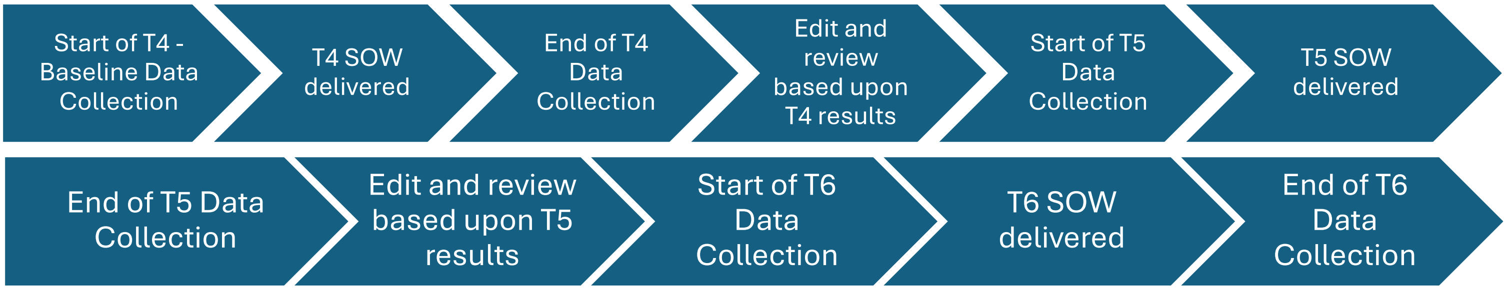
This research follows on from previous data collected (Huggett and Howells, 2022), and involves the observation of the same sample group of students on whom this prior research was based over a prolonged period, forming a longitudinal case study sample (Caruana, Roman, Hernández-Sánchez and Solli, 2015). Therefore, this study provided an opportunity to examine the data collected in the previous study (Huggett and Howells, 2022) in order to create a customised scheme of work (SOW) containing MC interventions to target and improve these children's PD weaknesses.

Additionally, the recommended next steps, in order to overcome the lack of PD in these children, require PD educators needed guidance on how to effectively involve children in a variety of activities that enhance PD in the impacted areas (Huggett and Howells, 2022). Furthermore, Huggett and Howells (2022) added that these children required a tailored plan that attempted to assist in strengthening both their FMS and GMS to drive them to reach EYFS developmental milestones before moving into Key Stage 1 (KS1). These children are now in

Year 1 yet it can be argued, based upon previous research undertaken in 2022, that they are not developmentally ready to be in KS1 (Huggett and Howells, 2022).

Therefore, this study acts upon previous recommendations, by Huggett and Howells (2022), and developed a SOW, based upon recently released government guidance, specifically aiming to develop the skills which my previous research found the children to be developmentally behind in. After the MC interventions within the SOW had been thoughtfully planned, the timeline of the study was developed (seen below in Figure 1).

Figure 1: The study timeline



The timeline above demonstrates how and when data was collected. Baseline data was gathered at the beginning of term 4 (T4), the SOW was then delivered, and further data was later collected during the last week of T4. This made it possible for me to pinpoint any progression or regression that transpired throughout the duration of T4's SOW or the school holidays (SH). This allowed me to modify the subsequent SOW (for terms 5 and 6) with the intention of developing the PD components that the children were either deficient in or showing only minor development in, making it an iterative process which changed depending on the needs of the children. The same procedure was then repeated for terms 5 (T5) and 6 (T6).

1.3.1 Why is this research important?

It is hard not to acknowledge that the pandemic had an impact on children's motor development, due to lack of movement opportunities, however, motor competency levels were also lower than anticipated before the pandemic and since the pandemic. The focus of this thesis is not on the impact of the pandemic, but it does show awareness of it.

Therefore, it is important to note the consequences of the pandemic which were characterised by Timmins (2021, pp.4) as ‘’the most disruptive period in children’s education since at least the start of the Second World War’’, many of the problems associated with young children’s PD existed prior to the pandemic. Despite the fact that regular physical activity (PA) promotes both mental and physical health, The World Health Organisation’s (WHO) recommended PA requirements were not met by more than 80% of children in 2022, post pandemic (WHO, 2020). However, many of the problems associated with young children’s PD existed prior to the pandemic, just 53.2% of children met WHO’s PA guidelines in 2018, prior to the pandemic (Sport England, 2019). Furthermore, in 2018, 2.1 million children (or 29.0%) were participating in less than 30 minutes of PA each day (Sport England, 2019).

Early childhood PA engagement alongside physical and motor development are the cornerstones of long-term psychological and physical well-being (Schmutz *et al*., 2020). As mentioned above, FMS and GMS are crucial for future PA levels, since participation in PA during the younger years can promote the development of FMS and GMS, which in turn enhance engagement in life-long PA (Stodden *et al*., 2008). Evidence also suggests that FMS and GMS play an important role in school readiness (SR) (Jones *et al*., 2021). However, according to Public Health England (2021) only 65.2% of children achieve a good level of PD by the end of reception. Jones *et al*. (2021) gathered data from 326 four and five-year-old children in the northeast of England for a cross-sectional investigation to examine the association between being physically active, having ‘good’ FMS and GMS, and being school-ready. According to a regression analysis of their findings, motor-skill characteristics and sedentary behaviour were strongly predictive of SR, unlike PA (Jones *et al.,* 2021). They continue to explain that sedentary behaviour and motor skills both strongly influence SR and that as a result, encouraging motor skills and developmentally suitable sedentary behaviour activities may improve the number of young children who are deemed as school ready. With sedentary behaviour being defined ‘as time spent sitting or lying with low energy expenditure, while awake, in the context of educational, home, and community settings and transportation' by WHO (2020b). The WHO (2020b) highlighted that sedentary behaviour is very important for development and can take many forms such as quite play.

During the pandemic, several paediatric organisations, such as Healthy Children (nd) and UNICEF (nd), emphasised the significance of play—both indoor and outdoor—to enhance PA. My previous study showed that many children were not reaching the age-related PD standards established in ELGs within the EYFS (Huggett and Howells, 2022). Results found that 19 out of 26 children struggled, or were unable, to hop forwards four times in a straight line due to poor GMS and that 15 out of 27 children struggled, or were unable, to use the tripod grip to hold a pencil due to poor FMS (Huggett and Howells, 2022). Furthermore, 3 out of the 9 children observed had difficulty taking their food to their mouth whilst eating, showing poor levels of hand-eye coordination. This may be attributable to a substantial decline in children's participation levels in PA brought on by widespread lockdowns and school closures. These findings reinforce Dunton's (2020) earlier results, which stated that the pandemic reduced children's potential for engagement in PA resulting in a negative impact upon multiple other factors, such as PD. It is vital for children to be developmentally ready for their transition to KS1 to access the full curriculum. For instance, Lazarus (2021) examines the effects that children's poor hand-eye coordination can have on a variety of activities, explaining that this can cause issues with learning to read and write as well as with playing sports since it makes it difficult to hit or catch a ball. Additionally, difficulties with academic challenges might result from inadequate hand-eye coordination as it may affect an individual's ability to pay attention (Lazarus, 2021). Furthermore, Teach Handwriting (nd) explain that a child's handwriting may suffer from an improper pencil grip, which can also impose unneeded stress on the hand's ligaments and muscles (Teach Handwriting, nd). This makes writing difficult since the hand becomes stiff or cramped and rapidly gets tired, ultimately becoming very discouraging for children and consequently preventing them from producing the necessary volume of written work (Teach Handwriting, nd). This can prove challenging for children when they are required to use diagonal and horizontal strokes that are required to join letters in order for them to meet end of year expectations in year 3 (DfE, 2014).

1.4 Research aims

The aim of this study is to investigate how interventions can support young children's PD through the creation of a bespoke SOW. This SOW is designed to develop FMS, GMS, core strength, and coordination, using movement-based MC interventions. These elements form the key pillars around which the SOW is built, with the goal of helping children meet EYFS developmental milestones and enhance their overall PD.

Chapter 2: Literature Review

The purpose of this literature review is to outline, review and critique the related areas to how interventions can help support young children's PD. The literature reviews the current key definitions of PA, PD and motor competency (MC) and the importance of these. This chapter will further focus on low socio-economic status and SR; the ELGs and the national curriculum; core strength and co-ordination; GMS; FMS; the impact of SH on motor skill development.

2.1 What is Physical Activity and why is it important?

Any 'physiological movement' generated by muscles that requires energy expenditure is referred to as PA, according to the World Health Organisation (WHO) (nd). Any movement is regarded as physical exercise, whether it is undertaken for enjoyment, transportation, or work (WHO, nd). A systematic research review by Veldman *et al.* (2021) demonstrated that more engagement in PA contributes to improved MC and cognitive development in the early years. Timmons *et al*. (2012) also recorded a positive relationship between PA and adiposity. Across observational studies made by Carson *et al*. (2017), PA was consistently associated with fitness, desirable motor development and bone and skeletal health. Light and moderate levels of PA were not consistently linked to any health indicators, but moderate to vigorous levels, vigorous levels, and overall levels of PA were consistently positively linked to a number of health indicators (Carson *et al.,* 2017). According to Stanford, Davie, and Mulcahy (2021), early PA is influenced by the child's age and physical ability, and by engaging in this PA, children are able to achieve significant developmental milestones earlier than other individuals who do not engage in the same quantity of PA. According to PA recommendations made by The Department of Health and Social Care (2019), PA refers to a variety of activities, such as cardiovascular, muscular and bone strengthening, and balance training and is characterised further by Miles (2007) as dependent on intensity, frequency, and duration.

The Early Years Foundation Stage (EYFS) framework (DfE, 2021) explains that PA is crucial for a child's general development, allowing them to lead content and active lives. According to Mader (2022), various researchers have discovered that play often found within the EYFS is a natural and vital aspect of a child's development, although it is often overlooked. Houser *et al.* (2016) elucidate that child-initiated play within early years settings allow young children to connect with their surroundings in a variety of ways, including PA involvement. Active outdoor play can improve social skills, motor development, and PA (Barnes *et al.,* 2016). Although there are several ways to define play, active play may be defined as any sort of unstructured PA engagement (Oncu, 2015).

PA is a term that is often confused with 'exercise' and 'physical fitness', partially because these terms are somewhat interchangeable (Caspersen, Powell and Christenson, 1985). Although the primary focus of this study is on PD and young children, it is helpful to consider other concepts that are closely related to PD (which will be discussed in more detail below), such as PA, physical fitness, school sports, and PE. AS PE lead, it's been noticed that the aforementioned are frequently confused within a primary school setting by both teachers and children as they are related notions that intersect in the realm of movement and health. These terms are frequently confused and misinterpreted as they commonly overlap in their objectives and outcomes. For instance, PE curriculums often include components of health, PA, PD, physical fitness as well as play (Association for Physical Education, 2015) (AFPE). Similarly, engaging in regular PA can contribute to both PD (such as improving FMS and GMS) and physical fitness (such as increasing cardiovascular endurance). From an educators perspective, I believe this interconnection between the terms tends to contribute to the confusion, especially when discussing them in different contexts or disciplines.

According to Whitehead (2019), the meaning of PE varies from person to person, hence its purpose is contested, which could potentially be the cause for children's confusion. As noted by McKenzie (2001), in the past, PE has been compared to a chameleon that frequently changes its colours in response to many individuals' differing interests and priorities. However, USports (2021) state that despite their similarities, PA and PE have distinct variances that should be recognised. They make it clear that the phrase "physical activity" refers to a variety of body motions (USports, 2021). This includes less formal activities such as walking to school as well as PE and school sports. However, the goal of PE is to teach the individual a new skill which will frequently be accomplished over a series of coordinated lessons to aid in the development of a new skill (USports, 2021). Nevertheless, it should be noted that Ofsted (2022b) explain that the careful selection and sequencing of content necessary to physically educate every learner so that they know more and can do more cannot be replaced by extracurricular activities, such as school sports. Additionally, USports (2021) state that school sports include PA, but they will also incorporate additional extracurriculars, for instance, a competition between local schools. PA has been demonstrated to be beneficial for academic success (Williams, 1988), intellectual performance, focus, memory and classroom behaviour (Trudeau and Shephard, 2008). PA is a complex, multi-dimensional behaviour that encompasses the full scope of movement from transportation to and from places, exercise and competitive sport (Miles, 2007, Howells, 2012). This ambiguity of language is seen within the Lords Committee (National Plan for Sport and Recreation Committee, 2021), which refers to sport as organised competitive games, and the All-Party Parliamentary Group on Fit and Healthy Childhood (2019), which refers to movement as PA. Additionally, within the EYFS there is a key focus placed on PD (DfE, 2021) but this disappears as children to progress into Key Stage one (KS1) and the focus is just on 'PE' with an emphasis on performing dances, partaking in team games, and mastering fundamental movements. According to DfE (2023a), GMS and FMS development are crucial since they lay the groundwork for the development of 'healthy bodies as well as social and emotional well-being' (pp.10). Which then raises questions; why is PD suddenly less important when children enter KS1? What if children do not meet PD expectations within EYFS?

According to the WHO (2019), if young children under the age of 5 years are to grow up healthy, they must spend less time watching devices or being confined to strollers, obtain more quality sleep, and participate in greater levels of active play. Children aged 3 to 4 years should participate in at least 180 minutes of a variety of PA, with at least 60 minutes being moderate- to vigorous-intensity PA throughout the course of a day (WHO, 2019). It is a further recommendation by WHO (2020a) that adolescents, aged 5 to 17 years, engage in an average of 60 minutes per day of moderate-to-vigorous intensity, mostly aerobic, PA over the course of the week. It should be noted that this is less than the above recommendation of 180 minutes of engagement with PA throughout the course of the day, of which 60 of that should be moderate-to-vigorous intensity, for 3–4-year-olds. Furthermore, it is recommended by the NHS (2021) that they engage in muscle and bone strengthening activities, at least three days per week. The National Institute of Health (2018) explain that the very optimum period to invest in bone health via PA and nutrition is throughout childhood since up to 90% of peak bone mass is acquired by males and girls by ages 20 and 18 years, respectively. This is especially important since childhood PA protects against poor bone density, diseases, and loss of physical function later in life and improves bone strength and density in adulthood (Weaver *et al.,* 2016). Muscle and bone health are therefore essential elements of PA that each separately contribute to overall health and functional capacity and can provide lifetime advantages (Chlakley, Thompson and Clark, 2021), which is why it is important that children of this age participate in muscle and bone strengthening activities no less than three times per week (WHO, 2020).

2.2 What is Physical Development and why is it important?

A child's increasing capacity to utilise their body and their physical abilities is referred to as their motor development, which is a crucial component of their overall PD (Wisconsin Department of Health Services, nd). One of the seven areas of learning and development included in England's EYFS Statutory Framework is PD (DfE, 2014). Along with communication and language development, and personal, social, and emotional development, PD is recognised as one of the key domains (DfE, 2014). Howells *et al*. (2018) elucidate that within the specialised fields of reading, mathematics, understanding the world, and expressive arts and design, these key topics are intertwined and interrelated. PD is defined by DfE (2014a) as integrating and producing possibilities that allow children to be both 'active and interactive' (p. 24); and to improve their co-ordination, movement, and control in the EYFS statutory framework.

PD is further defined by the Virtual Lab School (nd) as the progression and refinement of motor skills and that it is also one of the most important aspects of early childhood growth and development. The Welsh Governments Health, Social Care and Children's Services (nd) add to this by elucidating that PD is generally classified as either growth or development and that growth refers to physical changes such as a rise in height, weight and size. Therefore, development is the process via which children gain control of their bodily motions, allowing them to perform intricate activities with increasing efficiency and speed (Health, Social Care and Children's Services, nd).

According to the ELG of PD which is split into two (GMS and FMS), the focus is not just on the children's physical actions but also on their ability to comprehend the options and choices they are presented with (DfE, 2023a). For example, according to the DfE (2024), an example of surpassing the ELGs is that children may confidently jump and skip in time to music, or they can keep the paper firmly in place while writing using a proper pencil grip and regulating their letter size. This illustration emphasises the significance of paramount movement abilities and the necessity of including both FMS and GMS into PE lessons and PD activities to promote and advance these learning areas (Howells *et al*., 2018). It has been demonstrated that a young child's PD levels further affect their readiness for school, behaviour, social development, and intellectual success (Duncombe and Preedy, 2021).

FMS and GMS are explained by Early Movers (nd): GMS include the capacity to regulate significant bodily motions involving vast muscle groups, as well as core stability and alignment, such as pushing, pulling, rolling, crawling, walking, and sitting. FMS, on the other hand, are physical skills that include oblique muscles and hand-eye coordination which are generally more controlled and accurate (Early Movers, nd). According to Michigan State University (2016), FMS and GMS are essential for children to engage in during their developmental years as they aid in coordinating and regulating their body movements. GMS also serve to establish the foundations for FMS such as pinching, squeezing and holding (Michigan State University, 2016).

The EYFS framework (DfE, 2021), discusses that GMS and FMS develop gradually throughout early childhood, beginning with sensory experimentations and the advancement of a child's positional awareness, cohesion, and strength through activities such as crawling and play with both toys and adults. Adults are able to help young children improve their stability, equilibrium, core strength, spatial and situational awareness, agility and co-ordination by using imaginative activities and providing opportunities for play both indoors and outdoors (DfE, 2021). The recent resources provided by the government with the aim to help and support early years providers the ELG of PD has been split into three main groups 'based upon educational programmes' (DfE, 2022): core strength and co-ordination, GMS and FMS. Yet, it is interesting to note that neither core strength or coordination are named within the PD ELGs.

In the early years, children's capacity to perform movement skills increases rapidly as they begin to learn, improve, and develop a variety of GMS and FMS (Gallahue, Ozmun and Goodway, 2012). However, children need movement opportunities to enable these (DfE, 2023a). There have been questions surrounding the effect of gender on motor competence (MC), research indicates that females acquire FMS quicker than boys while boys acquire some GMS earlier than girls (Bala and Kati, 2009). Boys displayed overall MC superior to girls, in international research conducted in South Africa using the same assessment methodologies as employed in Bala and Kati (2009) study, and outperformed girls considerably (Pienaar and Kemp, 2014). In addition, studies from the USA and Indonesia carried out by Goodway *et al.* (2014) and from Germany and Switzerland conducted by Herrmann *et al.* (2015) reveal that girls exhibit lower levels of MC than boys. In their extensive analysis of research from across the world, Golding *et al.* (2014) further elucidate that girls demonstrate lower levels of motor ability than boys. On the contrary, Middle Eastern researchers Pahlevanian and Ahmadizadeh (2014) and British researchers Morley *et al.* (2015) found that when FMS are assessed in preschool-aged children, girls outperform boys. However, it is believed that between the ages of three and six, there is a large range of individual variances in MC development across genders and ages (Kokštejn *et al*., 2017). Paradoxically, Navarro-Patón *et al.* (2021b) illustrate that it is widely known that boys and girls acquire MC in the same sequence especially regarding young children (Venetsanou and Kambas, 2011). Therefore, as all the children were approximately the same age and in the same class, all the children within the sample were included as a whole group as a whole class approach to the interventions were taken.

2.3 What is motor competence?

According to Malina (2014) MC is the development of capability and proficiency in body movement activities. MC is further used to refer to an individual's ability to perform the many fundamental movement skills required in day-to-day life, such as tying shoelaces, fastening buttons or travelling to and from school, including FMS and GMS (Henderson, Sugden and Barnett, 1992).

MC is considered as a crucial skill facilitating accurate and coordinated movements, greatly enhancing everyday functions and overall performance (Canli *et al.,* 2023). By researchers, MC is often viewed as an umbrella term (Gabbard, 2021) which generally includes fundamental movement skills such as locomotor, object control and stability skills (Stodden *et al.,* 2008). Health and physical fitness identifiers, such as body weight, levels of PA, and perceived MC, can be closely associated with MC in early years (Cattuzzo *et al*., 2016 and Lubans *et al.,* 2010).

Flôres *et al.,* (2019) explain that the initial 5 years of an individual's life are considered to be a key period of development of physical competence where FMS and GMS must be developed within learning environments, with intent (Gallahue, Ozmun and Goodway, 2012). Elucidating that the development of MC should be of the upmost importance and interventions (Logan *et al*., 2012) are key as the expected level of MC is highly unlikely to be met without proper practice and feedback (Gallahue, Ozmun and Goodway, 2012). MC serves as a foundation in overall PD, encompassing FMS and GMS, influencing the acquisition, advancement, and incorporation of movement skills in several domains. Through the implementation of early interventions that promote the development of MC and offer opportunities for movement exploration and practice, as those outlined in this study, educators can facilitate the development of lifetime motor skills and holistic development in young children.

2.3.1 The importance of motor competence interventions

Fundamental movement skills are a building block for MC development (Pope *et al.,* 2011). MC interventions aim to then build the foundations for fundamental movement skills required for athletic involvement in school and in later life (Jones *et al.,* 2011). PD and maturation independently do not result in GMS and FMS competence; rather, extrinsic elements such as instructional procedure, practice, and reinforcement play an important role in motor skill development (Brian *et al.,* 2019). According to longitudinal research conducted by Branta *et al*., (1984) into age changes in FMS and GMS during childhood, MC develops throughout childhood (Branta et *al.,* 1984) demonstrating that reduced MC may continue into later life; hence, customised interventions should take place throughout childhood (Khodaverdi *et al*., 2022). Moreover, MC interventions can improve relationships with peers (Wagner *et al.* 2012), independence (Van der Linde *et al*. 2015), a child's ability to play (Cairney *et al*. 2010) and positively influence their academic achievement (Cameron *et al*. 2012). Furthermore, on average, children who partake in PD interventions achieve approximately five further months growth in cognitive outcomes (Education Endowment Foundation, 2023).

MC interventions must be designed and implemented depending on the needs of the individual children, necessitating a thorough assessment of the children's actual level of MC (Zimmer, 1999). Acting on Zimmer's (1999) recommendation this study is based on 25 children whose levels of MC and PD were assessed and a bespoke SOW was created to take account of their unique needs. Furthermore, MC interventions are most effective when delivered by PE professionals who are regarded as 'highly trained', not general teachers (Morgan *et al.,* 2013). With this in mind, in the role of PE lead within the school, this research took on the role of assessing these children, following on from Morgan *et al*., (2013) recommendations. Since there is no guidance on the type or duration for MC interventions, it is crucial to carry out a thorough and effective preassessment to improve overall MC in young children (Jiménez-Díaz, Chaves-Castro and Salazar, 2019). Therefore, this research ensured that data was collected on the children at the beginning and end of every term and the MC interventions within the SOW were edited and revised based upon these preassessments. While it would appear logical to enhance effective MC outcomes in young children by implementing MC interventions by means of an established theoretical framework Khodaverdi *et al.,* (2022) explain that additional time and financial resources may be needed.

After considering the ample benefits of MC interventions, it should be noted that there are also barriers to the implementation of MC interventions, these are detailed within Appendix A.

2.3.2 Low socio-economic status and motor competency

Morley *et al.* (2015), researchers in the UK, used the Bruininks-Oseretsky Test of Motor skills-2 to measure the motor skills of children aged 4 to 7. The findings revealed that poor socioeconomic level has a substantial impact on the development of GMS and FMS abilities ($p<0.001$). Nutrition, relationships, and opportunities for play all have the potential to have an impact on the GMS and FMS of children from a low socio-economic background (Van der Walt *et al*., 2020). Van der Walt *et al*., (2020), explain why GMS and FMS were significantly lower; they identify that pre-school children with limited access to a playground scored significantly lower on FMS subtests of the MABC-2 than peers with access to a playground ($p = 0.009$) in a cross-sectional descriptive prevalence study using multi-stage clustering. Balance subtest scores were also lower (Van der Walt *et al.,* 2020). Within the 25 children who this study is based upon, 9 of them (36%) are from financially disadvantaged backgrounds and are therefore entitled to pupil premium funding. Many of the families live in social housing and reside in a low socio-economic area and therefore lack movement opportunities within the home setting.

2.4 School readiness

Korkodilos (2015) of Public Health England, suggested SR is an indicator of a child's cognitive, social, and emotional readiness for success in school. At the end of the EYFS, children are considered to have reached a good level of development and, consequently, to be prepared for school if they have met all the expected ELGs in the three primary domains of learning (a) personal, social and emotional development, b) PD, and c) communication and language), as well as in the specific domains of English and Mathematics. Korkodilos (2015) further explains that SR at age five has a significant effect on future academic achievement in school and chances for success in life. Children who don't reach a good developmental stage and are therefore not considered school ready have difficulty with social skills, reading, mathematics, and physical skills, which impacts outcomes in childhood and later life such as academic achievement, well-being and overall health, alongside crime (Korkodilos, 2015).

2.4.1 The effect of motor competence on school readiness

All children should be prepared to succeed in school, in accordance with the Incheon Declaration and Framework for Action (UNESCO, 2015), and early childhood policy makers should prioritise this goal above all others (UNESCO, 2015). However, achieving this objective necessitates a detailed evaluation and comprehension of early childhood SR (Hirsh-Pasek *et al*., 2005), such as insights that can subsequently inform the design of tailored early childhood education to ensure successful transitions into formal education in KS1 (Kamphorst *et al.,* 2021).

Kamphorst *et al*., (2021) explain that few studies have incorporated motor skills into SR profiles, which is questionable considering various studies have identified associations between GMS, FMS and academic success (Grissmer *et al*., 2010). In particular, research shows that GMS serve as vital for academic abilities like reading and writing (Ricciadi *et al.,* 2021) as well as social interaction (Bart *et al*., 2007). FMS have also shown positive correlations with test performance in English and Mathematics (Carlson, Faja and Beck, 2016; Suggate *et al*., 2019). Therefore, promoting motor skill activities alongside developmentally positive sedentary behaviours may increase the number of school-ready children (Jones *et al*., 2021). Through employing the bespoke interventions within this study to increase the children's MC, the goal is to not only raise their PD levels but also provide holistic development for the child by providing them the tools they need to be 'school ready' and excel in other academic pursuits such as reading and writing.

2.5 The Early Learning Goals (ELGs)

The ELGs provide unambiguous standards for both children's development and education, and it is the role of both teachers and practitioners to assist the children in achieving these goals (DfE, 2021). The DfE (2021) elucidate that the initial aim of the ELGs is to accommodate a straightforward and effective transition for children into KS1 by presenting knowledge on each child's learning needs and development to the new teacher. According to Tickell (2011), the EYFS guidelines were created to provide a framework for delivering consistent and high-quality environments for children, recognising the importance of this age in a child's development.

Within this research, the measurements of PD were established upon these ELGs since these represent the average nationwide expectation for what young children should be achieving by the end of reception (DfE, 2021). Furthermore, these reflect the expectation of the school's leadership team and governors. As previously stated, despite the fact that these children are in year one, the majority of them did not fulfil the developmental milestones that they were expected to meet before entering KS1 (Huggett and Howells, 2022), which is why it is crucial to further discuss the current levels of PD and how we can improve them through bespoke motor competency interventions.

2.5.1 Physical Development within the English curriculum

The 2021 EYFS framework (DfE, 2021) has received several modifications since the previous framework in 2014 (DfE, 2014), including the addition of 'strength' and 'positional awareness,' as well as techniques for achieving these, such as crawling, tummy time, and play movement with objects alongside adults (DfE, 2021, pp.9). This involvement of adults is acknowledged for the first time in any variant of the EYFS guidelines. The Early Years Alliance (2021) highlighted that PD modifications would be enhanced to include a stronger emphasis on development from birth to reception, as well as the relationship across GMS and FMS. However, since the 2021 EYFS Framework, there has been no other changes regarding PD within the most recent EYFS statutory framework (DfE, 2023a).

Wright and Craig (2011) explain that personal and social skills are crucial for children to be more prosperous learners and, to make a more efficient transition to adult life. Research indicates that there is a cross-over between personal and social skills and PD. Early engagement in sports (Holt *et al.*, 2011) and PE (Weiss, 2011) can assist young children in acquiring these social and personal skills. Another new feature is a focus on 'repetition and varied opportunities to explore and play with' (DfE, 2021, pp.9). In addition, the concept of 'emotional well-being' is also introduced.

It would be logical to believe that this crucial topic, PD, is now entirely covered in early years settings. According to a recent survey undertaken prior to the pandemic, 90% of young children had reached the required levels of PD by the time they had completed the EYFS (DfE, 2017). However, at the same time, contradicting news headlines warn us that an increasing number of children were not "school ready" (Donnelly, 2014 and TES, 2017). Prior to the pandemic, Haynes and Haynes (2016) found that a substantial proportion of reception age children (4-5 years old) are unable to stand on one leg and have balance and spatial awareness issues. Only 17% of them possessed the GMS expected at admission to school, and 30% had visual tracking issues (both of which are required for reading and writing). Similarly, Duncombe (2019), found that 77% of the 2,363 students from 78 UK primary schools failed five or more out of 12 PD assessments: signifying a serious delay in PD. In addition to this, Huggett and Howells (2022) explain that the pandemic notably reduced children's opportunities for participation in PA which consequently had a negative impact on their PD. It would appear that the situation, prior to the pandemic, is not transparent nor as favourable as the DfE numbers imply. These findings demonstrate the importance of this study and why PD interventions are crucial for young children failing to meet PD expectations.

Despite the well evidenced benefits of engaging in PA (Timmons *et al.*, 2012), such as the benefits for emotional, mental, and physical health, all of which positively impact learning: alongside supporting growth and PD (Kohl and Cook, 2013), studies investigating PA within the EYFS have reported low PA levels (Tucker, 2008). Roscoe *et al*. (2019) found that none of 178, 3- and 4-year-olds, met the PA recommendations levels of 180 minutes per day. Comparably, a European study from Konstabel *et al*. (2014) combined accelerometer data from multiple countries within Europe and identified that an average of 1.04, 4- and 5-year-old children only partake in less than the recommended 60 minutes of moderate-to-vigorous

PA per day. However, it should be noted that although there is a dearth of research suggesting that PA recommendations are not met internationally, PA levels differ with some studies documenting high levels of PA (Jones *et al*., 2023), such as Hesketh *et al*. (2014) who found that all 593 4-year-old children met the 180 minute of PA a day guideline.

Jones *et al.* (2023) stresses the significance of exploring what prevents or enables early years children from being physically active, as this understanding permits targeted interventions to be designed and developed to encourage healthy behaviours, such as the one created for the purpose of this research. Knowing that COVID-19 has had a severe impact on both the participation levels of PA and PD levels of young children (Huggett and Howells, 2022), alongside the fact that children's PD levels where a problem prior to the pandemic, has allowed me to move onto the logical next step; developing an intervention to improve young children's PD delays in the hope of rectifying some of the damage caused. The effect that the pandemic has had on the PD of young children is further explained in Appendix B.

Not only is PD itself important, but it is vital for teachers and practitioners to have a solid understanding of what child PD is to provide children with the opportunity to develop this or as Swift (2017, p45) states, the children will be 'let down from the onset'. We should take into consideration the significant number (74%) of educators, parents, and childcare providers who considered that children's PD had either improved or remained the same during the pandemic, according to Ofsted's (2022c) earlier findings. It is extremely difficult to address this critical issue if those who play a vital role in the child's lives are unaware of the effects that the pandemic has had on their PD, as discussed in my earlier study (Huggett and Howells, 2022). For this reason, it's critical that the results of my earlier research—that children are falling behind in a number of PD domains (Huggett and Howells, 2022) —be taken into consideration throughout this bespoke SOW to not only provide children with opportunities to meet PD expectations but to educate staff on the importance of this.

2.6 Core Strength and Co-ordination

GMS and FMS grow progressively during early infancy, beginning with sensory explorations and the development of a child's coordination, positional awareness and strength through crawling, tummy time, and play movement with objects (DfE, 2022).

Core strength is defined by DfE (2022) as a child's capacity to maintain their stance and move from the centre of their body outwards which has been added as a new element within the Help for Early Years providers document (DfE, 2022) but not within the ELGs (DfE, 2023a). According to Nationwide Children (2018), there are several misconceptions surrounding the 'core.' They continue to suggest that the core is the centre of our bodies and that it functions to stabilise the trunk while limbs move throughout functional movements, and that when perceived in this way, the core includes muscles that stabilise the hips, the torso and the muscles that stabilise the shoulders (Nationwide Children, 2018).

Bernstein (1967, cited by Turvey, 1990), a physiologist, defined coordination as 'a problem of mastering the very many degrees of freedom involved in a particular movement—of reducing the number of independent variables to be controlled' (pp. 938). Coordination is further defined by DfE (2022) as the brain's ability to control the movement of bodily parts, and similar to core strength is now a new element within the Help for Early Years Providers document (DfE, 2022), but is not found within the ELGs (DfE, 2023a). This was built upon by The AfPE (AFPE, nda) who add that it is not only the ability to control the movement of the body, but it is the ability to control it in co-operation with the body's sensory functions such as catching a ball which demonstrates hand and eye coordination. Coordination is also defined, by Dogra (2021), as the process of activating motor units of several muscles while simultaneously inhibiting all muscles to perform the desired activity.

2.6.1 Why is core strength and co-ordination important?

Nationwide Children (2018) explain that the core muscles have two main purposes: to protect the spine from excess pressure and transmit force from the lower to the upper body and conversely. Theracare (2021), a paediatric clinic in the United States, explain that strong core muscles are essential for a child's GMS and FMS development and that an absence of core stability not only makes specific motor skills tougher to execute, but can also lead to multiple problems and discomfort in later life. Weak core muscles can make individuals more vulnerable poor posture, lower back discomfort, and muscular injuries, according to the MayoClinic (2022). Developing your core muscles can reduce the chance of falls and assist with back discomfort (MayoClinic, 2022). Laurie (2022) believes that everything we do revolves around core strength, which consequently has an influence on all aspects of development. Poor posture is frequently caused by a lack of core strength, which causes gravity to pull down, resulting in slumped sitting, poor endurance while standing, and weak arms (Laurie, 2022).

Incorrect writing posture frequently indicates that a child's body is performing additional work than appropriate (Occupational Therapy Helping Children, nd), which indicates a lack of core strength. Laurie (2022) adds that another indicator of inadequate core strength is when a child slumps over their desk during lessons. The Multiple Sclerosis Trust (2018) elucidate that weak core muscles can initiate a destructive cycle in which the core muscles become less effective as a result of injury or a lack of activity combined with poor posture. Muscles that are less efficient require more energy to move (Bowden, 2018), this results in an imbalance in the paired muscles that move each region of your body (The Multiple Sclerosis Trust, 2018). Essentially, as a result of exercising harder, certain muscles get shorter and tighter whilst others then become lengthy and frail.

Great Basin Orthopaedics (nd) elucidate that when the core becomes stronger, balance and coordination improve. Core workouts, according to Freeletics (nd), a digital coaching app, also activate a specific section of the brain called the cerebellum, which impacts coordination, spatial awareness, and balance. Cook *et al*. (2014), on the other hand, stress that core stability needs greater coordination versus isolated strength. Within early years settings, DfE (2022) advise practitioners to encourage children to roll and flatten dough with their hands or a rolling pin to help them practice using both hands in a coordinated manner. Children can also practice hand-eye coordination by pouring ingredients into bowls and spooning batter into tins (DfE, 2022).

Bilateral and hand-eye coordination are two forms of coordination that are essential for children (NHS, 2013). Bilateral coordination is the capacity to efficiently employ and coordinate motions of the legs and arms in activities (NHS, 2013), as well as to use both sides of the body simultaneously (Alder Hay Childrens NHS Foundation Trust, nd). According to the Alder Hay Childrens NHS Foundation Trust (nd), bilateral activities require your child to use three different movements: symmetrical movements (both hands use identical movements, such as rolling a rolling pin), reciprocal or alternating movements (one hand is used first, then the other, such as constructing a tower with blocks), and supporting role (one hand undertakes more skilled work whilst the other hand supports, such as cutting with scissors). Bilateral coordination is crucial since it not only improves attention and intellectual skills (Piek *et al*., 2004), but it also enhances FMS such as hand stability and two-handed control, as well as assisting to coordinate GMS (Fernandes, 2013). Furthermore, alternating bilateral motions utilise more cerebellum in the brain, positively influencing vestibular sense and spatiotemporal tasks like balance and posture (Tseng and Schol, 2005), which leads to assisting abilities such as play, dressing up, and handwriting (Danto and Pruzansky, 2011).

Hand-eye coordination is defined by Ayaga (2024) as an acquired ability that includes using one's eyes and hands to complete an activity such as drawing a picture, writing or catching a ball. The eyes provide information to an individual, such as the presence of a ball in the air, and the eyes instruct the hands to grab it – this dual process incorporates visual perception from the eyes as well as the utilisation of movement referred to as skills to complete the action (Swain, nd). Tanic (2021) describes hand-eye coordination as 'vital' for academic achievement as it enables children to utilize their vision and muscles to do tasks such as writing, sketching, tying shoelaces, or catching a ball. Hand-eye coordination is also thought to help children learn to read (Mayesky, 2014).

2.6.2 Core strength, co-ordination and the EYFS

The statutory EYFS framework (DfE, 2021) merely discusses core strength and coordination by suggesting that adults have the ability to help children improve their core strength, stability, balance, spatial awareness, co-ordination, and agility by developing games and giving chances for play both in inside and outside settings. This has consequently confused educators, EYFS teachers and practitioners as there has been a lack of acknowledgment for core strength and coordination within this 2021 framework, yet it holds such a vital role as one of the '3 areas' within the government's latest guidance: Help for Early Years providers (DfE, 2022). The other two of the '3 areas' mentioned within this framework (DfE, 2022) are FMS and GMS which are discussed in depth within the latest EYFS framework (DfE, 2021). This addition of core strength and coordination to the EYFS frameworks is clearly important for the PD of young children, but it may be an area that teachers and educators require CPD in.

2.7 Why are gross motor skills important?

DfE (2022) elucidate that in addition to having a positive impact on wellbeing and providing children with socialisation chances during play, GMS are crucial for children's development of FMS as well as their capacity to take well-intended, safe risks and become more coordinated. Levels of gross motor proficiency are further strongly correlated with cognitive development, according to Veldman *et al*. (2019); their findings highlight the necessity of promoting GMS early on since they may be crucial for cognitive development in the early years.

2.7.1 Gross motor skills and the EYFS

The EYFS framework (DfE, 2021) states that GMS and FMS progress gradually throughout a child's formative years, beginning with the development of a child's coordination, positional awareness and strength as well as sensory explorations. The DfE (2021) continue to explain that the essential components for the growth and development of healthy bodies, as well as social and emotional wellbeing, are GMS. Within the PD section of the EYFS, GMS have their own ELG. Within this, the children are expected to be able to: negotiate both space and obstacles safely, whilst considering themselves and others as well as demonstrating strength, balance and coordination when playing DfE (2021). In addition to this DfE (2021) outline that children are expected to be able to move enthusiastically; undertaking activities which provide opportunities for them to run, jump, dance, hop, skip and climb. Appendix C further explains what GMS looks like in practice.

2.8 Why are fine motor skills important?

FMS, in particular, have become a significant predictor of learning in the EYFS, according to Loras (2020). Evidence from extensive longitudinal data undertaken in both the United States and in Britain reveal a consistent relationship between early FMS and later academic success in subjects such as reading, mathematics and science (Loras, 2020). In addition to this, children who have good FMS before starting school have been observed to make greater mathematical advancements over the course of the year (Luo, Jose, Huntsinger, and Pigott, 2007; Son and Meisels, 2006). American researchers Wolff, Gunnoe, and Cohen (1985) add to this by highlighting that by kindergarten, FMS are better predictors of reading achievement than GMS.

A child's PA levels (Jaakkola *et al.,* 2016) and health outcomes, including obesity and motor development (Bremer and Cairney, 2018) will be more beneficial the sooner they may begin mastering FMS through proper instruction and practice opportunities (Gallahue, Ozmun, and Goodway, 2011). FMS partnered with coordination create MC within a child (Barnett *et al.,* 2016). According to Robinson and Goodway (2009), FMS are a collection of movements that are still being developed and are essential for completing more complex skills, for other activities and sports (Robinson and Goodway, 2009); they are further explained as "the movement equivalent of the ABCs" (Goodway, Famelia and Bakhtiar, 2014, p. 47) and "the equivalent of the movement to the alphabet of reading" (p.2) by Navarro-Patón *et al*. (2021a). NHS Isle of Wight (nd) explain that not only is the ability to use FMS necessary for accomplishing daily tasks, but a lack of these skills can also be damaging to a child's self-esteem, their academic success may be jeopardised, and they may have very few play alternatives if they are unable to accomplish these basic activities. Additionally, children are unable to acquire the necessary independence in generic life skills such as dressing and eating oneself, which will have social repercussions on both peer and parental relationships (NHS Isle of Wight, nd). Other actions such as a child's ability to eat, write legibly, use a computer and flip pages in a book can also be impacted by poor FMS (Children and Young People's Health Services, 2018).

2.8.1 Fine motor skills and the EYFS

The EYFS framework (DfE, 2021) elucidates that both precision and FMS are vital for hand-eye coordination, which is thereafter interrelated with early reading. The DfE (2021) further explain that children are able to acquire control, skill and confidence through receiving multiple opportunities to both play and explore puzzles, games, arts and crafts, and by engaging in the use of small tools partnered with adult support and feedback. As mentioned earlier, the EYFS has a specific ELG for FMS within the PD segment. The DfE (2021) states that by the end of the EYFS, children should be able to: hold a pencil correctly, often using the tripod grip; utilise a variety of small instruments, such as paint brushes, cutlery, and scissors; and start to draw with both accuracy and care. The focus of FMS within this study will focus on the use of cutlery and scissors, as these are the more advanced elements of FMS, as they involve bilateral movements (holding paper and cutting hand, holding knife and fork or spoon and forks) and isn't limited to unilateral FMS of pencil holding or paint brushes. What FMS looks like in practice is further discussed within Appendix E.

2.9 The impact of school holidays on physical activity and physical development

According to Emm-Collison *et al.* (2019), children's participation in PA declines over the SH, which then impacts their PD. According to Ukactive (2019), throughout the summer break, children lose up to 80% of their total fitness, with those from lower-income households seeing this decline at a rate that is 18 times quicker than that of their wealthier peers. Emm-Collison *et al.* (2019) continue to explain that many parents take their child's PA levels into consideration while making childcare arrangements for the SH. Nonetheless, many parents must rely on their children's grandparents to look after them, due to employment obligations. Despite the belief that children participate in less PA when they are with grandparents, grandparents were the main providers of informal childcare (Emm-Collison *et al.,* 2019). Holiday clubs were an alternate option, but parents are reluctant to send their children to these due to the expense and location. Furthermore, according to the director of UK Active, Shakespeare (nd, cited by MacInnes, 2021) 39% of sports facilities in England are located inside school gates, and most of them are closed during SH.

During SH, a greater percentage of children are opting to participate in various sedentary activities, therefore decreasing PA participation levels during these holidays (Weaver *et al.,* 2019). A minority of studies have investigated the behaviour and the relationship between changes in PA levels throughout regular term time and SH (Weaver *et al.,* 2019). Two studies in particular, that examined this relationship are: one by McCue, Marlatt and Sirard, (2013) and the other by Brazendale *et al.* (2017)—they both found children were less active during the summer than they were throughout the course of the school year.

Weaver *et al.* (2019) further elucidate that intervention targets may be determined by evaluating which behaviours are changing adversely over time periods, such as SH. Again, further emphasising the need for retesting of the children's PD levels both before and after the SH.

2.10 Conclusion

This evaluation of literature has considered a wide range of topics relating to the PD of young children and the advantages of MC treatments to enhance the PD and holistic development of a child. It has taken a reflective approach towards exiting knowledge and the gaps within this, helping me to shape the overall focus of this study, research aims and questions alongside the interventions found within the SOW. The methods of research used, as well as methodological literature and considerations, within this study, will be discussed within the following chapter: the methodology.

Chapter 3: Methodology

This chapter aims to explore the methodology adopted within this study, as well as to discuss methodological literature and considerations. Data collection and analysis methods will also be discussed, to identify the most suitable method to answer the research questions stated in section 1.4. This chapter will also explain the demographic of the study school and the children within the study class.

3.1 The school

A controlled Church of England rural village primary school set in the Southeast of England served as the site of this study. This is the same school, and the same children as within our previous research study (Huggett and Howells, 2022). A total of 205 children from a variety of backgrounds, including social housing and gated communities, attended this one-form entry school. At the time the research was conducted, 14 of the 25 students in the schools' year one class were aged five (m=6, f=8) and 11 were aged six (m=6, f=5).

3.2 The Sample

A sample is described as a 'group of people, objects or items that are taken from a large population for a measurement' by Mujere (2016, p. 107). Since conducting a census of the entire population is often viewed as impractical and never inexpensive, a sample is required (Lohr, 1999). Samples may be divided into probability samples and nonprobability samples, which describe how the participants were selected (Hade and Lemeshow, 2008). Probability sampling, according to the National Statistical Office of Canada (2021), is the method of choosing a sample from a specific population established on chance or the random selection principle.

A convenience sample is explained by Mugo (2002) as a convenient sample of individuals selected from a population for observation. The National Statistical Office of Canada (2021) highlights that this sampling method therefore assumes the sample is representative of the population. The sample found within this study is representative of our school population. Battaglia (2008, cited by Lavrakas, 2008) elucidates that convenience sampling, unlike purposive sampling, does not depend on professional judgement to select a representative sample of components. The simplicity of getting a sample is instead the main selection factor; the expense of discovering certain population segments, the sample's geographic dispersion, and the ease of gathering interview data from the chosen segments are all factors in the sample's ease of acquisition (Hade and Lemeshow, 2008). Bhardwaj (2019) claims that it is straightforward and affordable to obtain convenience samples. Furthermore, they are often beneficial for preliminary investigations and hypothesis development. Yet, Bhardwaj (2019) emphasises that a convenience sample is associated with a significant risk of sampling mistakes. The convenience sample is key to improving and focusing in depth on children within my school due to identifying, in previous research (Huggett and Howells, 2022), that these children were developmentally behind. The recommendations from this research were a bespoke follow up SOW, such as the one found within this research.

As discussed in the literature review, Polimac *et al*. (2013) revealed no significant differences in the entire system of motor attributes studied in relation to gender in pre-school age children, meaning that this study will not be gender specific. Furthermore, according to Navarro-Patón *et al.* (2021c), from an education point of view, there is an absence of noticeable disparities when comparing 4-year-old boys and to girls, in terms of gross motor development and fine motor development. Although, the children participating within this research are not of a pre-school or reception age, it has been previously discovered that they have not yet met the PD goals of average 4–5-year-old children attending reception settings within the UK (Huggett and Howells, 2022). In addition, the SOW was a whole class intervention, therefore not gender specific.

3.3 The impact of seasonal changes on children's physical activity and physical development.

Environmental variables have drawn an extensive amount of attention in recent times, and it is apparent that they are essential for promoting PA in young children (Owen *et al.,* 2000). Seasonal changes of weather elements, including temperature, rainfall, and sun exposure, have been found to be barriers to PA (Gordon-Larsen *et al.,* 2000). Time spent outside is a significant predictor of PA (Baranowski *et al.*, 1993); yet, during the winter, this access is obviously restricted (Silva *et al.,* 2011).

An analysis of literature, undertaken by Tucker and Gilliland (2007), suggests that 73% of the papers indicated a substantial impact of weather on PA. According to one paper by Loucaides *et al.* (2004), weather can constitute for up to 42% of the variation in PA. Further research identified that children's average PA levels peaked in April and reached their lowest levels in February, Atkin *et al.* (2016) discovered. Autumn and winter had lower levels of PA than spring and weekends in the winter months were when children were recorded to be the least active. It should also be noted that, despite the fact that there is typically a spike in the number of children playing outside during the summer months, in a study conducted by Save The Children (2022), 30% of the children stated their parents or neighbours had told them to stop making noise outside, and 25% said they had been told to stop playing on the street. However, early summer is when children are deemed to be the most active (Atkin *et al*., 2016).

Atkins *et al.* (2016) further elucidates that "during spring and summer, when the weather is better and the days are longer, they tend to be playing out and more active, but during the darker, colder months, they are much less active". To decrease the level of seasonal variation over the course of the study it was ensured that the interventions within the SOW, alongside the data collection points, were carried out within the spring and summer seasons at the points where the children were considered by Atkin *et al*. (2016) as 'most active'.

3.4 Case study design

A case study is defined by Crowe *et al.* (2011) as a research strategy utilised to gain a thorough, extensive comprehension of an intricate problem in a real-world context. According to Rowley (2002), a case study as a research technique typically appears as an effective solution for students and other novice researchers looking to do a small-scale research project based on their workplace. Due to the potential for a comprehensive examination of one aspect of an issue, the case study technique can be especially useful for lone researchers (Bell and Waters, 2018), such as this research. As PE lead within the school, the researcher opted to continue with the case study approach based on my prior research and conclusions (Huggett and Howells, 2022).

According to Tengnäs (2016), from Sweden, case studies and the case study technique was not always recognised as a genuine scientific method, but have subsequently been discovered to be better as research methodologies than initially anticipated. Tengnäs (2016) continues to elaborate that they were first viewed as a research approach with several drawbacks, but Schoch (2020) defines case study design as components that connect preliminary research ideas to final research results. Schoch (2020) further explains that the initial research idea starts with an issue to research, which entails identifying a shortage of understanding of a topic or issue, such as the topic of this research. Following the identification of the problem, the purpose statement and research question are developed to ensure a thorough research process, an adequate case study design combines current literature relevant to the issue (Schoch, 2020), which is why the literature review is so vital to this research. To gain more value, the case study design should be logical, efficient, well thought out and simple to copy (Fox-Wolfgramm, 1997). This research is methodical and easily transferable to other educational settings as the criteria is rational and easily accessible for other effective educators to evaluate the PD needs of their children.

Yazan (2015) explains that within social science research, case study methodology has long been contentious in comparison to other social research methodologies, the use of case studies as a research technique are often considered to be lacking rigour and impartiality. Although, Denscombe (2007, pp. 43) highlights that 'the extent to which findings from the case study can be generalised to other examples in the class depends on how far the case study example is similar to others of its type'. Nevertheless, Rowley (2002) opposes her earlier argument by emphasising that, despite this criticism, case studies are extensively employed as they can provide insights that other methodologies cannot. Furthermore, this technique includes several distinct qualities which can provide the opportunity for researchers to explore naturally occurring social events in sporting environments (Thomas, 2015). It should be noted that to ensure rigor and impartiality the researcher was not the class teacher of the study class. This was purposeful, as it would give me the opportunity to examine the impact of the interventions found within the SOW without me influencing their PD within holistic curriculum.

Ebneyamini and Sadeghi Moghadam (2018) explain that the concept of generalisation from case studies was a frequent critique and thus featured in the literature with regularity (Tellis, 1997). In the scientific world, the generalisability of case study conclusions is widely critiqued (Wikfeldt, 2016), since some view it as just exploratory research with no conclusive evidence (Dul and Hak, 2007). It should be noted that Smith (2021) believes that the constructivist paradigm of a case study places the reader’s ability to form generalisations wholly in his or her hands. Smith (2021) further explains that as a case study has a subjective and interpretivism nature, generalising results should be considered as approximating projected outcomes rather than demonstrating causation or making predictions. Yin (2017) expands on this concept by stating that, unlike experiments which involve a high level of trust in a causal relationship between phenomena may be attained, drawing conclusions obtained from a case study can be incredibly challenging. The strength of a case study, on the other hand, is presented by Smith (2021) who highlights its potential to build a harmonic link between the reader’s personal experiences and the case study itself, allowing for a better comprehension of events in their context. In other words, case study generalisations might be considered naturalistic rather than predictive. According to Ruddin (2006), we cannot engage with our reality in a comprehensible manner until we generalise. Robinson and Norris (2001) go on to explain that generalisation is inherent in our cognitive skills and therefore is unavoidable. Flyvbjerg (2006, 2001) supports the idea of qualitative generalisation and dismisses case studies’ incapacity to provide methods for scientific growth as a mistake. Ruddin (2006) further advocates for case studies as he believes that it is critical to avoid diminishing the quality and validity of case study results. He adds that when we draw inferences from individual research, “we do not infer things ‘from’ a case study; we impose a construction, a pattern on meaning, ‘onto’ the case” study (Ruddin, 2006, pp.800). Generalisation, according to Rowley (2002), is only possible if the case study design is appropriately guided and influenced by theory and thus can be demonstrated to add to existing theory. This study is guided by theory, addresses a gap within research and allows me to capture and present an in-depth and detailed picture of the issue at hand, using a wide range of data sources so the data collected can build upon existing generalised research.

As stated by Bryman (2008), case study research generally includes a longitudinal component. To identify any notable changes that have transpired within the phenomena under research over a time period, a longitudinal study involves investigating the same phenomenon on two or more occasions (Bryman, 2008). Bryman (2008) further explains that a researcher can embody a longitudinal element into their research by fully submerging themselves in previous data, consulting earlier interviews supervised by themselves or others, or by returning to the case under study later to look for trends and changes. As previously stated, this closely pertains to my previous research which was carried out with the same group of children, continuing the longitudinal case study (Huggett and Howells, 2022) which has involved examining the same children within two separate studies. Furthermore, within this study, at two separate points over the course of the three terms, a pause to consider if the interventions found within the SOW are effective and making adjustments based upon this was utilised.

3.5 Practitioner research

According to Gutierez (2019), there is a long-standing belief that research is limited to the more academic, notably universities. She does, however, clarify that research-based professional development has grown increasingly prominent as it is recognised that teachers may be competent research practitioners who use their classes as tools for data collection (Gutierez, 2016). The dispute over practitioner research continues, demonstrating a significant gap between theory and practise in education (Al-Ghattami and Al-Husseini, 2014). On the one hand, educators doubt the validity of academic research, claiming that it is excessively theoretical and has only an indirect impact on the reality of teaching (Beycioglu *et al.*, 2010; Bevan, 2004). According to Al-Ghattami and Al-Husseini (2014), educators also believe that research from academia cannot substitute for hands-on experience gained through daily participation in general classroom practice. However, encouraging teachers to conduct research can help bridge the gap between theory and practice and establish an appropriate compromise between school and university (McLaughlin, 2004). Moreover, study participation should enable educators to express themselves while conveying their perspectives. Besides, it is also promoted as a means of making education more democratic (Cochran-Smith and Lytle, 1990).

Gutierez (2019) elucidates that practitioner research is immersed in teachers' everyday routines, and their inquiry is contextualised by students' interactions to hypothesise and examine successful and significant teaching approaches. The objective of practitioner research is to assist educators in becoming practitioners who are lifelong active learners who pose questions and conduct research throughout their careers (Cochran-Smith *et al*., 2009). Practitioner research is comparable to action research, which is intended to enhance teacher knowledge and abilities to become more responsive to students' learning needs. It is primarily intended for teachers' ongoing professional development (Dana, Gimbert and Silva, 2001), which becomes more significant when they concentrate on their particular classroom context (Raphael *et al*., 2014) in the midst of unravelling the tangled instructional complexity, investigating their readiness to conform to ever evolving teaching and learning techniques (Loucks-Horsley *et al*., 1987).

This study is entirely based on practitioner research; baseline data was collected, and a SOW tailored to the requirements of the children within the study was devised and implemented. This was then reviewed and evaluated at the end of each term, based upon the data collected, tailored interventions which specifically targeted the areas which were identified as making minimal progress over the previous term were then the focus of the following term. As can be seen within chapter 1.3, in Figure 1, there were two edit and review periods at the ET4 and the ET5. The Rural Health Information Hub (nd) explain that evaluation offers a methodical way to reflect upon interventions, determine how effectively they achieve their objectives, as well as assisting in identifying the aspects of said interventions that work well, or others that may require additional attention. Ma *et al.* (2021) highlight that rather than using a one-size-fits-all strategy, tailored interventions, such as those found within this study, provide individualised solutions that take into account an individual's requirements and circumstances in order to accomplish its objective.

According to Johnston *et al*. (2019), it is critical to understand the many perspectives that educators, such as myself, bring to practitioner inquiry research. They add that when students are involved and participate in the research process, their curriculum becomes socially and culturally relevant (Johnston *et al*., 2019); demonstrating the importance of children making their own decisions. Children had multiple opportunities to make their own decisions throughout this research, such as: being able to select which equipment they would like to use, which area they wish to weed around the school and which tree they would like to challenge themselves to climb.

3.5.1 The challenges of practitioner research

This research is based on 30 children aged 7-8 years, within year 3. The researcher was released from class in order to deliver the interventions and assessment circuits found within SOW to the study class. As mentioned above, to ensure rigour and impartiality throughout the study, the researcher was not the class teacher of the study children.

Unlike many notions in education that vanish when challenged with new competing ideas, practitioner research has endured the test of time, and the desire for teacher involvement in research has never been greater (Simms, 2013). Bullo, Labastida and Manalapas (2021) explain that although there are many advantages of conducting educational research, it has also become one of the most challenging tasks for educators. Due to these barriers, as well as the fact that Radford (2006) describes classrooms as chaotic places to conduct research, the researcher was unable to begin the interventions as early in the school year as they would have liked. Therefore, the implementation of the interventions found within my SOW began halfway throughout the school year in T4, ending in T6.

Sarkar (2014) states that one of the most significant challenges encountered by the teachers when conducting research is the process of acquiring permission for data collection. Prior to the collection of data, the basis of the interventions and assessment circuit found within SOW and presented this to the headteacher within my school. Once they were happy with the proposed plan, Bullo, Labastida and Manalapas (2021) highlight that the next obstacle is the lack of time within the school day to undertake research. This required careful consideration from my school leadership team who needed to find time within the general day to day running of the school for me to be released from my classroom to deliver the interventions and undertake data collection activities with the case study children. This consequently took time to action. Within an international study undertaken by Bullo, Labastida and Manalapas (2021) open-ended questionnaires and interviews were used to investigate educators' perceptions of involvement with and participation in teacher research, as well as their viewpoints on practitioner research. Work conditions and time restrictions were intertwined and discussed over 400 times in the open-ended questionnaire and interviews (Bullo, Labastida and Manalapas, 2021); further confirming the lack of time found within schools for teachers to take part in research across Europe. Making it more than understandable that the logistics of arranging cover in a small one form entry village primary school, such as the one used within this study, took a lot of careful planning; especially when the school were preparing for Ofsted. However, it should be noted that additional time allowed the researcher to effectively develop and tailor the MC interventions.

Lastly, Term 2 is undoubtedly considered to be one of the busiest terms of the academic year at a Church of England school. Finding additional time in the school calendar is especially difficult due to the preparation, practice, and performance of faith-based festivities such as nativities and Christingle performances alongside Christmas fairs. Partnered with general wet, windy and snowy weather Term 2 and Term 3 were not suitable to undertake suggested outdoor activities safely. Wick *et al.,* (2017) further explain that interventions which aim to improve MC, such as those found within this study, have been seen to be more effective if they take place for a time period between 4 weeks and 5 months in comparison to longer term interventions lasting for more than 6 months. This is also part of the reason that these interventions are, 19 weeks long, less than 5 months.

3.6 The Scheme of Work

To reverse the large decline in PA, that Oxtoby (2021) has previously characterised as difficult to reverse, systematic policy initiatives aiming at raising PA should be put into place, as underlined by Dunton *et al*. (2020). According to researchers who have studied the long-term effects of interventions, the best time to intervene is in the early years (Heckman, Stixrud, and Urzua, 2006). Sallis *et al*. (2020) and Van Sluijs *et al.* (2007) assure that research on PA promotion and preservation during childhood persistently shows that 'multi-component, multi-modal, and multi-outcome' interventions are the most effective. Therefore, my proposed SOW, and the interventions found within, includes a wide range of engaging activities (further details and explanation found within Appendix E), specifically designed to meet the PD needs of year one students, will have greater effect as they target a variety of PA modalities. By doing this, the interventions within the SOW were designed to promote the children's physical growth and help them achieve the EYFS PD ELGs. According to Kohl and Cook (2013), for PA initiatives to be beneficial, they must be consistent with the projected developmental changes in children's exercise capabilities and motor development, which influence the activities in which they may engage successfully. The researcher has taken this into consideration when designing the interventions within the SOW.

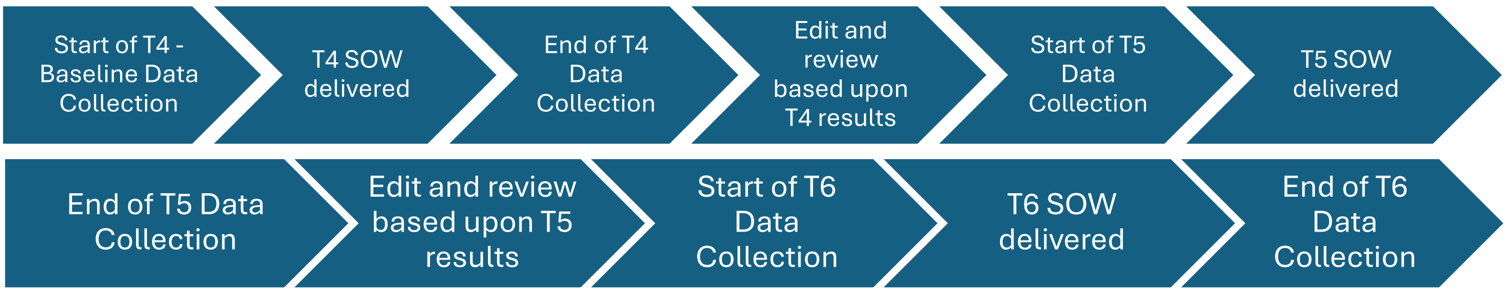
Difficulties with FMS and GMS continue into both primary and secondary school (Harrowell *et al.,* 2018), thus therapeutic intervention is crucial as FMS and GMS difficulties are not something children just grow out of (Hillier 2007). Robinson and Goodway (2009) alongside Valentini, Ramalho and Oliveira (2014) explain that motor skills must be 'learned, practiced and reinforced', despite the belief that pre-school age children acquire FMS via simple maturation (Clark, 2005). Children could be prevented from failing and the overall dropout rate could be decreased with early support and motor skill treatments (Wills, 2016). According to Jane, Burnett, and Sit (2018), the main focus of motor development interventions is on strategies that offer sufficient instruction with the sole objective of acquiring motor skills. The effectiveness of interventions for improving GMS in early childhood settings was examined in a systematic review by Veldman, Jones, and Okely

(2016), but studies involving children with health issues or with specific diagnoses, such as autism that could have contributed to motor skill difficulties, were excluded. The research emphasised the value of teacher and parent involvement in addition to methodologically sound therapies, while also highlighting the dearth of quality and quantity interventions geared at addressing difficulties with motor skills (Van der Walt, Plastow and Unger, 2020b). Eddy *et al*. (2019) more recent systematic review put a particular emphasis on the efficiency of school-based interventions for young children between the ages of 3 and 12. The study concluded that while school-based treatments generally had favourable results, the magnitude of the effect varied depending on the type of intervention. By creating interventions within the SOW which focusses on learning, practicing and repeating motor skills, in line with both Robinson and Goodway (2009) and Valentini, Ramalho and Oliveira (2014) views, the researcher evaluated the effectiveness of the recent suggestions made by DfE (2022) in their 'help for early years providers' document, when applied to practice. PD resources have been split into 3 areas: core strength and co-ordination, GMS and FMS (DfE, 2022). These suggested activities provided me the basis of this SOW. See Appendix E for the interventions found within the SOW.

3.7 Research methods

As explained previously within the introduction, this study involved the collection of qualitative data, entirely through observations. For clarity, the study timeline from section 1.3 is seen here below, again.

Figure 1: The study timeline



For each of the data collection points detailed within the figure, practitioner observations (see section 3.5 for further detail on practitioner observations), collected FMS, GMS and core strength and coordination data. This practitioner observation used the circuit floorplan and stations (see figure 2 for further details) to assess the children's motor skills (see section 3.9 for assessment criteria for motor skills). Separate practitioner observations were also undertaken for the use of scissors and cutlery, the observation sheets used for these can be seen in Table 2 and Table 3. The assessment criteria for these can also be seen in section 3.9.

This study lasted three academic terms, 19 weeks, and consisted of a circuit at the beginning and end of each term which the researcher specifically designed to include activities that measure the progression of FMS and GMS development. For the remaining 11 weeks, a SOW was developed, found in Appendix F, containing interventions based upon the government's latest advice for early years providers (DfE, 2022). This allowed the researcher to identify how beneficial the governments recommended activities are for our young children. Although these children are no longer in early years settings, as they are indeed year one children, my previous research (Huggett and Howells, 2022) shows that a sizable number of these children were failing to fulfil the EYFS's age-related PD requirements stipulated in ELGs, at the end of reception. These developmental milestones are described by Jackson (2022) as essential to promote strength, endurance, and coordination development, which are all skill sets required to live a healthy life and increase SR in children and are thus critical to achieve before the children progress onto KS1 curriculum PE.

3.7.1 Observations as research methods

According to Smith (2017), observations are categorised into two distinct categories: naturalistic and systematic. Naturalistic observations, as defined by Smith (2022) consider observation to be an unplanned and unstructured process, which indicates that the researcher does not shape the observation in any manner. Instead, they conduct observations in a natural environment. Smith (2022) further defines systematic observations as a more regulated technique that incorporates focused observations that are purposefully constructed. The circuit observation within this study uses the naturalistic approach and is shared in detail below within Figure 2.

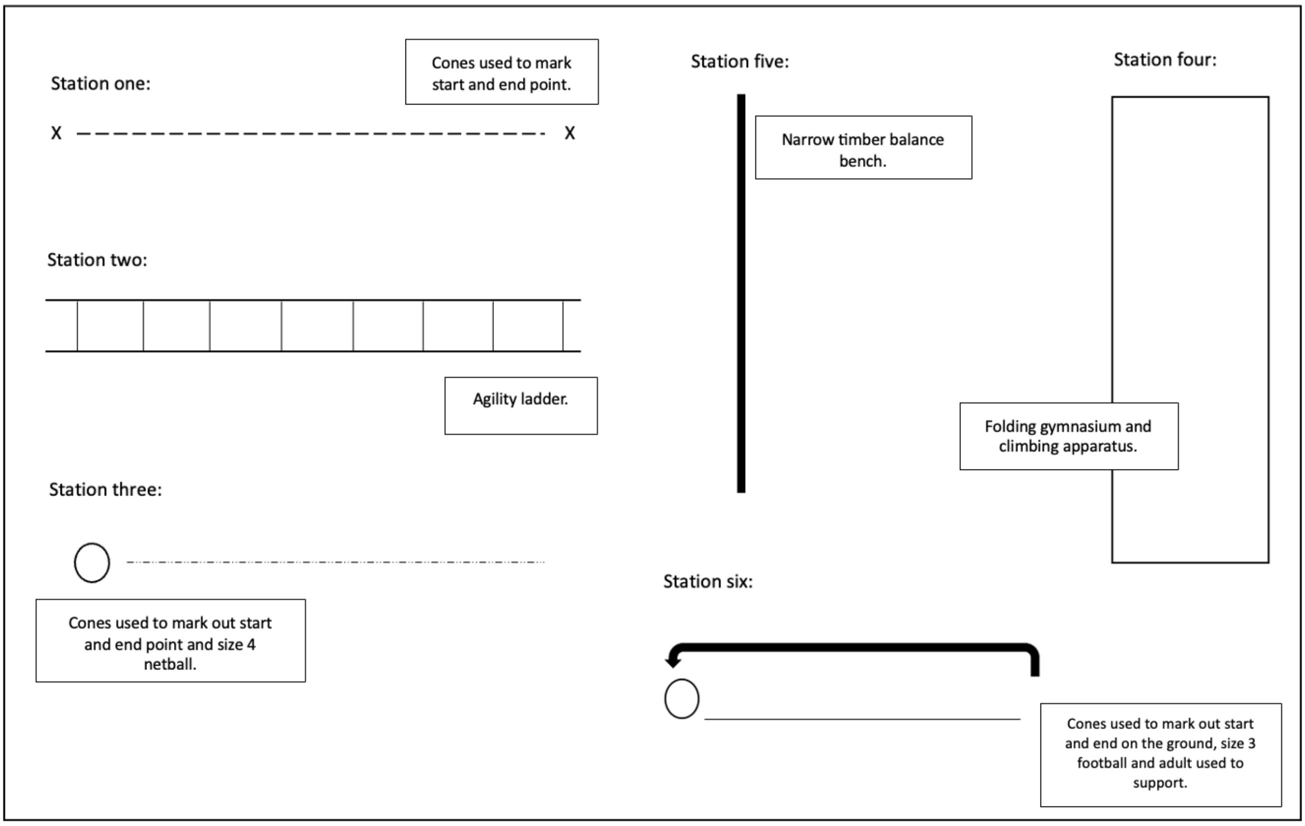
Observation sheets were developed, an example of one observation is shown below in Table 1. Each observation has an outlining success criterion for each skill assessed within the circuit (the success criteria for each skill can also be found within the observation sheets in Appendix G). As Rosenshine (2010) emphasises the value of modelling, these observation sheets were filled out at each of the six stations in each of the six circuits after the activities had been shown by an adult and the expectations had been communicated. Rosenshine (2010) believed that educators can support children's learning effectively by dissecting tasks into smaller parts and demonstrating how to accomplish them. A model is defined as "a blueprint which describes certain procedures for organizing content, task structures and the sequencing of learning activities" by Hastie and Casey (2014, p. 422). Through modelling, educators are able to demonstrate the activity effectively and ensure proper form is employed by the children (Curtin, 2014). According to Spreeuwenberg (2022), educators are fundamental in helping children reach important developmental milestones, and observations are a major component of this. Observation is a critical element of the practitioner's job since it aids in understanding how young children learn, acquiring knowledge about them personally (Drake, 2006), and determining their developmental stages (Forman and Hall, 2005). As Smith (2022) describes, directly observing behaviour is a vital aspect of learning.

Assessment is frequently used, and therefore critiqued, in early childhood education to measure children's progress toward developmental milestones or, more subtly, for SR, academic monitoring, or school achievement (Meisels, Stelle, and Quinn-Leering, 1993). Apart from these more dubious applications, assessment is also used to measure students' development, either normatively or in reference to some criterion, as well as to assess the influence of an educational programme (Pellegrini, 2001). Similarly to Pellegrini (2001), the researcher used this to develop their observations. Sirard and Pate (2001) explain that direct observation of a person's movements should be employed as the elite requirement for PA research, according to the description of PA as any body movement resulting in energy expenditure. Whilst observations of children's behaviours tend to be both time-consuming and expensive, they are ultimately the most effective method for evaluating children in a natural school setting (Pellegrini, 2001) and offer researchers many data collection opportunities (Smith, 2022). Although time consuming, direct observations have been used within this research to ensure that the elite standard for PA research mentioned by Sirard and Pate (2001) is met.

Table 1: observation sheet for hopping (adapted from Ulrich, 2000)

	Did the non-support leg swing forward in pendular fashion to produce force?	Did the foot of non-support leg remain behind the body?	Were the arms flexed and did they swing forward to produce force?	Did the child take off and land three consecutive times on their preferred foot?	Did the child take off and land three consecutive times on their non-preferred foot?
Child A					

Figure 2: Circuit floorplan and station details



Station one: Running / Galloping / Sliding

Children will be required to start off at one cone and run to the cone placed opposite them, after this they will then gallop back to the first cone. Lastly, the child will be required to slide to the opposite cone.

Station two: Hopping

There will be a speed and agility ladder on the floor in front of the children they will be required to hop forwards on one foot three times then swap feet and hop forward three time on that foot.

Station three: Dribbling ball and under arm roll

Children will be given a 8-10inch ball and they will be required to stand still and dribble the ball 4 times without moving their feet. After this the children will be required to under hand roll the ball to the person opposite them.

Station four: Climbing on apparatus

Children will be required to climb up the apparatus halfway, whilst being spotted by an adult.

Station five: Balance beam

The children will be required to get onto the beam and walk from one end of it to the other placing on foot in front of the other.

Station six: Kicking and catching

The child will re quired to kick a stationary ball to the teacher who is standing opposite them. After the teacher receives the ball, they will then throw it to the child for them to catch.

The circuit above (Figure 2) focusses on GMS, providing minimal opportunities for FMS to be observed. Therefore, data was collected on the children's use of scissors and cutlery at different times throughout the school day by other practitioners and myself. Again, practitioners were given guidance as to what the criteria looked like in action and how to record their observations on the recording sheets found below in Table 2 and Table 3. Prior to the baseline data collection point, a trial run of the circuit was undertaken to test both FMS and GMS together. This proved to be too much for other staff members to observe at the same time, leaving them feeling slightly out of their depth. To ensure a sense of rigor and uphold the trustworthiness of the data, the proposed data collection circuit was edited and revised, and therefore split into two: the data collection circuit (testing mostly GMS) and explicit sessions to observe the children's use of scissors and cutlery (FMS). Participating staff then received multiple practice and training sessions prior to the baseline data collection point.

Table 2: observation sheet for the use of scissors

	Does the child hold the scissors in their dominant hand with the correct fingers?	Does the child open and close the scissors when cutting oppose to tearing the paper?	Can the child cut in a straight line?	Can the child rotate the paper whilst cutting?	Additional comments
Child A					

Table 3: observation sheet for the use of cutlery

	Does the child use their fork in their non-dominant hand and their knife in their dominant hand?	When using cutlery does the child's index finger point down the back of the knife and fork towards the prongs and the blade?	When using cutlery does the child stab food with their fork?	When using cutlery does the child cut their food?	When using cutlery does the child take food directly to their mouth?	Additional Comments
Child A						

3.8 The role of the researcher within observations and the training of all observers

Since the goal of an observation is to create a narrative that informs others about complex social structures and interrelated behaviours of a group, establishing the researcher's position is critical (Smith, 2022).

Observations can be either overt, meaning everyone is aware that they are being observed, or covert which means that the participants are unaware that they are being observed and the individual observing them is hidden (U.S Department of Health and Human Services, nd). However, U.S Department of Health and Human Services (nd) also note, that due to ethical concerns about obscuring observations, overt observations are commonly required. In this case, the children were aware that they were being observed. Although this can cause other ethical concerns as it is likely to be exposed to the 'Hawthorne effect' which Payne and Payne (2004) define as the propensity, especially among social studies, for individuals to alter their behaviour as a result of being observed, so altering and sometime misrepresenting the research findings, generally unwillingly. However, observing children is general practice for teachers to assess a child's understanding and competence of a topic and help them to develop and learn, especially in EYFS and KS1 (Bruce, Louis and McCall, 2014). It should be noted that prior to the baseline data collection point, 'practice observations' were undertaken with the class to get them used to coming into sessions, therefore, the practice of myself observing the children for this research is merely a continuation of their 'norm'.

Hammer, du Prel and Blettner (2009) further clarify that observer bias is another possible disadvantage. Observer bias is defined, by Mahtani *et al.* (2018), as any systematic deviation from the truth when observing and documenting research data. The U.S Department of Health and Human Services (nd) explain that to achieve high quality and consistency in the data gathering process, it is vital that the observers be thoroughly trained, although the degree of training will be contingent on the intricacy of the data gathering and the observers' unique skills. As was already noted above in Figure 2 found in section 3.6.1, the circuit has six stations, making it difficult to supervise each one and gather data for every single child. As a result, the researcher received support from other educators, practitioners, and teaching assistants within the school setting to assess the children in relation to the criteria listed on the observation sheets. Understandably, it is more than likely that the other teachers, practitioners, and teaching assistants assisting with data collection would have a different understanding of the criterion than the researcher. To rectify this, as can be seen in the SOW (found in Appendix F), the first session of week 4 was a 'mock circuit' and acted as a way to train others within the observational assessments as the researcher would not be the sole professional performing these observations. Milat *et al.* (2013) highlighted the importance of such training for professionals who are involved in research or a programme, are critical since they can have a major impact on the success of studies. This is why this research followed a form of 'careful study planning', recommended by Hammer, du Prel and Blettner (2009, pp.664), and included the mock circuit as a training time. This enabled all the teachers, practitioners, and teaching assistants an opportunity to practice using the data collecting sheets and for me to work with them to emphasise precisely what each success criteria (SC) looked like in practice. This consequently aimed to minimise any disparities in the understanding of each criterion, to ensure that consistency across the data collection process is upheld regardless of which adult gathered the data, as recommended by the U.S Department of Health and Human Services (nd) above.

3.9 Assessment criteria for motor skills

For many decades, the development of accurate and reliable measures to evaluate MC (the attributes that underpin performance, such as balance, agility, running speed and cohesion) has served as a foundation of motor development research (Morley *et al*., 2015). Most motor proficiency assessments have involved participants completing exercises and comparing them to norm-referenced measurable scores against a set of pre-established benchmarks (Cools *et al*., 2009). Kirk and Rhodes (2011) elucidate that such evaluations are often used to examine the impact of an intervention, typically aimed at enhancing young people's movement abilities, physical exercise, on children's motor proficiency. Similarly, to Cools *et al.* (2009) above observations, the researcher will compare the children within this study to a set of pre-established criteria to examine the impact of the interventions found within the SOW derived from recent government advice.

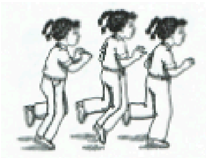
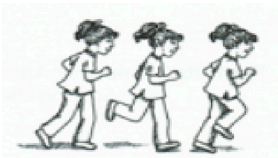
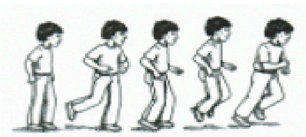
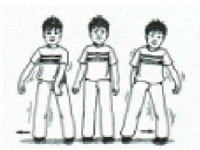
3.9.1 Assessment criteria for hopping, running, galloping, sliding, kicking, catching, dribbling a ball and an underarm roll

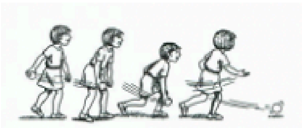
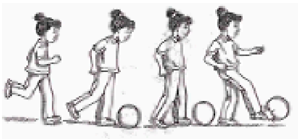
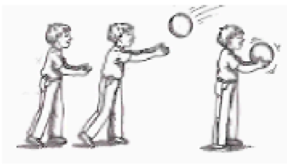
Within this research the researcher elected to use the criteria from subtests of the second edition of The Test of Gross Motor Development (TGMD-2) (Ulrich, 2000). The TGMD-2 can be defined as a standardized norm and criterion-referenced test (Aye *et al*., 2017) comprised of two gross motor development subtests, object and locomotor control, each of which has six tasks that measure a distinct element of gross motor development (Ulrich, 2000) (found in Appendix H). Some of the success criterion for these subtests can be found within Table 1 in section 3.6.1. Cools *et al*., (2009) review analysed the test substance, validity, and normative samples of seven movement skill assessment tools such as the TGMD-2. The review found that TGMD-2 does not examine FMS or stability movement skill development. Although the TGMD-2 is ideal to measure GMS, an alternate assessment criterion will be used to ensure that the researcher is able to examine FMS development in addition to GMS development.

Reflecting upon Cools *et al*. (2009) criticism, the children will be assessed repeatedly over the course of three terms to see how the scheme's implementation impacts the development of the participants movement skills. Cools *et al*. (2009) goes on to clarify that the TGMD-2 assessment tool is age appropriate for young children, such as those within this study, as there is an emphasis on object control movement skill development as well as giving information on skill mastering: both below and over skill level.

However, recent research (Huggett and Howells, 2022) indicated that just several of these subtests were challenging for these sample children. Taking this into consideration, eight specific subtests and their criterion were selected that the sample children had previously found difficult due to their delayed PD: hopping, running, galloping, sliding, dribbling a ball, catching, kicking and an underarm roll.

Table 4: Assessment criteria used from TGMD-2

Activity	***Criteria for assessment***
Hopping 	*Non-support leg swings forward in pendular fashion to produce force* *Foot of non-support leg remains behind body* *Arms flexed and swung forward to produce force* *Takes off and lands three consecutive times on preferred foot* *Takes off and lands three consecutive times on non-preferred foot*
Running 	*Arms move in opposition to legs* *Brief period where both feet are on off the ground* *Narrow foot placement landing on heel or toe (not flat footed)* *Non-support leg bent approx. 90 degrees*
Galloping 	*Arms bent and lifted to waist level at take-off* *A step forward with lead foot followed by a step with trailing foot to position adjacent to or behind the lead foot* *Brief period when both feet are off the floor* *Maintains a rhythmic pattern for four consecutive gallops*
Sliding 	*Body turned sideways so shoulders are aligned with the line on the floor* *Sideways step with lead foot followed by a slide of trailing next to leading* *A minimum of four continuous step-slide cycles to the right* *A minimum of four continuous step-slide cycles to the left*

Stationary dribble 	*Contacts ball with one hand at around belt level* *Pushes ball with fingertips (not a slap)* *Ball contacts surface in front of or to the outside of foot on the preferred side* *Maintains control of ball for four consecutive bounces without having to move feet to retrieve*
Underhand roll 	*Preferred hand swings down and back, reaching behind the trunk while chest faces cones* *Strides forward with foot opposite the preferred hand towards another child* *Bend knees to lower body* *Releases ball close to the floor so ball does not bounce more than 4 inches high*
Kicking 	*Rapid continuous approach to the ball* *An elongated stride or leap immediately prior to ball contact* *Non-kicking foot placed even with or slightly behind the ball* *Kicks ball with instep of preferred foot or toe*
Catching 	*Preparation phase where hands are in front of the body and elbows are flexed* *Arms extend while reaching for the ball as it arrives* *Ball is caught by hands only*

This criterion was outlined on observation sheets, that can be found in Appendix G, which enabled myself and other educators to be able to record if each individual child met or was unable to meet each specific criterion. This was repeated for each of the six circuits.

3.9.2 Assessment criteria for climbing

Within previous research (Huggett and Howells, 2022), it was identified other areas that the children had difficulty with, areas that were not included within the TGMD-2 subtests: climbing and balancing. Plevnik *et al.* (2012) created four qualitative factors of climbing, which were subjectively assessed on a three-point scale with point one being the lowest possible rating and point three the highest, to assess climbing proficiency (these criteria can be found in Appendix I).

Criteria was derived from proficiency variables and criteria mentioned in The Assessment of Climbing Skills in Four-Year-Old Children, developed in Croatia (Plevnik, Simunic and Pišot, 2014). Considering this criterion was established for four-year-olds, the decision was made to use only the criteria given the highest value (see Table 5 below). It is also worth noting that the children within the sample failed to reach the EYFS's age-related PD requirements during their last term in reception (Huggett and Howells, 2022). This suggests that their gross motor development is not comparable to that of a typical year one child (5-6-year-old), which is why this criterion is appropriate for their skills.

Table 5: Assessment criteria for climbing

Criteria 1:	**Criteria 2:**	**Criteria 3:**	**Criteria 4:**
Climbing is very rhythmic.	Child observes only the direction of climbing	Child mainly uses over grip and closed grip	The child often or always uses a diagonal reciprocal movement activation pattern

It is important to note the differences and similarities between Croatian education systems and English education systems. This criterion was developed in Croatia to measure climbing proficiency in 4-year-olds. Similarly, to England, Croatian pre-school education is voluntary for children aged 3 to 6 and is given through pre-school institutions. Elementary education is compulsory beginning at the age of six and lasting eight years with PE being one of the compulsory subjects throughout elementary school, which is again the same as UK schools. According to the Ordinance on the Content and Duration of Pre-Primary Educational Program (2008), the main task of the pre-primary educational programme in Croatia is to develop and improve a child's physical, emotional, social, and cognitive potential, as well as to stimulate her/his communication skills required for new forms of learning.

3.9.3 Assessment criteria for balance

A good assessment technique, according to Saether *et al.* (2013), should not only target the domain of concern, but be trustworthy, reliable, be simple to administer, and easy to accommodate change. I've used an adapted version of the assessment criteria previously used by Hutchinson, Yao and Hutchinson (2016) to assess balance in America, within this case study. To measure balance and core motor control, they employed simplified adaptations of the standard one-leg balance tests conducted on both steady and unsteady surfaces. Hutchinson, Yao and Hutchinson's (2016) research examined and documented the capacity of the participants to maintain balance. They were scaled from one (representing "normal" balance) to five (being an abnormal balance requiring step down). Within the circuit, the children were required to walk across a balance beam steadily and carefully, stopping in the middle. As the children were not asked to do a simple one leg balance, such as in Hutchinson, Yao and Hutchinson (2016) previous research, it was deemed necessary to adapt and modify their 5-point scale criteria. The criteria which was used to conduct this research can be found below, in Table 6.

Table 6: Assessment criteria for balance

Criteria 1:	**Criteria 2:**	**Criteria 3:**
No upper extremity and torso movement beyond central balance line.	The contralateral foot was not placed onto the ground.	Good hip control (no dropped hip).

According to Shafiq (2022), there are clear structural, academic, and instructional disparities between the US and UK school systems. Children often start formal schooling in the UK at the age of four, which is earlier than in the US and therefore the UK is said to place a higher early emphasis on academics (Relocate, 2022). However, young children's PE is highly valued in both the UK (Ofsted, 2022b) and the US (Chicago Public Schools, nd.). The aforementioned criterion was derived in Chicago. According to Chicago Public Schools (nd), they ensure schools create individuals who are physically literate and who have the knowledge, abilities, and confidence to partake in PA for the rest of their lives. In theory, our year one cohort participating in this study should be able to meet the balance criterion since UK children begin school earlier than US children, where the balance criterion is derived, and therefore participate in structured and child-led PD and PA within early years settings earlier than children from Chicago. Meaning this can be classed as a good assessment technique, according to Saether *et al.* (2013), as it targets the domain of concern, can be simply administered, and is adaptable to change.

3.9.4 Assessment criteria for the use of scissors and cutlery

The Department for Children, Schools and Families, within an ELG, required children to be able to 'use a range of small and large equipment' (2008, p.15). Within the 2014 framework from the DfE this was altered to incorporate particular tools, for instance a pencil. (DfE, 2023a, p. 39). Since 2014, further clarification has been given elaborating the phrase 'small tools' to include scissors, paintbrushes, and cutlery (DfE, 2023a, p.39).

The researcher will be using the same assessment criteria as used in Huggett and Howells (2022), found in Table 5 below. Observation sheets were created (found in Appendix G) with criteria for the use of both cutlery and scissors centred on age-associated PD needs outlined in Development Matters document (DfE, 2021) and the EYFS (DfE, 2021), allowing myself to record whether children able to or unable to meet the criterion.

Table 7: Assessment criteria for the use of scissors and cutlery

Using scissors	**Criteria 1:**	Does the child hold scissors in their dominant hand with the correct fingers?
	Criteria 2:	Does the child open and close scissors when cutting in opposed to tearing the paper?
	Criteria 3:	Can the child cut in a straight line?
	Criteria 4:	Does the child rotate the paper whilst cutting?
Using cutlery	**Criteria 1:**	When using cutlery, does the child's index finger point down the back of the knife and fork towards the prongs and the blade?
	Criteria 2:	When using cutlery, does the child hold their fork in their non-dominant hand and their knife in their dominant hand?
	Criteria 3:	When using cutlery, does the child cut their food?
	Criteria 4:	When using cutlery, does the child stab their food with their fork?
	Criteria 5:	When eating, can the child have take food to their mouth?
	Criteria 6:	Does the child use both their knife and fork?

3.10 Data collection and analysis

Data collection was through a 3-part system collected over 3 academic terms, April to July. The extensive data points included:

1) **baseline line PD measurement at the ST4**, the skills were: hopping, galloping, skipping, sliding, kicking, catching, dribbling, rolling, climbing, balancing, scissors usage and cutlery usage. Each PD item had 3-6 SC. A focused PD intervention SOW was implemented for the whole class.
2) **PD was collected at the ET4**, all the skills were reassessed at the end of term to look for progression, maintenance or regression in the skills.
3) This 2-part data collection process of start of term and end of term data collection points were repeated for the next 2 terms, T5 and T6. This produced overall a six data collection points which were used to assess the effectiveness of the MC interventions (SOW) and any regression occurring across holidays for all the GMS and FMS.

3.10.1 Trend Analysis

Trend analysis is defined as a research technique generally used for determining how and why things have changed or will change over time, according to Thomas *et al.* (2010). Trend analysis can be further characterised as a method of analysis that gathers data before attempting to identify patterns or trends in that information, to comprehend or anticipate behaviours. Regarding this study, trend analysis was used to compare the number of children who were able to meet success criteria for specific FMS and GMS actions for all the PD skills. Specifically, comparing data from baseline at the start of term 4 (ST4), to the end of term 4 (ET4), the start of term 5 (ST5), end of term 5 (ET5), start of term 6 (ST6) and end of term 6 (ET6). Furthermore, this will allow me to identify the impact of each SOW intervention and the impact that SH have on motor development.

3.10.2 Statistical Analysis

Due to the timeline and nature of the data, generalised estimating equations were used to analyse statistical data. To determine if there were changes throughout the SOW and tailored

MC interventions the Wald chi-square statistic was used. If significant (the significance threshold was set at 0.05), pairwise comparisons were employed to determine where these differences were throughout the scheme.

Data was coded in binary format (code 1 for achieving, code 0 not achieved). These non-parametric data with multiple repeated measures were then analysed using a generalised estimating equation (GEE). The GEE is designed to handle correlated data sets and non-parametric data (Hanley *et al.*, 2003). An example of one of the GEE outputs can be found in Appendix J. The Sidak test was then used for pairwise analysis with no corrections.

According to Hawthorne (2023), statistical significance testing is a commonly employed technique for ascertaining the validity and reproducibility of study findings. However, a number of concerns have emerged alongside research that casts doubt on the applicability and effectiveness of this statistical significance testing (Hawthorne, 2023). Grenville (2019) states that countless unforeseen repercussions result from the widespread misperception that being statistically significant' is the ultimate measure of truth.

According to Andrade (2019), there are two main reasons why the statistical significance method is under scrutiny: first, research data can have far more significance than what a p value and its statistical significance can convey; second, they are often misinterpreted, leading to inaccurate interpretation and evaluation. In order to avoid the mistake of misinterpreting data as statistically significant, when it may or may not be, the researcher will explain in the results section any progression or regression present within the percentage of children meeting each criterion. Thus, ensuring all context is given.

3.11 Ethical considerations

Strict ethical norms and procedures are in place to protect children from potential injury or exploitation when they are used as research subjects (Coyne, 2010). Researchers must seek the informed agreement of children and their parents or legal guardians before doing research on minors (Gill, 2004; McIntosh *et al.,* 2000). The position of the researcher within the contexts investigated, as well as the possible intricacy of the connections and interactions under inspection, all raise ethical concerns in practitioner research. According to Somekh (1995, p. 340), this might present 'knotty ethical problems' for the researcher to work through. 'Children are particularly susceptible to intrusions of private space and behaviour by researchers', as explained by Homan (2001, pp. 334), therefore an ethical approach to research is crucial (Tinson, 2009). Shaw, Brady, and Davey (2011) highlight that before any personal data is collected, consent to participate in the study must be obtained. When doing research with children and young people, it may take a number of steps of approval from gatekeepers before a researcher is in a position to ask for each child's assent (Shaw, Brady, and Davey, 2011).

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Canterbury Christ Church University (ETH2223-0101, 19 November 2022). All aspects of ethical considerations have been considered and discussed further within Appendix K.

3.12 Conclusion

The key methods and strategies that contribute to the research design of this study have been discussed within this chapter. As explained above, the researcher continued to utilise the case study approach within this study while ensuring to maintain the highest standards of rigour and impartiality. Furthermore, the methods and approaches chosen contributed to the study's validity, ethical considerations, research aims and questions, and data collection techniques. The following chapter will present the results of the study and discuss which skills and SC are deemed to have a significant effect of time.

Chapter 4: Results

This chapter will present the results gathered from observations of the six different data collection points for each skill performed within the circuits at the beginning and end of each of the three terms. Each skill has been split into their different SC. Further detailed pairwise comparisons (also using these abbreviations) for all of the results, that were identified to have a significant effect of time ($p<0.05$), can be found within Appendix L. Moreover, it is important to note that all results depict improvements, but not all of them are deemed as 'significant'. As mentioned previously (in chapter 2.8), it is important to identify both progression and regression points to consider the impact of SH on the children's PD journeys over the course of the timeline of this study.

4.1 Hopping

Figure 3 shows the percentage number of children meeting each of the five SC for hopping over the timeline of the study.

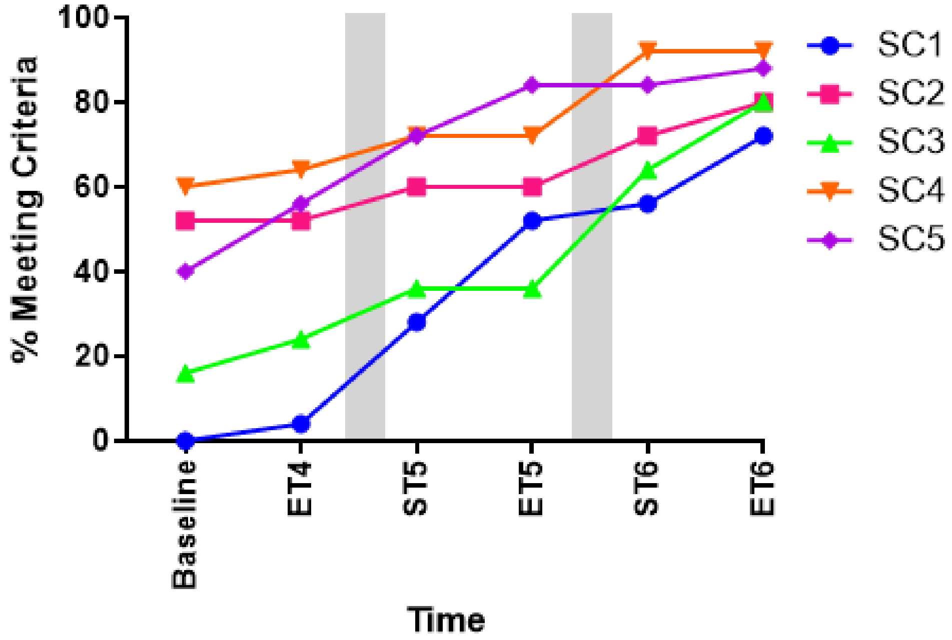


Figure 3: Hopping

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Within four of the five SC for hopping significant improvements were evident. These included: non-support leg swinging forward in pendular fashion to produce force (SC1) significantly improving 75% from baseline to ET6 ($\chi 2$ 17.091, $p<0.001$), foot of non-support leg remaining behind the body (SC2) significantly improving from 52% to 80% ($\chi 2$ 8.620, $p=0.035$), arms flexed and swing forward (SC3) which significantly improved 64% across the three terms ($\chi 2$ 22.730, $p<0.001$) and take off and lands three consecutive times on non-preferred foot (SC5) which significantly improved 48% ($\chi 2$ 18.756, $p=0.002$). Contrarily, SC4 (taking off and landing three consecutive times on preferred foot) shows no significant advancements ($\chi 2$ 7.786, $p=0.051$).

4.2 Running

Below, Figure 4 shows the percentage number of children meeting each of the four SC for running over the timeline of the study.

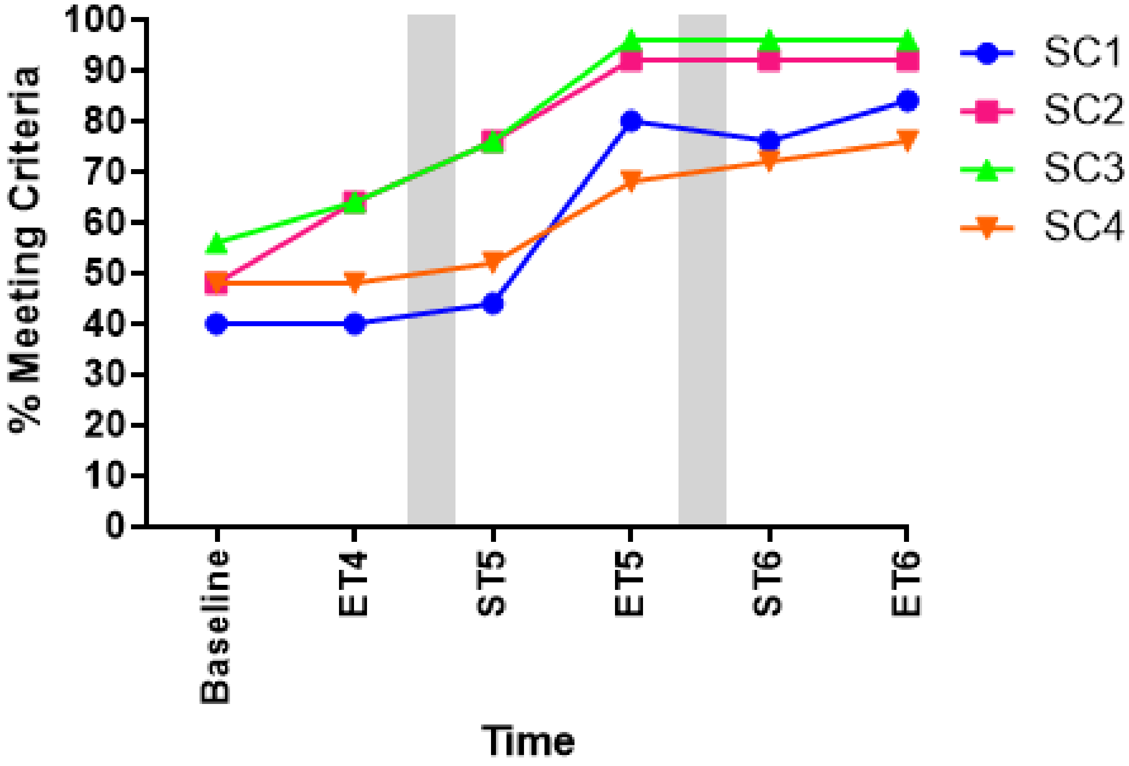


Figure 4: Running

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Significant improvements were identified within three of the four SC for running. These improvements can be seen in the following criteria: arms moving in opposition to legs (SC1) increasing 44% from baseline to ET6 ($\chi 2$ 14.561, p=0.006), a brief period where both feet are off of the ground (SC2) significantly improving from 48% to 92% ($\chi 2$ 13.216, p=0.04) and narrow foot placement landing on heel or toe (not flat footed) (SC3) which significantly improved 40% over the course of the three terms ($\chi 2$ 9.957, p=0.019). However, SC4 (non-support leg bent at approximately 90 degrees) revealed no significant developments ($\chi 2$ 8.677, p=0.070).

4.3 Galloping

Figure 5, found below, shows the percentage number of children meeting each of the four SC for galloping over the timeline of the study.

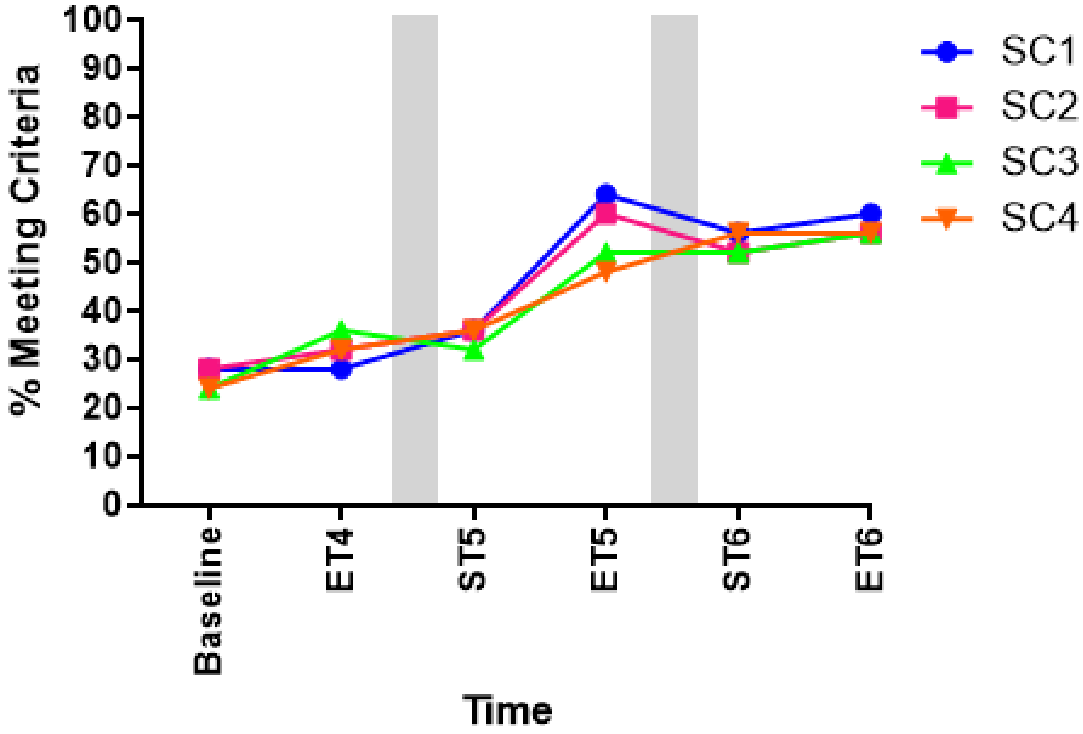


Figure 5: Galloping

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Within all four SC for galloping significant improvements were apparent. These SC are as follows: arms bent and lifted to waist level at take-off (SC1) increasing from 28% during baseline to 60% at ET6 ($\chi 2$ 15.008, p=0.005), stepping forward with lead foot followed by a step with trailing foot to position adjacent to or behind the lead foot (SC2) significantly improving 28% ($\chi 2$ 17.692, p=0.03), brief period when both feet are off the floor (SC3) significantly improving from 24% to 56% ($\chi 2$ 10.151, p=0.038) and maintaining a rhythmic pattern for four consecutive gallops (SC4) significantly improving 32% ($\chi 2$ 10.151, p=0.038).

4.4 Sliding

Figure 6 shows the percentage number of children, over the timeline of the study, meeting each of the four SC for sliding.

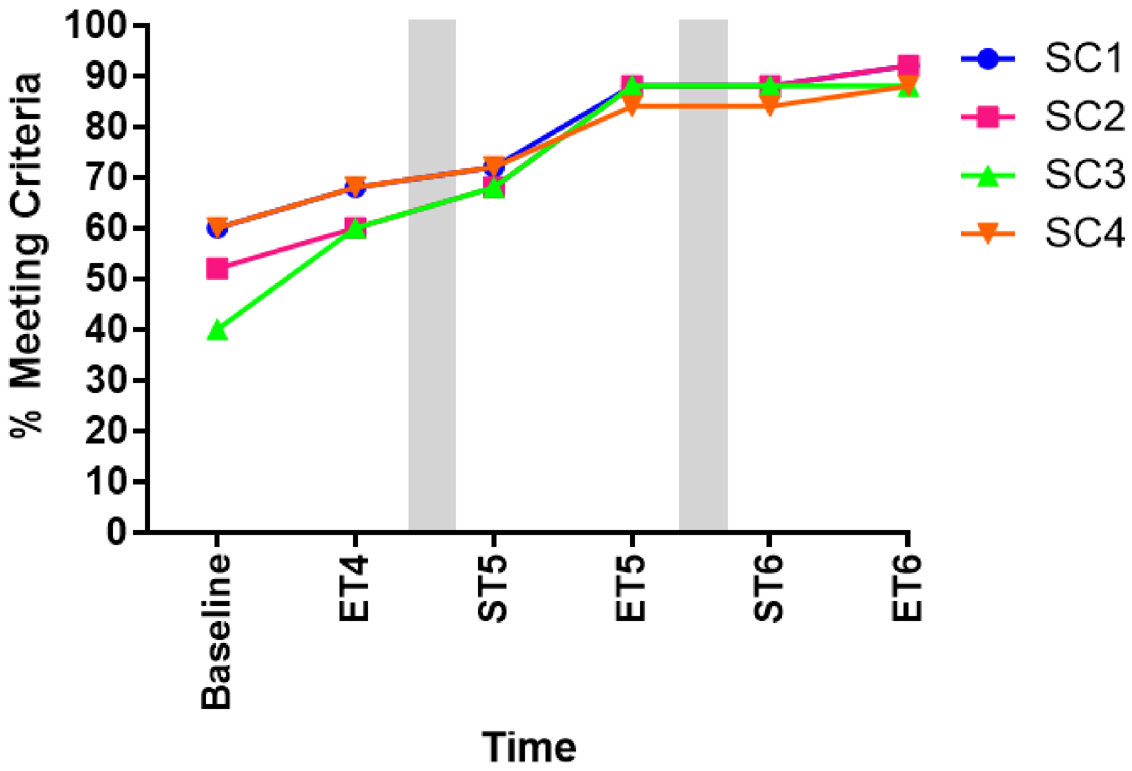


Figure 6: Sliding

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Significant developments can be identified in three of the four SC for sliding. These developments can be seen in: body turned sideways so shoulders are aligned with the line on the floor (SC1) which significantly improving 32% from baseline to ET6 ($\chi 2$ 9.578, p=0.048), sideways step with lead foot followed by a slide of trailing next to leading (SC2) improving from 60% during baseline to 92% at ET6 ($\chi 2$ 12.362, p=0.015) and a minimum of four continuous step-slide cycles to the right (SC3) which significantly improving 44% ($\chi 2$ 17.109, p=0.002). The final SC for sliding shows that there is no significant effect of time ($\chi 2$ 8.445, p=0.77).

4.5 Dribbling

Figure 7, found below, depicts the percentage number of children meeting each of the four SC for dribbling over the timeline of the study.

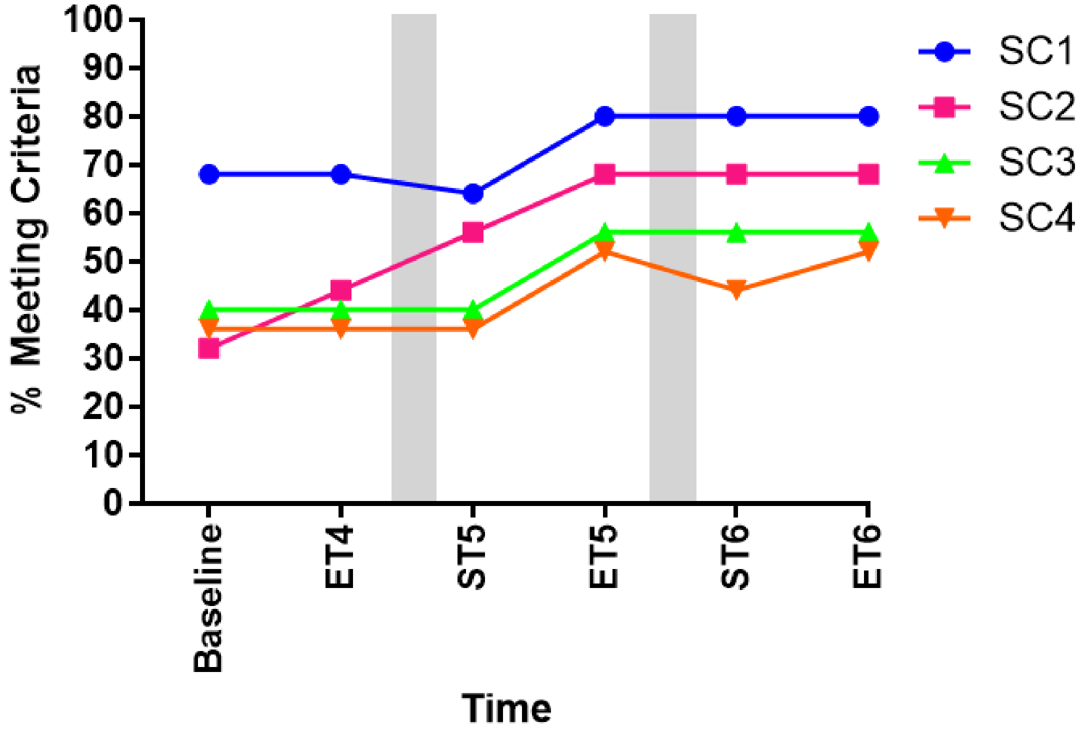


Figure 7: Dribbling

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

In two of the four SC for dribbling significant advancements can be noticed. These advancements are evident in the following SC: pushes ball with fingertips (not a slap) (SC2) which significantly improved 36% from baseline to ET6 ($\chi 2$ 11.705, $p=0.020$) and maintaining control of the ball for four consecutive bounces without having to move feet to retrieve it (SC4) significantly improving from 36% at baseline to 52% at ET6 ($\chi 2$ 8.088, $p=0.018$). However, no significant advancements were evident in SC1 (contacting the ball with one hand at around belt level) ($\chi 2$ 7.221, $p=0.065$) and SC3 (ball contacting the surface in front of or to the outside of foot on the preferred side) ($\chi 2$ 5.429, $p=0.143$).

4.6 Underarm roll

Figure 8 shows the percentage number of children meeting each of the four SC for an underarm roll over the timeline of the study.

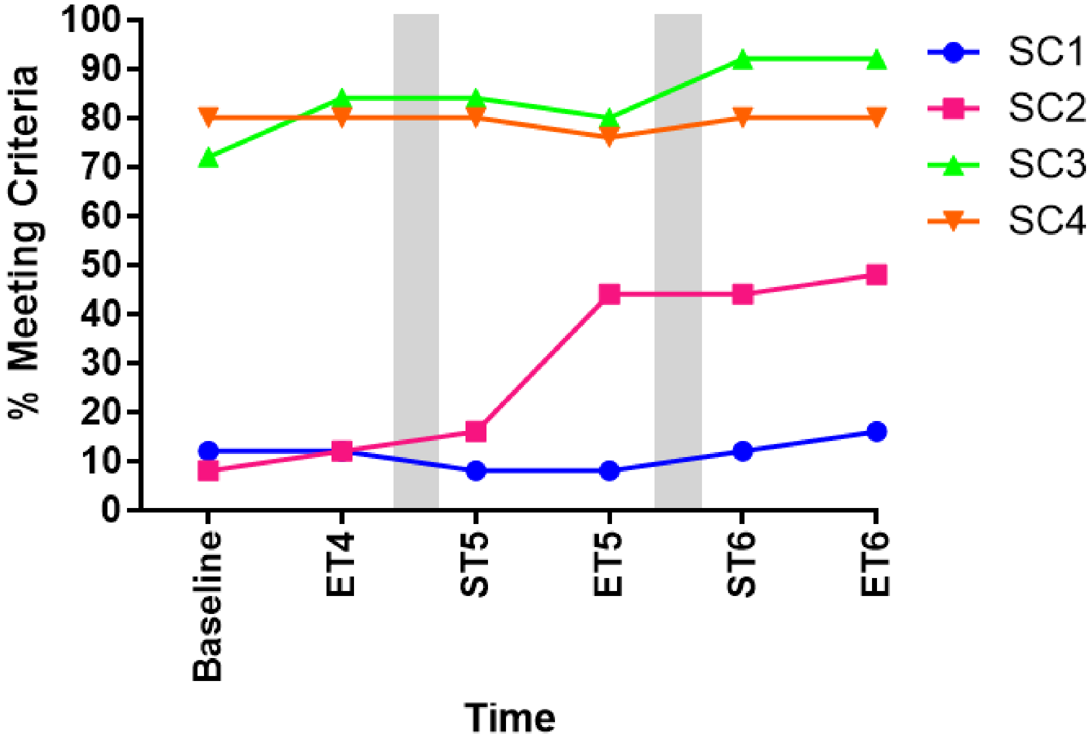


Figure 8: Underarm Roll

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Similarly, two of the four SC for a roll show significant developments; striding forward with foot opposite the preferred hand, towards another child (SC2) significantly improving 40% from baseline to ET6 ($\chi 2$ 12.594, p=0.013) and bending knees to lower body (SC3) significantly improving from 72% to 92% ($\chi 2$ 13.825, p=0.003). However, no significant effect of time ($\chi 2$ 2.116, p=0.347) was evident for SC1, preferred hand swings down and back. No further significant differences were found within SC4; reaching behind the trunk or releases ball close to the floor so ball does not bounce more than 4 inches high ($\chi 2$ 1.037, p=0.309).

4.7 Climbing

Below, Figure 9 depicts the percentage number of children meeting each of the four SC for climbing over the timeline of the study.

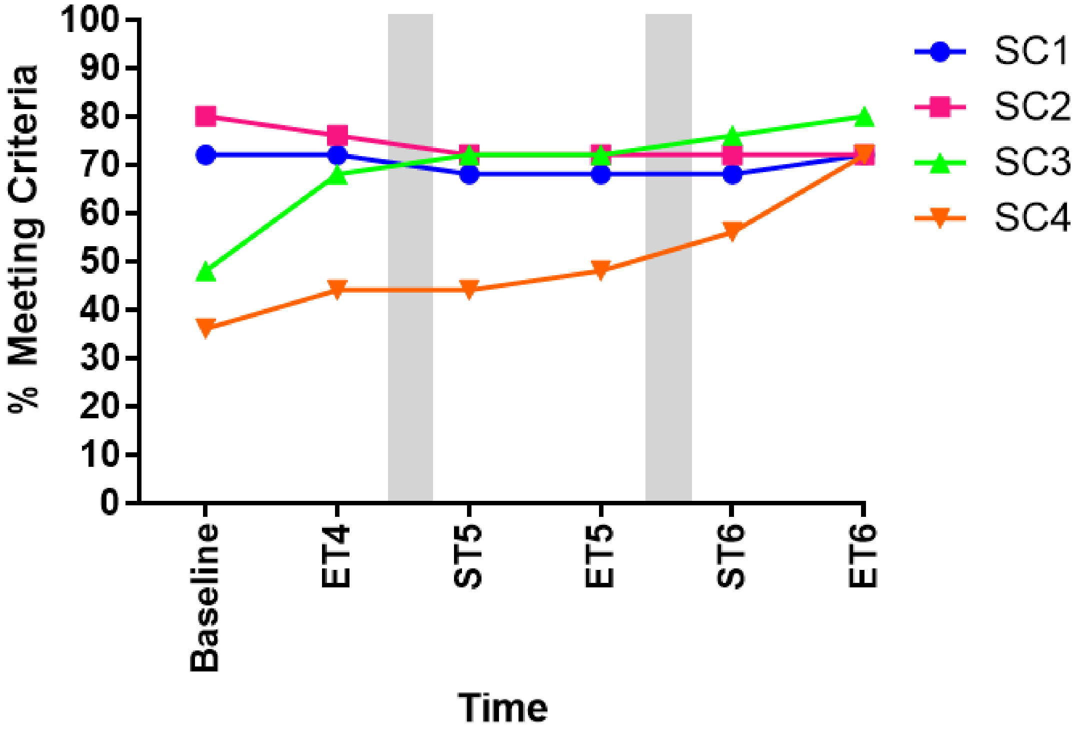


Figure 9: Climbing

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Significant advancements were evident within two of the four SC for climbing. These significant advancements can be seen in mainly using over grip and closed grip (SC3) which significantly improves 32% from baseline to ET6 ($\chi 2$ 11.544, p=0.042) and the use of diagonal reciprocal movement activation pattern (SC4) significantly improving from 36% to 72% ($\chi 2$ 12.611, p=0.013). Contrarily, no significant effect of time was found within SC1, climbing rhythmically ($\chi 2$ 1.039, p=0.308), or in SC2, observing only the direction of climbing ($\chi 2$ 2.147, p=0.342).

4.8 Balance

Figure 10 shows the percentage number of children, over the timeline of the study, meeting each of the three SC for balance.

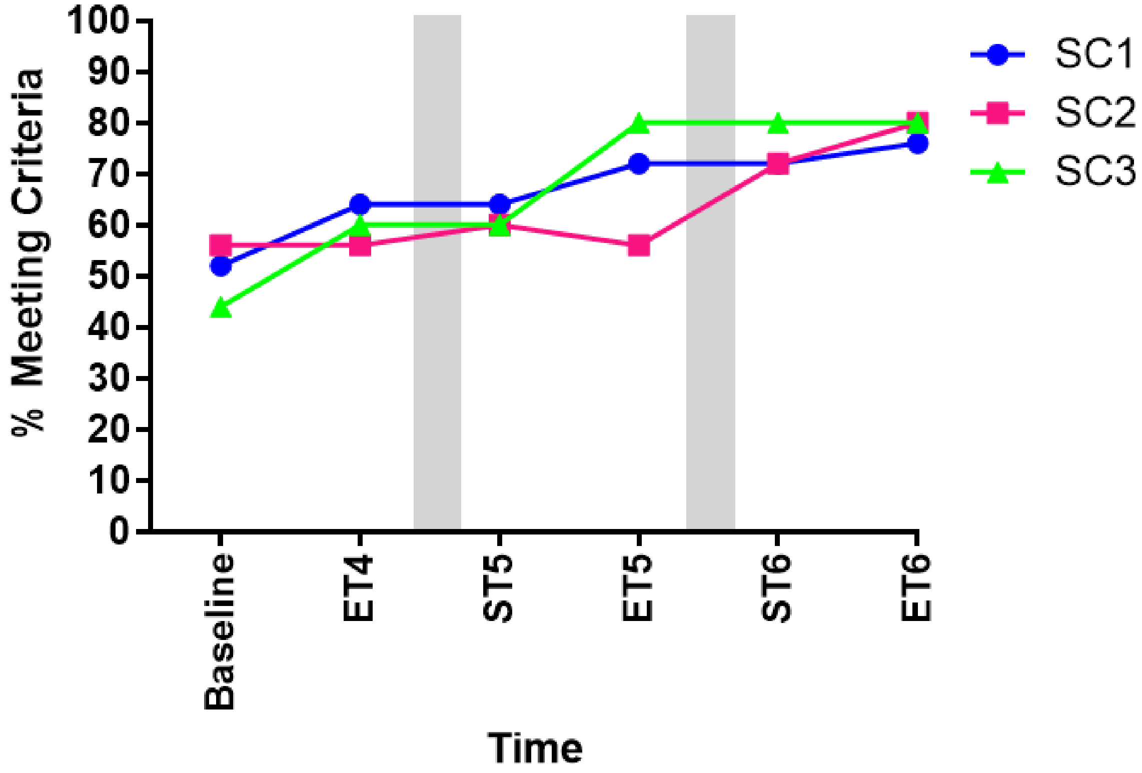


Figure 10: Balance

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Only one of the three SC for kicking was identified to have has a significant improvement: good hip control (no dropped hip) (SC3) significantly improving from 44% during baseline to 80% at ET6 ($\chi2$ 11.818, p=0.019). The other two SC were found to have no significant effect of time: no upper extremity and torso movement beyond central balance line (SC1) ($\chi2$ 7.254, p=0.064) and the contralateral foot being kept off of the ground (SC2) ($\chi2$ 7.453, p=0.189).

4.9 Kicking

Figure 11, found below, shows the percentage number of children meeting each of the four SC for kicking over the timeline of the study.

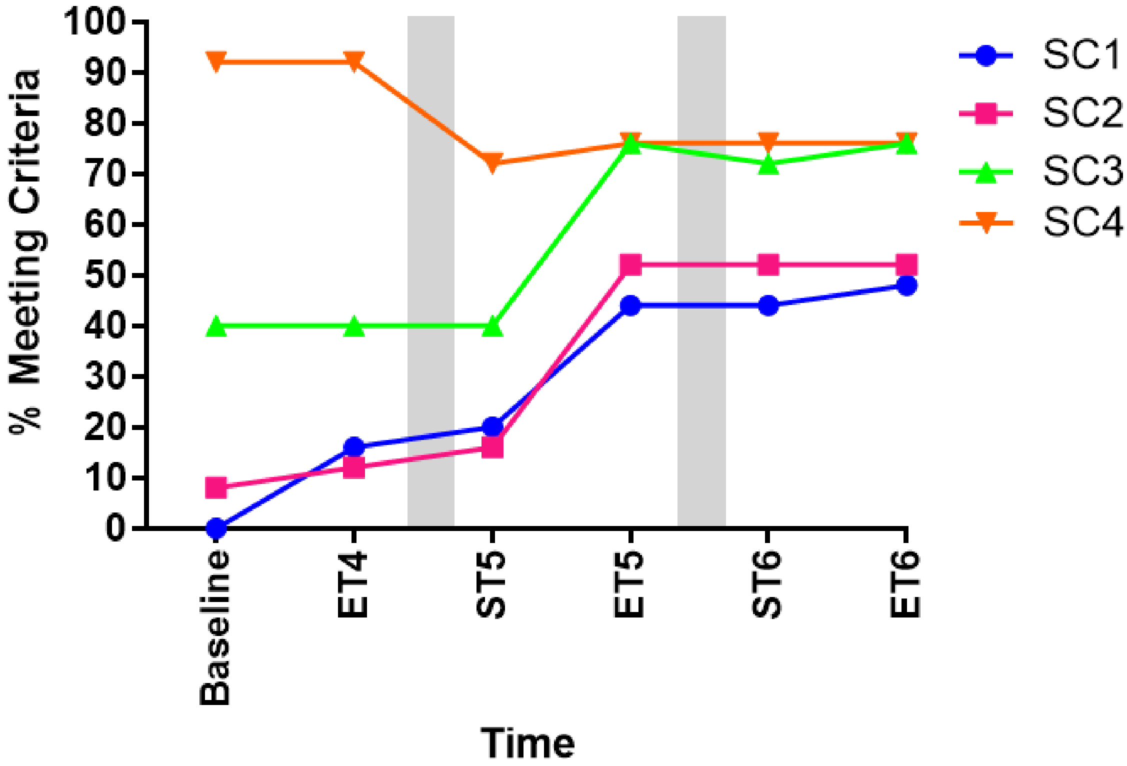


Figure 11: Kicking

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

A total of three, out of four, SC were identified to have had significant advancements within the skill of kicking. These advancements can be seen in the following criteria: rapid continuous approach to the ball (SC1) significantly improving 48% from baseline to ET6 ($\chi2$ 9.887, $p=0.020$), an elongated stride or leap immediately prior to ball contact (SC2) significantly improving from 8% at baseline to 52% at ET6 ($\chi2$ 14.381, $p=0.006$) and the non-kicking foot placed even with or slightly behind the ball (SC3) significantly improving 36% ($\chi2$ 12.353, $p=0.002$). The final criteria, kicking the ball with instep of preferred foot (shoelaces) or toe, was found to have no significant effect (SC4) ($\chi2$ 3.297, $p=0.192$).

4.10 Catching

Figure 12 shows the percentage number of children meeting each of the three SC for catching over the timeline of the study.

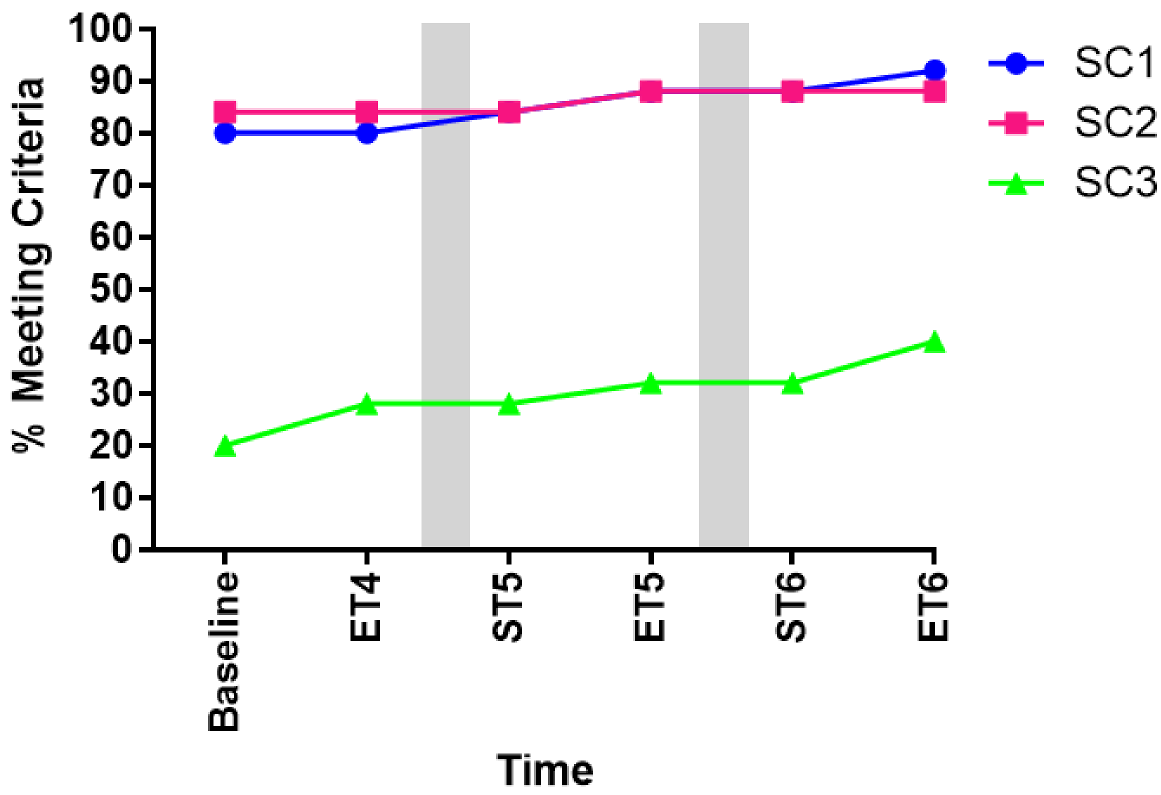


Figure 12: Catching

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Within all of the three SC of catching, none of them highlighted a significant advancement in development of any skill: preparation phase where hands are in front of the body and elbows are flexed (SC1) ($\chi 2$ 3.265, p=0.353), arms extend while reaching for the ball as it arrives (SC2) ($\chi 2$ 1.032, p=0.310) and ball is caught by hands only (SC3) ($\chi 2$ 5.854, p=0.119).

4.11 The use of scissors

Figure 13 depicts the percentage number of children, over the timeline of the study, meeting each of the four SC for the use of scissors.

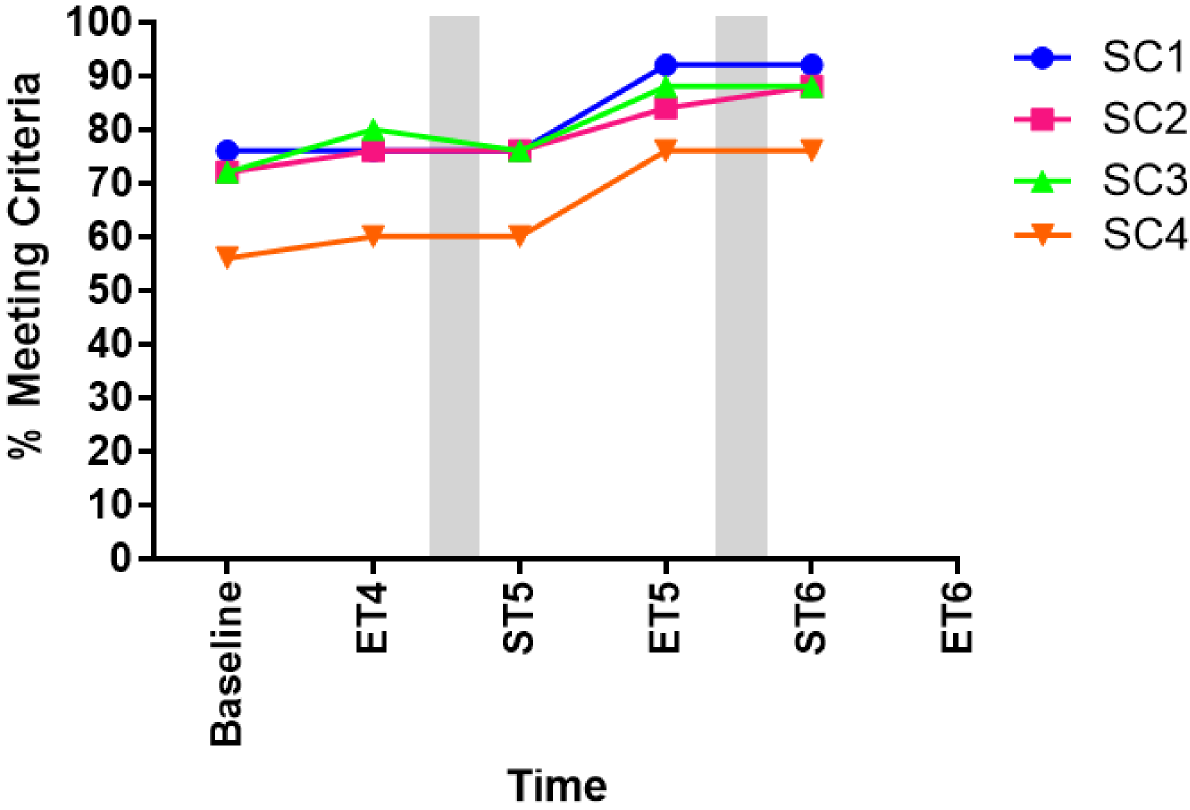


Figure 13: The use of scissors

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Within the four criteria for the use of scissors only one criterion had significant development: to cut in a straight line (SC3) significantly improving 16% from baseline to ET6 (χ^2 14.543, p=0.006). Meanwhile no significant effects of time were evident within the other three criteria: holding scissors in the dominant hand with the correct fingers (SC1) (χ^2 4.182, p=0.124), opening and closing the scissors when cutting in oppose to tearing the paper (SC2) (χ^2 6.839, p=0.145) and rotating the paper whilst cutting (SC4) (χ^2 5.802, p=0.055). It should be acknowledged that the last data collection point (at the ET6) was missed for this skill. The data for the four SC within this skill were gathered until the ST6.

4.12 The use of cutlery

Below, Figure 14 depicts the percentage number of children meeting each of the five SC for the use of cutlery over the timeline of the study.

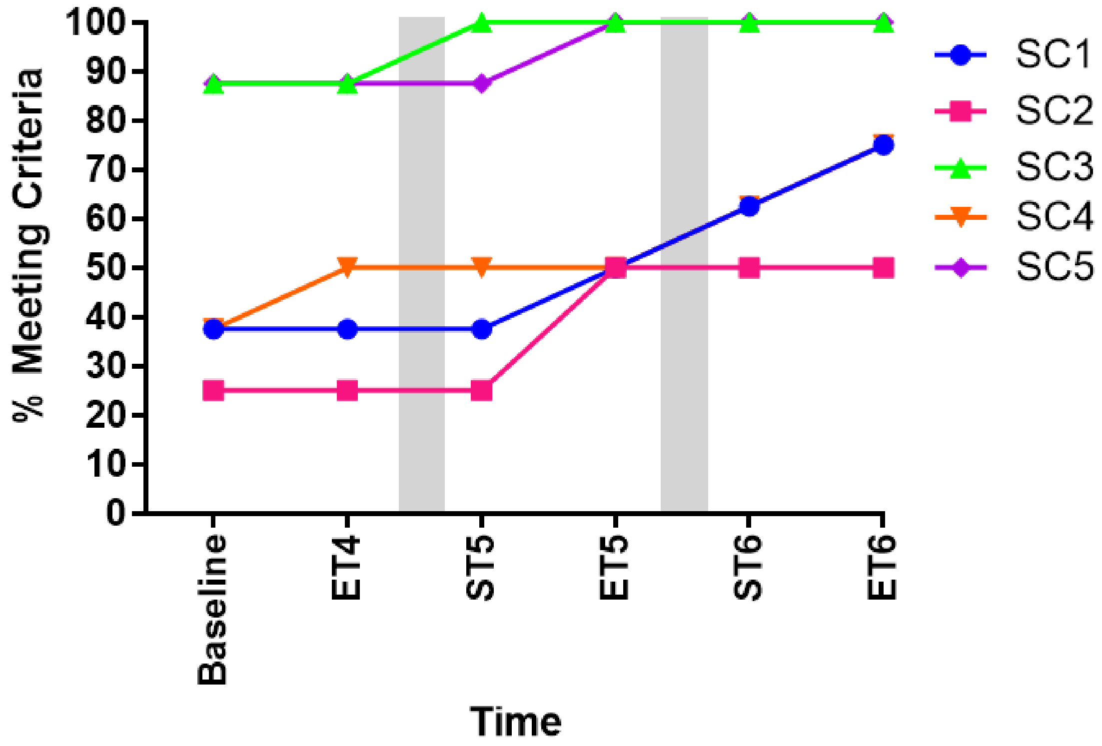


Figure 14: The use of cutlery

(ET4 = end of term 4. ST5 = start of term 5, ET5 = end of term 5, ST6 = start of term 6, ET6 = end of term 6, SC = success criteria).

Finally, within the five criteria for the use of cutlery, no significant improvements were identified: hold fork in non-dominant hand and knife in dominant hand (SC1) (χ^2 3.917, p=0.271), index finger pointing down the back of the knife and fork towards the prongs and the blade (SC2) (χ^2 3.890, p=0.143), stab food with a fork (SC3) (χ^2 0, p=1), cut the food with knife and fork (SC4) (χ^2 3.917, p=0.271) and take food to his/her mouth accurately (SC5) (χ^2 0, p=1).

4.13 The development of skills

Within each of the 12 skills observed within this study, the percentage of children executing each skill (and therefore meeting every SC outlined for that skill) increased over the period which the interventions within the SOW were delivered. Below is a table showing the percentage of children executing each skill during the baseline assessment (beginning of T4) and the final observation (the end of T6). This summary table is presented within this chapter clearly to be used for discussion purposes in the following chapter. The table below also outlines which section each of the skills is discussed within; GMS, FMS or core-strength and coordination.

Table 8 - The percentage of children executing each skill effectively during baseline assessment in comparison to end of T6 assessment.

	GMS	FMS	CS&C	Percentage of children executing the skill successfully, and therefore meeting each of the SC found within the skill, during the baseline assessment	Percentage of children executing he skill successfully, and therefore meeting each of the SC found within the skill, during the final assessment at the ET6
Hopping	×		×	32%	52%
Running	×		×	40%	72%
Galloping	×		×	24%	52%
Sliding	×		×	40%	88%
Dribbling		×	×	32%	52%
Underarm roll	×	×	×	8%	16%
Climbing	×	×	×	36%	72%
Balance	×		×	44%	76%
Kicking	×			0%	48%
Catching		×	×	20%	40%
The use scissors		×	×	56%	76%
The use of cutlery		×	×	25%	50%

Furthermore, although not every child was able to complete and execute the skill by meeting all the SC found within it. A percentage increase was identified within all 48 SC found across the 12 skills over the course of the implementation of the interventions found within the SOW. These percentages, for the number of children meeting each SC across all the 6 data collection points, can be found within Appendix M.

4.14 Conclusion

This chapter has presented the results gathered from observations of the six different data collection points, for each of the 12 skills performed within the circuits, which took place at the beginning and end of each of the three academic terms. It provided further detailing in regard to which of the SC found within each of the skills has been deemed to have a significant effect of time ($p<0.05$). The next chapter will discuss these results in relation to the literature review and how they answer the research aims and questions.

Chapter 5: Discussion

The aim of this study was to investigate how interventions can support young children's PD through the creation of a bespoke SOW. The SOW was designed to develop FMS, GMS, core strength, and coordination, using movement-based MC interventions. Statistically significant improvements (see Chapter 4) can be seen after the implementation of the interventions within aspects of GMS: hopping; running; galloping; sliding, dribbling; rolling a ball; climbing; balancing; kicking; catching; as well as in FMS in the use of scissors ($p<0.05$), however, no significant statistical improvements were identified within the use of cutlery ($p>0.05$). These specific improvements linked to the 3 – 6 elements of the SC for each the skills will be discussed and linked to the SOW. Furthermore, progression and regression that was evident over the course of the implementation of the MC interventions found within the SOW and the possible reasons and implications for these will be discussed, as well as SR and SH. Within this study a large amount of data was collected. Therefore, only certain aspects of the data will be discussed which have been deemed as the most significant, however all the data can be found within the results section and within Appendix L.

5.1 Preamble

Jiménez-Díaz, Chaves-Castro and Salazar (2019), highlighted it is crucial to carry out a thorough and effective preassessment to improve overall MC in young children as there is no guidance on the type or duration for MC interventions. Although Howells (2012) explains PA as a complex behaviour variable that can be especially challenging to measure in young children, this research has shown the importance of longitudinal assessment to provide a clear overview of the case study children's current MC. The baseline assessment in the research showed a low percentage of children meeting criteria within each of the SC (see Appendix M), identifying that these children were not meeting age-related expectations outlined within the ELGs (DfE, 2023). This indicates that the children were not developmentally ready to progress into KS1 (Huggett and Howells, 2022) and that the straightforward and effective transition between EYFS and KS1 that the DfE (2021) aim for was not possible for these children. This baseline measurement identified the need for intervention, to ensure the children within the case study school, were not left developmentally behind as undertaken in this research.

It should also be noted that some of the data discussed, for multiple criteria within the skills, show progression over the course of the SOW but are not deemed ‘statistically significant’. It is imperative to bear in mind that this does not necessarily imply a lack of progress or no impact (Cochrane Collaboration, 2013); rather, it implies that we cannot be certain that this progress was not the result of chance (Education Endowment Foundation, 2014) or other contributing factors. Therefore, as range of SC that are, and are not, deemed ‘statistically significant’ will be discussed - as they are noteworthy outcomes of this study and therefore contribute to lifelong and life wide development of a child.

5.2 How are gross motor skills developed?

As highlighted above in 2.6.1, GMS development is crucial for the development of healthy bodies, as well as social and emotional wellbeing (DfE, 2021). This SOW and the MC interventions within this, sought to develop these GMS through not only indoor but outdoor activities, as they are commonly acknowledged as a key aspect of development for young children which is often overlooked (Davies, 2006).

5.2.1 Hopping

Within the skill of hopping, accelerated progress is evident within SC1; non-support leg swings forward in pendular fashion to produce force. Progress was identified over each of the three terms but the most progress occurred in T5 and T6. To execute this SC effectively the children needed adequate leg strength and power to generate force during the hop. The muscles of both legs, particularly the quadriceps, hamstrings, and calf muscles, needed to contract forcefully to propel their bodies upward and forward. Within the SOW there are many interventions which support the development of leg strength required for the successful execution of this SC, such as:

- **Gardening** - Gardening encourages and promotes children's PD muscular strength, FMS, and coordination (DfE, 2023). Even though it is not deemed as an exercise that directly targets leg muscles, it is still a type of PA that strengthens the muscles in the lower body. Leg muscles are used for squatting, bending, and lifting when doing tasks such as planting, weeding, and moving bags of soil. These repeated motions can gradually develop the leg muscles, especially the quadriceps, hamstrings, and glutes.
- **Climbing** - Climbing is an effective way to strengthen leg muscles as it involves pushing and pulling with the leg muscles to propel the body upward and support body weight. It engages muscles like the quadriceps, hamstrings, calves, and glutes, while also challenging balance and stability.
- **Building an obstacle course** - van Hyfte *et al*. (2021) explain that repetitive participation with obstacle courses can lead to improved MC. Therefore, within the SOW, this involved building and manoeuvring through the obstacle course, which is proposed to aid in developing leg strength. The children were actively encouraged to incorporate tasks such as jumping over equipment, climbing, crawling under obstacles, and running between stations – all of which develop lower body strength.

Furthermore, the regular modelling and repetition of the skills throughout the assessment circuits contributes to the progression identified within this SC. As explained by Kajanus (2016), the repetition of the physical skill leads to the mastery of the skill.

5.2.2 Running

Running involves a repetitive sequence of movements, including lifting the legs, swinging the arms, and propelling the body forward; all of which require GMS to coordinate the large muscle groups in the legs, hips, and core to generate propulsion and maintain momentum. Running also requires adequate muscle strength and power to lift the body off the ground during each stride. SC2 within the skill of running involved the children having both feet off the ground for a brief period of time. This requires well-developed GMS as the muscles in the legs, particularly the quadriceps, hamstrings, and calf muscles, generate the force for propulsion. It should be noted that although GMS are vital for the execution of this SC, so is dynamic balance. This aspect of the skill will be discussed further below in section 5.5.2. During the baseline assessment 48% of children were meeting SC2 which rose to 68% by the end of T4. This figure further rose upon the return from the school break at the beginning of T5 from 64% to 76% at the end of T5, rising to 92% by the end of T6. Each of the terms there were many interventions which specifically targeted the development of GMS, and consequently contributed to the increased of the percentage of children meeting SC2 over the three terms, some of which are detailed below:

- **Building obstacle courses** – Purposeful play activities, such as obstacle courses, encourage children to participate in PA while promoting the development of MC (Sutapa *et al.*, 2021). Within this intervention the children were required to set up obstacle courses and were actively encouraged to include activities such as crawling, jumping and climbing. Crawling is a fundamental movement pattern that engages muscles in the legs, hips, and core. For example, the children crawled through tunnels and under obstacles within the courses which contributed to the development of both coordination and strength in the lower body muscles. The children also jumped over hurdles and leaped across gaps between equipment which challenge the lower body muscles to generate power and force. These jumping and crawling exercises helped to develop strength and coordination in the legs, needed to execute SC2 of running effectively.
- **Adventurous climbing and swinging** – According to Ridgers *et al.* (2011), greater time spent outdoors by young children is often associated with higher levels of PA, which in turn supports enhanced motor development. During these interventions children participated in indoor and outdoor adventurous climbing and swinging. Climbing and swinging require significant engagement of the muscles in the legs, including the quadriceps, hamstrings, glutes, and calves. These muscles worked together to generate force and propel the body upwards or forwards during climbing and swinging movements, and therefore placing resistance on the lower body muscles, promoting strength development. Additionally, the repeated contraction of leg muscles during

climbing or the force generated to push off and swing forward when swinging helped the children to strengthen muscles throughout their lower body.

- **Gardening** – Hands-on activities such as gardening, are known to promote the amount of PA that young children participate in (Lee *et al.,* 2017). The lifting and carrying of soil, navigation of uneven terrain, pushing and pulling of weeds and use of a shovel or spade to dig holes, turn soil, or plant seeds all required lower body strength and coordination. The pushing and lifting motions involved in digging engage muscles in the legs, therefore contributing to GMS development.

5.2.3 Galloping

Similar to what was mentioned above within 5.3.2, the skill of galloping requires a brief period of time where both feet are off of the ground (SC3). As expected, the results show similar levels of improvement over the course of the three terms rising from 24% during the baseline assessment to 52% by the end of T6, due to the interventions mentioned above: building obstacle courses, adventurous climbing and swinging and gardening.

The fourth SC of galloping requires the children to maintain a rhythmic gallop for four consecutive gallops. To execute a gallop rhythmically, the body engages muscles including the legs, hips, and core to execute the movement smoothly. Rhythmic galloping requires the entire body to be involved in the movement; the arms swing rhythmically to assist with balance and momentum, while the trunk and core muscles help stabilise the body and maintain an upright posture. Previous research (Hu *et al.*, 2020) has also emphasized the importance of rhythmic physical activity such as galloping as ways to improve children's overall fundamental movement skills, as seen in this study. The alternating steps and propulsion forward involve the muscles of the lower body. This SC gradually increased over the course of the three terms from 24% during the baseline assessment to 56% at the end of T6. This is due to the numerous interventions within the SOW that specifically targeted the development of GMS and whole-body movements such as:

- **Building obstacle courses** - By designing, setting up and then completing their own obstacle courses including activities such as crawling, climbing, jumping, and balancing the children encouraged whole-body movements and GMS development. The children navigated their way through their courses, engaging various muscle groups and improving coordination and agility.
- **Adventurous climbing and swinging** – Within these interventions the children were scaling structures such climbing walls, trees, and playground equipment which engaged their entire bodies in a range of movements, including reaching, pulling, stepping, and balancing; strengthening muscles, improves coordination, promotes spatial awareness and developing GMS. By the children swinging on swings, ropes, and monkey bars they also incorporated whole-body movements that required coordinated actions of the arms, legs, and trunk.

5.2.4 Sliding

Within the skill of sliding the children were required to complete a minimum of four continuous step-slide cycles to the right (SC3) and four continuous step-slide cycles to the left (SC4). Step sliding required the children to generate the force necessary to propel their bodies sideways. This involved activating muscles in their legs, hips, and core to push off with the stepping foot and control the sliding motion of the other foot. GMS are essential for coordinating these movements and generating the required force. SC3 and SC4 both showed a steady increase across all three of the terms. SC3 rose from 40% during baseline to 88% at the ET6. Similarly, SC4 rose from 60% during baseline to 88% by the ET6. This is due to the multiple interventions undertake and repeated throughout the course of the three terms which aimed to develop GMS and therefore help the children to generate the force for propulsion. The following interventions are outlined within section 5.3.2 in detail: **building obstacle courses, adventurous climbing and swinging and gardening.** The DfE (2022) recommended climbing as an activity to build core strength in children, as it involves weight bearing, repositioning the body and lifting all contributing to strength development. The engagement with regular climbing throughout the SOW likely contributed to the improvement found across SC3 and SC4.

It is also important to note that step sliding engages the entire body, not just the legs. The interventions found within the SOW which contributed to development of whole-body movement, such as those mentioned above in 5.3.3 (building obstacle courses, and adventurous swinging and climbing), were also vital in increasing the percentage of children meeting SC3 and SC4 within the skill of sliding.

5.2.5 Underarm roll

As explained previously, GMS involve the larger muscle groups and movements of the body (Early Movers, nd). These muscles are responsible for generating power and momentum needed for the underarm roll. The force needed to drive the ball forward at an adequate rate is produced by the synchronised movement of the arm, shoulder, and torso. To execute an effective underarm roll, the children required a fluid follow-through motion to release the ball close to the floor (SC4). A more precise and controlled roll is produced when a well-developed GMS facilitates the execution of a fluid follow-through action, allowing the energy from the initial motion to be transmitted to the ball with ease. SC4 of the underarm roll showed no progression over the course of the three terms – 80% of children met the SC during the baseline assessment and 80% met the SC at the ET6. This could be due to a lack of focus on the skill of the 'follow-through' motion present within the SOW, in opposed to the level of development of their GMS. On reflection, the researcher would ensure that throwing balls or beanbags underarm (with an emphasis on following through after release) was regularly modelled and encouraged in activities present within the SOW such as the **building of obstacle** courses. Furthermore, the researcher would incorporate target games within the SOW where children would be required to roll balls or other equipment towards a target area, encouraging them to aim for specific targets while maintaining a consistent follow-through motion. Cooper (1967) supports the use of obstacle courses that are planned and implemented efficiently as they explain that they can be effective in developing a whole range of muscular strength.

5.2.6 Climbing

Climbing involved the coordinated movement of the children's entire body, including the arms, legs, torso, and core muscles will be discussed in more detail below in section 5.5.7. For the children to perform these intricate movements, which include reaching, pulling, pushing, and stepping to scale the climbing wall, developed GMS were necessary. The overall percentage of children executing the skill of climbing rose from 36% during the baseline assessment to 72% at the ET6. Climbing relies heavily on upper body GMS due to the significant involvement of the arms, shoulders, and upper back muscles in pulling and supporting the body weight during ascent. The repetition of interventions mentioned above in section 5.3.1 which target explicit development of GMS contributed to the huge improvements seen across the three terms as DfE (2022) explain that through weight-bearing such as lifting and repositioning large items or by hanging and swinging from climbing equipment contribute to the development of upper-body strength (DfE, 2022).

Furthermore, the children have access to climbing facilities everyday outside on the playground, having potential to promote PD due to the rich affordance landscape (Flôres *et al.,* 2019). However, it is important to consider Koller (2004) who explained that just because this activity which has the ability to specifically target GMS development does not necessarily mean that the children will immediately recognise this and take advantage of it. However, as PE lead it is my responsibility to ensure that children have the opportunity to engage in adjacent environments at school, and in sporting situations—as stressed by Flôres *et al.* (2019).

5.2.7 Balance

Well-developed GMS contribute to good postural control, allowing the children to maintain an upright and balanced position while walking along the beam. SC1 of balance required the children to ensure there was no upper extremity and torso movement beyond the central balance line. This involved coordinating movements of trunk, limbs, and head to counteract shifts in weight and maintain equilibrium. Steady improvements were identified within SC1, rising from 52% during baseline assessment to 76% by the ET6- with no regression or progression identified within SH. This improvement is due to interventions found within the SOW such as the building obstacle courses. The children were actively encouraged to include activities such as crawling and climbing under and over obstacles, balancing on beams, and stepping over hurdles. By navigating their way through the courses, the children developed and maintained postural control in various positions and movements. Furthermore, the children's involvement in multiple other activities, outside of the SOW, contributed to the development of their postural control such as those which include repositioning large, heavy items or by hanging from climbing equipment (DfE, 2022):

- Participating in **outdoor bouldering activities on the playground**, which challenged the children to use their upper body strength and core stability to navigate multiple different climbing routes- requiring balance, coordination, and postural control while ascending and descending.
- Engaging with **playground equipment** which offered opportunities for the children to practice balancing, hanging, and climbing, which all contribute to the development of postural control.
- Attending **dance and gymnastics clubs** before and after school. Handstands, cartwheels, and backbends are examples of gymnastics exercises that call on balance, coordination, and core strength. Many of the children were inspired to move their bodies in synchronised, expressive ways through dance exercises. The variety of dancing forms encouraged flexibility, balance, and postural control.

Within SC3 the children were required to ensure they had good hip control with no dropped hip. When walking on a beam, maintaining level hips required strong core muscles, including the muscles of the abdomen, lower back, and pelvis. These muscles provide stability and support to the hips, allowing the children's hips to remain level and steady during the activity. When walking on the beam the children required continuous adjustments to maintain their stability, and good hip control ensures that these adjustments are made effectively to prevent hip dropping or tilting. Improvements within this SC were present over the course of T4 rising 16% from 44% during the baseline assessment to 60% at the ET4. This figure continued to rise from 60% upon the children's return at the ST5 to 80% at the ET5. These improvements are due to the following interventions and activities found within T4 and T5 SOW:

- **Wheelbarrow walks** – wheelbarrow walks were a huge part of each warmup activity within T4. They involve the children walking on their hands while a partner holds their legs. This activity strengthens the muscles of the arms, shoulders, and core while promoting coordination and stability.
- **Building obstacle courses** – The children were actively encouraged to build obstacle courses that included activities such balancing on beams, stepping over hurdles and navigating their way through and around cones and other equipment. These challenges required the children to engage their core muscles to maintain stability while moving through the vastly different courses created by each group.

5.3 How are fine motor skills developed?

As explained earlier by Gallahue, Ozmun, and Goodway (2011), the sooner children have the opportunity to develop their FMS through proper instruction and practice opportunities, such as those found within the SOW of this study, the better their self-esteem, academic success (NHS Isle of Wight, nd) and long-term health outcomes become (Bremer and Cairney, 2018) – since they are comparable to ABCs regarding their significance in movement (Goodway, Famelia and Bakhtiar, 2014). This study sought to provide the children variety of rich chances for both big and small movements, as recommended by the DfE (2022). These were provided through the 9 different MC interventions found within the SOW (outlined in Appendix E and F) alongside the frequent repetition of the assessment circuit (found in Figure 2 within section 3.6.1). As PE lead within my school and a class teacher myself, it was crucial to me that every child within this study was encouraged in the development of their FMS and supported by adults when necessary (as further recommended by DfE, 2022). Other practitioners, alongside the research, were there throughout the delivery of the SOW to support children, offer alternate equipment which was better suited and provide praise and encouragement.

Overall, when observing data gathered on the SC, less progress was identified within SC that focus on FMS development in comparison to SC that focussed on GMS development. Although less progress was identified across the board in regard to SC relating to FMS development - within the use of scissors, just 25% of children were found to execute SC2 during baseline assessment yet that figure rose to 100% by the ET6. SC which requires FMS, found within some of the other skills, will be detailed further below.

5.3.1 Dribbling

Within the skill of dribbling, pushing a ball with the fingertips (SC2) requires developed FMS due to the precision and control needed to manipulate the ball effectively. When pushing a ball with the fingertips, the child must exert the right amount of pressure and apply force in a controlled manner. FMS allow the children to isolate the movements of their fingers and adjust the force they exert with precision. This level of control is necessary to ensure that the ball travels in the desired direction and with the desired speed. Pushing a ball with the fingertips also requires coordination between hand movements and visual perception. There was improvement over the course of T4 and T5, rising from 32% of children meeting SC2 during the baseline assessment to 68% by the end of T5. Within T4 the children participated in a lesson where they made cookies, contributing to their development of precision and control of FMS (DfE, 2022). Measuring out ingredients, mixing dough, and using a rolling pin all foster precise coordination and control of FMS. Similarly, pressing cookie cutters into the dough carefully and lifting them out without distorting shapes further define FMS. Anggraheni (2019) elucidates that the benefits of cooking activities include early childhood growth and development, and effective practice pf children's FMS, leading to development. Furthermore, Maranatha and Briliany (2023) found notable improvements in the FMS development of children who participated in enjoyable cooking activities. The children also participated in an intervention which required them to build their own obstacle course. **Setting up the obstacles** required the children to handle various objects, such as arranging cones, placing hurdles, positioning balance beams and tying knots. The children's dexterity and control over their hand motions improved as a result of these activities, which also enhanced their FMS.

5.3.2 Underarm roll

Effective underarm roll execution demands developed FMS, just as accurate ball gipping calls for developed FMS. A smooth roll necessitates having an appropriate tension and control when holding the ball. Furthermore, developed FMS enable the children to control their wrist movements accurately, flexing and rotating their wrist to impart the desired spin to the ball. As seen above in Table 8, there was an 8% increase of children being able to effectively execute an underarm roll over the course of the three terms. In comparison to other improvements, this is considerably lower. Within the skill of an underarm roll the children are expected to grip the ball using just one hand, which is different to all other skills which require the children to grip a ball with two hands (catching) or to grip smaller objects (scissors or cutlery). Gripping a ball requires more hand strength and often involves spreading the fingers wider apart to encompass its surface. This requires greater finger dexterity and coordination to maintain a secure grip compared to holding smaller objects such as scissors or cutlery. Holding a larger ball for an extended period, such as swinging the arm back to the desired position before bringing it forward to release in an underarm roll, requires sustained muscle control and endurance, particularly in the hands, wrists, and forearms. The children more than likely needed to build up their muscle strength and stamina within their hands, wrists, and forearms within interventions over time to grip the balls comfortably. Upon reflection some of these skills were not targeted as explicitly as others found within other skills which more than likely accounts for the lack of evident improvement over the three terms.

5.3.3 Climbing

When climbing, children often need to make small adjustments to their grip on holds, especially when using an over grip which is grip required within SC3 for climbing. Dramatic improvements were identified within SC3 – rising from 48% during baseline assessment to 68% by the end of T4. However, over the course of T5 no improvements were identified, upon the return from the one-week school break at the end of T4 72% of children were meeting this SC. This figure remained the same throughout T5. This figure then rose to 80% of children by the end of T6. Well-developed FMS allow the children to make the subtle adjustments required to execute this SC successfully with their hands in order to maintain a secure grip on the hold. This type of grip requires precise finger placement and tension control to maximise contact with the hold and distribute their body weight effectively. Over the course of T4 and T6 many interventions within the SOW targeted the development of FMS and tension control:

- **Baking cookies and making playdough** - Within these interventions the children baked their own cookies and made their own playdough. They kneaded and rolled the dough which required varied levels of finger tension control. The children also squeezed and shaped the cookies and playdough which helped to develop strength and dexterity in their fingers.
- **Adventurous outdoor climbing and swinging** – Howells (2016) emphasises the importance of understanding how outdoor spaces are utilised to promote PA and PD. In line with this, the SOW included outdoor activities such as climbing and swinging, allowing children to engage in these physical challenges. Within this intervention the children partook in climbing and swinging in the outdoor environment, this consisted of playground equipment, trees and rope swings within the school grounds. Children must use mostly their hands and fingers to support their body weight as they climb and swing. Gripping onto holds, ropes, or bars provided a challenge for the muscles in the children's fingers, hands, and forearms, gradually building grip strength and finger tension control over time. Children had to change their finger tension to suit the needs of each unique grasp on the variety of trees, climbing apparatus, and monkey bars, which included a variation of surfaces. This helped children acquire finely tuned control (Howells, 2016).
- **Building obstacle courses** – Within this intervention the children were instructed to construct an obstacle course including tasks that encourage the development of FMS such as tying knots and securing ropes. These activities required precise finger movements and tension control to manipulate and fasten equipment in place. Within this intervention the children also had the chance to climb over numerous objects, with an adult modelling the correct hand placement for this. This type of modelling is supported by Curtin (2014) who explains that through modelling, educators are able

to demonstrate the activity effectively and ensure proper form is employed by the children (Curtin, 2014).

- **Weaving** - Weaving enhanced the children's FMS by supporting them with grasping, establishing their pincer grip, and manipulating various materials (Gov.uk, 2022).

As the children begun to develop, learn and improve a variety of FMS throughout these activities, their capacity to perform movement skills, such as climbing, increased rapidly, as outlined by Gallahue, Ozmun and Goodway (2012). Michigan State University (2016) explain that participation in activities that have a focus on FMS, such as the ones outlined above, are also crucial for children to develop their coordination and regulation of their body movements.

5.3.4 Catching

Similar to 5.4.1, catching a ball requires developed finger dexterity and grip control. The act of the children catching a ball involved quick hand and finger movements in order to close their hand around the ball. FMS, particularly finger dexterity, allowed the children to perform these movements efficiently. During the baseline assessment the overall number of children who met each SC within the skill of catching was just 20%, which doubled to 40% by the ET6. This is due to the many interventions within the SOW aimed to develop the children's FMS, consequently improving their finger dexterity (which are discussed above within section 5.4.1).

5.3.5 The use of scissors

Mastering the use of scissors, which involves both hand–eye coordination and precise limb control, can contribute to the development of other FMS (Tarmidi and Bakar, 2022). SC1 within the skill of using scissors required the children to hold the scissors with their correct fingers in their dominant hand. This action of holding the scissors required FMS fundamentally because it involved the control and coordination of the children's fingers and hand muscles to manipulate the scissors effectively. The children hold scissors with a precision grip, which entails grasping the handles of the scissors with their thumb, index, and middle fingers. For children to be able to precisely place their fingers and apply the proper amount of pressure to grasp the scissors firmly, they require well-developed FMS. SC1 saw its first increase in the percentage of children meeting it within T5, increasing from 75% at the beginning of T5 to 92% by the ET5.

Furthermore, SC2 within the skill of using scissors required the children to open and close their scissors when cutting paper, in oppose to ripping it. A steady progression over the course of T4 and T5 was identified within this SC with 72% of children meeting the SC during the baseline assessment rising to 88% at the ST6. Well-developed FMS enable the children to regulate the amount of pressure they apply to the scissors handles to ensure that the blades meet smoothly and cut through the paper without excessive force, avoiding tearing.

Both SC1 and SC2 require the children to be able to regulate the delicate control the children needed to have over their finger muscles to achieve the desired cutting effect – ensuring that the correct amount of pressure to hold the scissors correctly and apply the correct amount of pressure when cutting. This is developed within interventions found within the SOW, such as:

- **Using scissors** – within the SOW the children had an explicit lesson in using scissors correctly. By ensuring children have explicit lessons modelling the correct amount of pressure the children were able to work within small groups with adult support and guidance, developing their understanding of the amount of pressure to apply and when to apply it through discussion and modelling.
- **Gardening** - Engaging children in gardening activities and enabling them to use a variety of tools can significantly support the development of their motor skills (Gutek, 2004). Within the SOW, children were required to trim plants with scissors and pruners (guided by adults), ensuring that they were applying the right amount of pressure to cut without damaging the plant. This activity helped the children to develop control over pressure regulation and FMS.

Within SC2, the thumb is an essential component in the operation of the scissors, as it controls the opening and closing of the tool. FMS are required to synchronise thumb movement in order to manage the cutting process and smoothly operate the scissors. Within the SOW the children participated in weaving, which involved them cutting strips of paper to weave. By engaging in crafting activities such as this that involve cutting paper allowed the children to practice using scissors, promoting skill development and precision.

5.3.6 The use of cutlery

Within SC4 of the use of cutlery children are required to cut their food with a knife and fork. Cutting through different types of food requires varying levels of pressure. FMS allow the children to adjust the pressure exerted on the knife according to the food's texture. During the baseline assessment, 37.5% of the children met SC4 by the ET6 that figure rose to 75%. This is thought to be due to the extensive number of interventions within the SOW that aim to develop FMS which are discussed in detail within this section (5.4).

5.4 How are core strength and coordination developed?

The development of core strength is crucial not just for core muscles but to improve balance and coordination (Great Basin Orthopaedics, nd). Through the SOW specifically tailored to improve core strength and coordination activities such as baking required the children to children to roll and flatten dough with their hands or a rolling pin to help them practice using both hands in a coordinated manner, as recommended by DfE (2022) to promote development of coordination. Other activities specifically focussed on the development of bilateral coordination – using both sides of the body simultaneously (Alder Hay Childrens NHS Foundation Trust, nd) – to climb, use a rolling pin or weave paper. Hand-eye coordination is vital for academic success (Tanic, 2021) and when learning to read (Mayesky, 2014).

It is paramount to remember that core strength and coordination is not a subsection of PD within the ELG's like FMS and GMS, instead it is mentioned in the DfE (2022) Help for Early

Years document. Just a brief mention of core strength and coordination is given in the statutory EYFS framework (DfE, 2021), which suggests that adults may assist children to develop these skills by creating activities and giving them opportunities to play both indoors and outside. As outlined previously in 2.5.2, due to the lack of recognition for core strength and coordination within this 2021 framework—despite its pivotal role as one of the "three areas" within the government's most recent guidance, Help for Early Years providers (DfE, 2022)—this has subsequently confused educators, EYFS teachers, and practitioners. This poses the question; Why is core strength and coordination not regarded as one of the PD ELGs within the EYFS Statutory Framework? Especially when considering that every skill observed within this study requires an aspect of core strength and coordination to be executed correctly. However, not all these skills require both FMS and GMS. Without a mention of core strength and coordination within the ELGs, and the confusion that emerged from its sudden appearance within the Help for Early Years providers document (DfE, 2022) it is evident that early years educators are not receiving enough guidance on how to effectively develop young children's core strength and coordination through engaging activities.

5.4.1 Hopping

SC1 within the skill of hopping has a 36% increase over the course of T5. This SC requires efficient bilateral coordination which is the capacity to efficiently employ and coordinate motions of the legs and arms in activities (NHS, 2013), as well as to use both sides of the body simultaneously (Alder Hay Childrens NHS Foundation Trust, nd). Within the skill of hopping, bilateral coordination is key as children are required to push down with one leg whilst pulling up the other, when hopping four times in a row, using and coordinating both sides of their bodies in opposition to each other. This 36% increase that occurred over the course of T5 was due to multiple interventions found within the T5 SOW, such as:

- **Building obstacle courses** – Firstly, when building the actual courses, the children were placing equipment such as cones, hurdles, or balance beams in different points within their courses which required the children to use both hands together to manipulate and position the equipment. Later during the intervention, the children had the opportunity to navigate their own way through their own, and others, obstacle courses. Moving through the obstacle courses required the children to coordinate the movements of both sides of their body to navigate turns, twists, and changes in terrain and elevation.

- **Wrapping and moving items** – This activity required children to wrap items in wrapping paper and secure using tape. The children had to use scissors to cut wrapping paper which required coordination between their dominant hand, which held the scissors, and their non-dominant hand, which held the paper. The children then had to stabilise the paper with one hand while cutting with the other hand, promoting bilateral coordination. To secure the wrapping paper, the children had to use one hand to hold the paper steady and the other hand to tear and apply the tape, requiring bilateral coordination.
- **Gardening** – Within this intervention the children were pulling weeds from the soil which involves gripping the weed with one hand and pulling it out while stabilising the surrounding soil with the other hand. This develops coordination between the children's hands.

DfE (2022) released guidance to support educators; they explained that children must have many opportunities to engage in activities both inside (such as the building of the obstacle course) and outside (such as the gardening) to gradually gain more control over their body and what they can do.

To meet SC2 of hopping the children were required to ensure their non-support leg stayed behind their body. Over the course of T6 the percentage of children meeting this SC rose from 72% to 80%, following a high percentage increase over both SH (which will be discussed further in more detail within section 5.7. This SC required balance as the children had to keep their non-support leg behind their body during a hop which shifts the centre of gravity. This made the children's legs need for stability and balance even more critical. To keep the movement under control and avoid excessive side-to-side or forward-backward sway, the core muscles must exert greater force. Balance remained at the forefront of the planning of the interventions within the SOW, in activities such as:

- **Balance beam walking** – within T6 the children partook in two assessment circuits and one intervention which focussed on the building of obstacle courses, which utilise balance beams to balancing. By walking along the narrow balance, the children improve their dynamic balance and coordination.
- **Building obstacle courses** – Through this intervention the children were encouraged to design obstacle courses with various challenges such as balance beams, stepping stones, and hurdles. Navigating through these courses required the children to maintain balance while performing different movements.

5.4.2 Running

The ability to keep one's balance while moving or executing dynamic motions is known as dynamic balance. During running, the body uses dynamic balance to stabilise and regulate its position in the air before landing again when both feet are briefly off the ground. Within SC2 of running the children were required to ensure that the foot of their non-support leg always remained behind their body. In order to execute this SC, the children had to consider the motions of their arms, legs, and trunk to produce an effective running stride which required coordination. No progression was identified when considering SC2 during T4 and T5. However, progression was made over each SH (which will be discussed further below in section 5.7) and during T6 where it rose from 72% at the ST6 to 80% by the ET6. Within T6 the children engaged in the building of obstacle courses, which has been highlighted above in section 5.5.1 that it develops dynamic balance. In addition to this, the children regularly engage in hopscotch during break and lunchtime which involves hopping and jumping while maintaining balance and stability. The children began to progress from simple hopping patterns to more complex sequences, challenging their dynamic balance.

Within running, SC3 explains that the children need to ensure they are adopting narrow foot placement landing on their heels or toes. Coordination is required to ensure that the chosen foot placement and landing technique are executed smoothly. This involved the children coordinating the movements of their legs, feet, arms, and trunk to maintain balance and stability while running. The following activities can be found within the T4 and T5 SOW, which contributed to the development of balance needed to execute SC3 effectively:

- **Adventurous climbing and swinging** – By the children climbing and swinging on playground equipment, trees and rope swings they had to coordinate their movements to navigate the outside and inside environments safely. The children also had to synchronise their hand and foot placements, adjust their body position in order to balance, and then time their movements in order to propel themselves forward when swinging on a rope.
- **Gardening** – The children engaged with gardening activities such as digging, planting, weeding, and watering which required the children to coordinate their movements to manipulate tools and materials effectively.

5.4.3 Galloping

Galloping is a locomotor movement which requires dynamic balance as it involves continuous movement in which the body transitions between phases of support and flight. The overall results show an increase form 24% of children being able to execute the skill during the baseline assessment to 52% by the ET6. This further supports the idea that the interventions mentioned above within section 5.5.1 and 5.5.2 assisted in the development of dynamic balance over the course of the three terms.

5.4.4 Sliding

When considering the skill sliding, SC2 (sideways step with lead foot followed by a slide of trailing foot) significant steady improvements were identified over each term rising from 52% of children meeting this SC during the baseline assessment to 88% at the end of T6. Sliding is a technique where the lower body actively moves laterally. To provide the required power and direction for the slide, the children needed to coordinate their leg muscles, especially those in the hips, thighs, and calves. Coordinating these muscles helped the children to achieve quick, fluid movements without falls. Within the SOW multiple interventions aim to develop the coordination of muscles within the lower body, such as:

- **Hopping** – Hopping can be found within the assessments circuit which occurs 2-3 times per term. The children's lower body muscles were strengthened, and their balance and coordination were tested while they hopped on one foot. Hopping whilst balancing on one foot required the children's bodies to constantly change its state of balance. One-foot hopping activities such as these helped the children to develop balance and control over their body's motions over time.
- **Climbing** - Climbing is evident in the term-specific assessment circuits as well as adventurous indoor and outdoor climbing interventions. To produce power and drive the body higher whilst climbing, the children's muscles in their legs, hips, and feet must be synchronised. The quadriceps, hamstrings, calves, glutes, and foot muscles must collaborate to propel the children off the footholds on the wall while preserving stability.
- **Dribbling a ball** – Within one of the circuits during the assessment circuit at the beginning and end of each term the children were required to dribble a ball. Performing sports drills such as these required the children to be become aware of their body position, posture, and movements in relation to the ball and other players. This therefore improved the children's proprioception, which is crucial for coordination.

5.4.5 Dribbling

During the baseline assessment just 32% of children were meeting each of the SC found within the skill of dribbling. By the ET6 this figure has rose 20% to 52% of children. Core strength is essential for maintaining stability and balance while dribbling. The core muscles, including the abdominals, obliques, and lower back muscles, provide a solid foundation for the body's movements. They help stabilise the torso and pelvis, allowing the child to maintain an upright posture and absorb the forces generated during dribbling movements. Dribbling involves dynamic movements of the body, requiring coordination between multiple muscle groups. Core strength helps stabilise the body during these movements, preventing excessive swaying or twisting that could lead to loss of control. Strong core muscles also facilitate smooth transitions between dribbling motions, such as crossovers or behind-the-back dribbles. Further when dribbling, the child is often moving meaning at times they were balancing on just one leg. This single-leg support requires good balance to maintain stability and prevent falling over. Without balance, it becomes challenging to control the ball while executing moves such as crossovers, spin moves, or hesitation dribbles.

When considering SC4 of dribbling, maintaining control of ball for four consecutive bounces without having to move feet to retrieve it, improvements were seen across only one of the terms. In order to synchronise their finger movements with what they see, enabling them to track the balls position and adjust their actions accordingly, the children required well developed FMS. Hand-eye coordination is essential for accurately timing pushes and controlling the ball's trajectory. There was no increase within the percentage of children meeting SC4 over the course of T4. Therefore, the T5 SOW was revised to ensure that all interventions within that term targeted FMS development and hand-eye coordination. These interventions can be found below, they accommodated an increase of 16% over the course of T5.

- **The construction of obstacle courses** – By constructing the obstacle courses, the children were constantly manipulating objects with the hands while visually assessing spatial relationships and alignment.
- **Gardening** – During this intervention the children removed weeds from areas around the school and planted seeds in pots. Both actions require precise hand movements. It requires precise hand-eye coordination to grasp weeds at their base and then carefully pull them out without disturbing nearby plants or roots.
- **Using scissors** – Within this intervention the children practiced the explicit skill of cutting. Using the scissors required the children to use precise hand movements to manipulate the blades and cut along the designated lines whilst coordinating their hand movements with visual cues from the target area (therefore developing their hand-eye coordination).

- **Wrapping and moving items (within the moving house game)** – Within this game the children needed to wrap up everyday items using wrapping paper and tape. The children had to use precise hand motions to hold and crease the wrapping paper around the item's edges. Coordinating hand motions with visual alignment cues was necessary to line the paper edges and apply pressure to generate precise folds. Tearing off tape strips and placing them precisely along the seams required precise hand motions to apply tape to hold the wrapping paper in place. The application of the tape is ensured by hand-eye coordinated movements.

Within this SC an 8% regression was then identified over the two-week school break which occurs after T5. The interventions within T6 were then tailored to target hand-eye coordination again causing an increase of 8% by the end of T6 which will be discussed in more detail below in section 5.8. Further involvement in sports, such as basketball, football, tennis, or volleyball, within their other weekly PE lesson, during break and lunchtimes allowed the children to further develop their visual tracking of the ball as well as coordination of hand or foot movements to interact with it.

5.4.6 Underarm roll

When undertaking an underarm roll, hand-eye coordination is essential. To evaluate the distance and trajectory of the roll and then modify the movements of their hands accordingly to guarantee the ball landed where it was intended—with the child standing opposite them—the children had to coordinate their actions with their visual perception. Although the overall percentage of children successfully executing this skill only rose from 8% during the baseline assessment to 16% at the ET6, it is important to note that that is due to the lack of improvement within once specific SC. Huge improvements (which can be found within Appendix M) were seen within SC2, SC3 and SC4 over the course of the three terms. Regularly throwing and catching pieces of equipment helped the children to improve their hand-eye coordination as they had to track the ball's movement visually and coordinate their hands to catch and throw it accurately and supports previous findings (Lazarus, 2024) of improvements that can be made when focusing on hand and eye coordination. This is due to a number of activities found within the SOW that specifically target hand-eye coordination, such as:

- **Weaving** – When weaving the children had to manipulate paper strips to create patterns or designs (an example of this can be found in Appendix E). To weave effectively, the children were required to visually track the placement of the paper strips and coordinate their hand movements to manipulate them. This therefore developed the children's precise hand-eye coordination.
- **Using scissors and cutlery** - Using scissors and cutlery involved the children coordinating their hand movements with visual cues to cut or manipulate materials and foods effectively. When using scissors, the children had to visually track the cutting line while coordinating their hand movements to control the scissors' blades. Similarly, when using cutlery, the children had to visually guide the knife or fork to pick up the food, cut it into manageable pieces, and bring it to their mouths. All of which developed their hand-eye coordination.
- **Baking cookies and making playdough** – Baking cookies and making playdough involved the children participating in various tasks such as measuring ingredients and mixing dough. Each of these tasks required the development of hand-eye coordination.
- **Catching and throwing** – the children's abilities to catch and throw equipment was developed through the delivery of assessment circuits and obstacle courses found within the SOW. Regularly throwing and catching pieces of equipment helped the children to improve their hand-eye coordination as they had to track the ball's movement visually and coordinate their hands to catch and throw it accurately.

More specifically, within SC2 the children are required to stride forward with the foot opposite the preferred hand towards the other child. Successfully executing this SC requires coordination between the upper and lower body. For example, if the child is right-handed, they might naturally prefer to lead with their right foot when walking or running. However, needing to stride forward with the left foot while the right hand performs the underarm roll requires bilateral coordination between the arms and legs. A small improvement of 4% was seen over the course of T4 within SC2 but this was followed by a significantly larger increase of 28% over the course of T5. This huge improvement identified over the course of T5 is thought to be due to the implementation of a game which was used as a **warmup activity** every week prior to the commencement of the interventions. The activity was similar to the well-known game of **stuck in the mud** but with a slight twist; it required the children to underarm roll a ball, whilst striding forward, underneath another child who was in 'the bridge' position in order to 'unstick' them.

5.4.7 Climbing

Similar to above, climbing requires bilateral coordination. Fernandes (2013) explains that the development of bilateral coordination is crucial as it enhances FMS, such as hand stability and two-handed control, as well as assisting to coordinate GMS. Bilateral coordination is essential within the skill of climbing, as it allows the children to use both sides of their bodies in a coordinated way to be able to ascend, maintain balance, and navigate their way around the hand holes on the climbing wall. Within SC4 of climbing, the children are required to use diagonal reciprocal movements. This demands the children to have bilateral coordination in order to synchronise the actions of both sides of their bodies. Within the SOW, in addition to the activities mentioned above in 5.5.6, the development of bilateral coordination can be found in multiple interventions such as:

- **Coordinated star jumps** – star jumps can be found within the assessment circuit at the beginning and end of every term alongside warm up activities. Executing coordinated star jumps required the children to synchronise the movements of their arms and legs simultaneously. This challenged their bilateral coordination as both sides of the body needed to work together to perform the movement correctly.
- **Throwing and catching a ball with two hands** – the children participated within the assessment circuit twice a term which required the children to throw and catch a ball. Furthermore, the throwing and catching of equipment was present in other interventions such as the obstacle courses. The throwing and catching of a ball, or any other piece of equipment, with both hands encourages the children to develop their

bilateral coordination as they are required to coordinate their hand movements to throw and catch the ball.

- **Climbing** - within adventurous indoor and outdoor climbing the children the developed of diagonal reciprocal movement and coordination within climbing interventions. As a result of this, alongside the emphasis of core strength, further developments can be seen in SC4 of climbing (children adopting diagonal reciprocal movement patterns often or always) rising progressively from 36% of children meeting the criteria during baseline assessment to 72% of children meeting criteria by the ET6.

5.4.8 Balance

Balance is crucial for managing the body's centre of gravity over the narrow surface of the beam which the children are required to walk across within the assessment circuit. By keeping one foot off the floor, the body redistributes its weight and adjusts its centre of gravity to maintain stability on the beam. Within SC2 of balance the children were required to ensure that they did not place their contralateral foot onto the ground. When balancing on the narrow beam the children had to constantly adjust their weight distribution and consider their centre of gravity to prevent themselves from falling off the beam. Interestingly, the improvements within this SC were not identified over the course of the school terms, they were identified over the SH. Over the course of the first holiday which was two weeks an increase of 4% of children met the criteria upon their return to school at the ST5, in comparison to the ET4. At the ET5 56% of children had met this SC. However, at the ST6 72% of children met it.

5.4.9 Catching

Visually tracking an object's path and then synchronising hand movements to intercept and grab it are the steps necessary for catching. It takes fine hand-eye coordination to complete this skill successfully. Within SC2 of catching the children are expected to reach out to attempt to catch the ball. However, to meet this SC, they do not have to physically catch it. Within SC3 the children must extend their arms reaching for the ball, requiring them to visually track it, and then catch it. SC3 demonstrates a steady increase of the number of children meeting this

SC over the three terms. This is due to the interventions that have been discussed above within section 5.5.5 and section 5.5.6, found across the SOW that aim to improve hand-eye coordination.

As discussed above in section 5.4.4 the percentage of children meeting each SC within the skill of catching rises from 20% during the baseline assessment to 40% at the ET6. Catching a ball required the children to judge the speed and direction accurately to be able to catch it. The increase seen within the overall data for catching is partially due to the activities found within the interventions which aim to develop positional awareness, such as:

- **Obstacle courses** - Navigating through obstacle courses challenges individuals to assess distances between obstacles and plan their movements accordingly to avoid collisions.
- **Stuck in the mud** – stuck in the mud was added into the warmup activities within the SOW with the intention to develop the children's positional awareness. The children's positional awareness abilities, such as their spatial awareness, judgement of distance and speed, planning of movement, spatial reasoning, body awareness, coordination, and response time, were developed through the dynamic and interactive game of Stuck in the Mud. By regularly engaging with this game the children were able to improve their capacity to make strategic decisions and navigate space efficiently, in a dynamic setting.

5.4.10 The use of scissors

SC4 within the skill of the use of scissors required the children to rotate the paper whilst cutting it with scissors. This requires hand-eye coordination primarily because it involves the children coordinating the movement of their hands and their eyes to achieve the desired outcome. As the paper is rotated, the children had to visually track the cutting line to ensure accuracy. Furthermore, SC4 requires bilateral coordination, as it involves the use of both hands in a coordinated manner. One hand typically holds and rotates the paper while the other hand operates the scissors. This requires coordination between the hands to ensure that the paper is rotated smoothly and at the desired angle while maintaining control over the cutting process. SC4 rises from 56% of children meeting the SC during the baseline assessment to 76% by the ST6. This is due to the interventions discussed above in section 5.5.5 and 5.5.6 that develop hand-eye coordination as well as in section 5.5.7 that develop bilateral coordination. In addition to the interventions mentioned above, by developing activities and providing **chances for play (both indoors and outdoors)** the reception class teachers allow the children to improve their coordination, balance, spatial awareness, core strength, stability, and agility (The School EYFS Plan, 2022). Through these activities and frequent and 'diverse chances to explore and play with puzzles, arts and crafts, and the practise of using small tools' (p. 7) (such as the use of scissors), these children begin to acquire skill, control, and confidence (The School EYFS Plan, 2022).

5.4.11 The use of cutlery

Using cutlery requires bilateral coordination as it involves the coordination of various movements to effectively handle cutlery for eating. When considering SC1 of the use of cutlery (holding the fork in the non-dominant hand and the knife in the dominant hand) it is important to remember that for the children to coordinate the grasp of the cutlery in their hand they require spatial awareness. The children must hold the cutlery in a manner that allows for control and manipulation while positioning it appropriately and ensuring both hands work in harmony together for use. SC1 rose from 37.5% during the baseline assessment to 75% at the ET6. This is again due to the interventions mentioned above in section 5.5.7 that develop bilateral coordination.

When considering SC5, which require the children to take the food to their mouth, hand-eye coordination is vital. The children had to ensure they accurately judged the distance and angle in order to successfully deliver the food to their mouth without mishaps. This SC rose from 87.5% during the baseline assessment to 100% but the ET6. Again, this is due to the multiple interventions targeting hand-eye coordination discussed in section 5.5.6.

5.5 Benefits of a bespoke scheme of work

In accordance with the Incheon Declaration and Framework for Action, all children should be prepared to succeed in school, and early childhood policy makers should prioritise this goal above all others (UNESCO, 2015). To achieve this objective Hirsh-Pasek *et al*., (2005) explained that a detailed evaluation and comprehension of early childhood SR is required to inform the design of tailored early childhood education, such as the bespoke SOW delivered within this study, to ensure successful transitions into KS1 (Kamphorst *et al.*, 2021). The creation of a tailored SOW (which promotes motor skill activities and development), not only increases the number of school-ready children (Jones *et al*., 2021), but facilitates a successful transition into formal education in KS1 (Kamphorst *et al.,* 2021). Overall, within each of the 12 skills observed there were a total of 48 SC. 28 of these 48 SC showed statistically significant improvements over the course of the implementation of the MC interventions within SOW. Therefore, ensuring that an increased number of children would be classed as 'school ready'.

MC interventions that are planned, implemented and consistently reviewed as within this study have been shown to impact the development of children reaching the ELG and therefore being 'ready' to transition into KS1 learning. This is important as previous research (Duncombe and Preedy, 2021) has highlighted that young children's PD impacts their readiness for school, behaviour, social development, and intellectual success. Emphasising how vital it is that educators are aware of the role they play of ensuring young children are physically developmentally ready for school. In order to meet UNESCO's (2015) goal for children to be equipped to succeed in school, Hirsh-Pasek *et al*., (2005) explained that a detailed evaluation and understanding of early childhood SR needed to inform the development of tailored early childhood education to ensure successful transitions into formal education in KS1 (Kamphorst *et al*., 2021), such as the further research shows that not only have these types of MC interventions had a positive influence upon the children's' PD but they have benefited a child's reading and writing abilities (Ricciadi *et al.,* 2021) as well as social interaction (Bart *et al*., 2007). As suggested by Jones *et al.,* (2021), by promoting FMS and GMS activities within the planned SOW, that counteract developmentally appropriate sedentary behaviour, the number of children 'ready' for school would have increased. This is a problem, though, since a large number of primary school PE leaders and teachers are generalist teachers have not had nearly enough PE training (National Plan for Sport and Recreation Committee, 2021) as they receive no more than six hours of training (Durden-Myers, 2021, cited by National Plan for Sport and Recreation Committee, 2021) and would therefore find it difficult to develop a tailored intervention plan. To gain the knowledge required to develop a tailored SOW educators will require CPD. As PE lead within my current school, based on literature and the current study it would be suggested that training should be delivered for the staff to support in future intervention implementations.

5.6 School holiday regression and progression

Emm-Collison *et al*. (2019) state that children's participation in PA declines over the SH, which consequently impacts their PD. This study somewhat supports Emm-Collison *et al*. (2019) findings as regression is evident, particularly in the one week May half term holiday (between ET5 and ST6 data collection points) within some galloping SC; SC1 and SC2 show regression and a lack of progression is identified within SC3. Further regression, within SC3 of kicking, can be seen during the same holiday occurring at the ET5. The number of children meeting the criterion drops at the ET5, over the SH. These regressions could also be partially down to the greater number of children that are beginning to partake in increased sedentary behaviour and therefore reduced PA during SH, as explained by Weaver *et al*., (2019).

Furthermore, grandparents were found to be the primary informal childcare providers during SH, which may one of the reasons why there is less movement opportunities occurring as children engage in less PA while they are with their grandparents according to Emm-Collison *et al.,* (2019). Emm-Collison *et al.,* (2019) also highlight that a many parents must depend on their children's grandparents to take care of their children owing to their obligations to work. The researcher stresses that the introduction of movement homework could help to support grandparents who look after children during SH by providing structured activities that keep children engaged in PA during the SH. Movement homework could alleviate the burden on grandparents by offering ready-made, productive ways to entertain the children, promoting physical fitness while ensuring they stay occupied. Additionally, PE homework promotes the development of healthy habits and an active lifestyle from a young age, which can have long-term benefits for maintaining health and preventing chronic diseases later in life.

On the contrary, to Emm-Collison et al. (2019) findings, within this study, the skill of hopping, at the ET4 just 4% of children met SC1, yet upon their return 28% of children were meeting this criterion. However, the time of year these holidays fall in should also be considered. As explained previously in chapter 2.9, it is abundantly evident that environmental variables are crucial for promoting PA in young people as individuals are anticipated to partake in more PA and spend less time engaging in passive behaviours as a result of environmental changes (Owen *et al.*, 2000). Atkin *et al*. (2016) explained that during the spring months, such as the easter half term which occurs at the ET4, children are inclined to play outside more frequently and therefore become more active. This therefore explains the increase in the number of children meeting hopping SC1. It further explains the later increase identified within the skill of hopping at the ET5, during the SH which occurs in May. Further improvements in SC1, 2 and 4 within the skill of galloping, are evident between the Easter holidays between the ET4 and the ST5. This is thought to be as a result of the seasonal changes, as children generally begin to spend an increased amount of time playing outside (Atkins *et al.,* 2016) and therefore engage in more activities that include the galloping. However, over the same time period, galloping SC3 (a brief period where both feet are off of the floor) shows regression. It should be noted that although there is generally an increase in children playing outside within summer months, it is important to note that compared to their grandparents' generation, where nearly three-quarters reported playing outside a few times a week, just one in four young children today play outside in their neighbourhood on a regular basis (Save The Children, 2022). Furthermore, 30% of the children who participated in the study carried out by Save The Children (2022) stated their neighbours or parents had warned them to cease making noise outside, and 25% stated that they had been advised to stop playing outside in their neighbourhood.

All things considered, any regression or absence of improvement that transpired during either of the SH highlights the significance of MC interventions, such the ones in this study, in addition to the critical role that schools play in general for children's PD. This further emphasises the need to retest the children's PD levels at the beginning of each term, upon the return of the children from their SH. This allowed me to observe which skills had continued to progress and which had regressed in order to review the SOW and ensure that the correct skills were being targeted. However, it raises the question of whether the value of movement mindset, that children encounter at school, is mirrored at home. Although it is vital to remember that schools and educators can only do so much, it leaves one to wonder if movement or PE homework assigned by schools to be completed in SH may reduce this apparent regression or lack of skill advancement. Aubert, Barnes and Aguilar-Farias (2018), explain that a significant portion of children lead sedentary lifestyles that jeopardise their wellbeing now and, in the years, to come. Despite the fact Hill (2018) states that homework is not often utilised as a learning aid for PA, according to Bailey, Heck, and Scheuer (2022), it provides children the chance to include active tasks into their everyday life as well as developing their motor abilities. While there are benefits to homework, the Education Endowment Fund (2021) points out that it's vital to be mindful that children from disadvantaged backgrounds are less likely to have access to an appropriate technology, space for home-learning, and parental assistance. These challenges might therefore widen the achievement gap for underprivileged students. Nonetheless, PA homework can be designed in a manner that it may be completed in a small space or outside in a public setting without the assistance of an adult or the usage of devices.

5.7 Limitations

One of the challenges that arose within this study was the difficulty we had in finding suitable trees for outdoor adventurous climbing interventions in a village school with ample grounds, which highlights a potential limitation for inner city schools. While such activities are recommended within educational guidelines (DfE, 2022), the scarcity of appropriate natural elements like trees in urban settings raises questions about the feasibility of implementing these activities in inner city schools. The disparity in access to natural outdoor spaces presents a significant obstacle for urban educators seeking to provide similar learning opportunities for their children. Addressing this limitation may require creative solutions such as utilising alternative structures or spaces for climbing activities or exploring partnerships with nearby parks or green spaces.

As noted previously within 4.11, there is an absence of the final data collection point on the use of scissors. Despite this, the wealth of information gathered from the five other assessment points presents an accurate perspective on children's developmental progress. Whilst time constraints within the study schools' timetable at the end of the academic year may have limited the inclusion of this final assessment, the researcher believes the data already obtained offers valuable insights into students' FMS development.

5.8 Conclusion

In answer to the initial study aims and research questions, this chapter has presented the results of the analysis of the data gathered during the study's six data collecting points. It also outlines and discusses the research's strengths, limitations, and applications. The following, and final, chapter draws conclusions upon the findings and provides recommendations for future practice based upon these.

Chapter 6: Conclusion

6.1 How can interventions help to support young children's physical development?

A bespoke SOW containing multiple engaging MC interventions aiming to develop the children's PD is effective. To optimise development, although the SOW and MC interventions within it are critical to the development of PD levels, it is imperative that these be combined with effective PE lessons and ample opportunities to engage in PA and sports both inside and outside of school in order to maximise development. Moreover, it is crucial that we aim to develop each and every child holistically and consider their unique differences. This is pivotal for improving each child's PD since every child is unique, with varying needs, challenges, and abilities. By addressing the child as a whole person, including their physical, cognitive, emotional, and social aspects, we can create a comprehensive approach to development that supports their overall well-being. As educators, it is our role to recognise and accommodate individual differences ensuring that children receive personalised assistance, enabling them to progress at their own pace and fulfil their potential regarding PD. This approach fosters inclusivity, self-confidence, and a positive attitude towards physical development, ultimately leading to healthier, happier, and more resilient children.

6.2 Recommendations for future practice

The results of this study highlighted the need for strategically planned MC interventions focussing on PD coupled with practitioner observations. As this study has demonstrated the possibility of significant longitudinal improvements across various aspects of the development of FMS and GMS it is my recommendation that this should be implemented nationwide to improve the PD outcomes and ensure that our young children are equipped with the skills, they need to access the KS1 NC within the UK.

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Appendices

Appendix A – Barriers to implementing motor competency interventions

Research indicates that while age-appropriate fundamental movements are essential for promoting PA, children encounter difficulty acquiring them (Eddy *et al.,* 2021). This has prompted requests for systematic school-based screening of children's FMS, according to Eddy *et al.* (2021). Within a study undertaken by Eddy *et al.* (2021) 65.3% of teachers reported that comprehension of fundamental movements would be favourable as few of them possess the knowledge (15%), and 71.8% would assess FMS provided that guidance and support would be issued. Many educators, however, felt that there were obstacles to the concepts behind these assessments, including a lack of knowledge and understanding, lack of opportunity due to time constraints and demotivation brought by the increase in workload the additional assessments would produce (Eddy *et al.*, 2021). This poses the question; how can we expect interventions for fine and gross motor abilities to be implemented when teacher knowledge around the topic is undeveloped and there is a lack of time within the current curriculum to accommodate it?

Appendix B – The impact of the pandemic on children's' physical development

According to UNESCO (2021) schools were closed for an average of 14 weeks worldwide; in England, this amounted to around 10 weeks (based on Gov.uk 2021 lockdown data), affecting 1.5 billion children worldwide (UNESCO, 2021 and Gustafsson, 2021). Ofsted (2020) reported in its interview findings that although children were permitted to return to school settings, possibilities for developing FMS and GMS had been constrained due to concerns regarding cross contamination. In practice, playdough, which is used to teach FMS through moulding, had been removed or drastically reduced. Similarly, washable toys replaced the role of dressing-up boxes and soft toys. Hewitt *et al*. (2020) claimed that both parents and educators struggled to offer an adequate number of activities that promote strength development before to the COVID-19 pandemic, and the further impact of the pandemic on this supply of opportunities is little understood. Ofsted (2022a) stated that in light of the absence of physical exercise during the pandemic, particularly access to sizable play equipment, some children did not develop the necessary GMS. Some children still lack autonomous self-care abilities, such as toileting and dressing themselves, to a higher extent than would be expected for their developmental stage (Ofsted, 2022a).

Lord Willis, the National Plan for Sport and Recreation committee leader, emphasises that the epidemic has made it very evident that the country urgently needs to get healthier and more active. Participation in sports and recreation, on the other hand, is declining (National Plan for Sport and Recreation Committee, 2021). Furthermore, the Select Committee on the Constitution (2021) determined that the Covid-19 epidemic underlined the magnitude and urgency of the issue to reverse the high rates of inactivity. According to the committee's findings, between May 2020 and May 2021, there was a 1.9% (0.7 million) decline in the number of persons categorised as active. Children and young people are advised to engage in at least 60 minutes of moderate to intense physical exercise each day, according to the NHS (2021). In addition to this, according to WHO (nd), children should engage in vigorous-intensity aerobic exercises, as well as those that improve muscle and bone, at least three days a week. However, new figures of current global data from WHO (nd) show that 81% of children do not engage sufficient PA. Research conducted in Spain by Arufe-Giráldez *et al*.

(2021) indicated that children below the age of five were not fulfilling the WHO's criteria for PA as a result of the pandemic. The children who participated in this research are between five and six years old, but were between the ages of 4 and 5 during my previous research (Huggett and Howells, 2022) which found similar findings to Arufe-Giráldez *et al*. (2021). Regardless of pre-pandemic baseline values, a recent meta-analysis by Neville *et al.* (2022) reveals that the length of daily physical activity dropped by 20%, this decrease was greater for more intense physical exercise such as moderate-to-vigorous PA. A variety of long-term effects of these restrictions, regarding adolescent health at different ages and developmental stages, have been identified by Neville *et al*. (2022) who elucidate that there is now an absence of behavioural and biopsychosocial advantages obtained from regular PA that would have normally continued into later stages of life. In an attempt to rectify this, they urge the immediate need to rekindle adolescents' interest in and support their desire for physical exercise (Neville *et al*., 2022).

On the contrary, a study conducted by James *et al.* (2021) discovered that PA levels, sleep time, contentment, and the general welfare of children had improved during school closures when compared to previous years. James *et al*. (2021) found that children that were entitled to receive free school meals, which is commonly used as an indicator for pupil premium (PP) eligibility, showed poorer self-assessed school competency and spent less time undertaking physical exercise than those who do not receive free school meals. According to the findings of this study, schools have an essential role in eliminating physical health disparities amongst children. It should be highlighted, however, that data was gathered through the 'HAPPEN At Home' survey, undertaken by James *et al*. (2021), which gathered information on health behaviours of children in 2020 was accessed and completed through an online survey. Online surveys have been condemned for not being representative of target communities (Vaske, 2011). Additionally, Vaske *et al*. (2011) contrasted two surveys undertaken in the Netherlands using similar questionnaires: a random mail survey and a convenience Internet survey. The authors cautioned against generalising the results of internet convenience surveys due to a lack of response from the elder population and the internet sample appearing to overrepresent individuals with the greatest education. Further supporting James *et al*. (2021)

finding, Hobbs and Bernard (2021) highlight that although changes in access to Early Childhood Education and care as a result of the pandemic have affected all children, they are more likely to have a negative influence on children's development for vulnerable children such as those that are underprivileged or have SEND.

My previous research that was carried out just after the pandemic in 2022 (Huggett and Howells, 2022) identified that, possibly as a result of the pandemic, a large quantity of children were not meeting age related PD expectations outlined in ELGs within the EYFS; several children lacked co-ordination in moving and positioning, struggled to negotiate space effectively and demonstrate strength in their FMS and GMS. Additionally, multiple children were unable to consistently use a tripod grip, and some were unable to use a fork to 'stab' food and found it hard to take food to their mouth, indicating poor levels of hand-eye coordination (Huggett and Howells, 2022). The findings of Dunton (2020), who noted that the pandemic greatly reduced children's possibilities for PA involvement, are consequently supported by these above findings. Additionally, these findings are clarified by Neville *et al*. (2022), who has recently stated that the constraints that were put in place during the pandemic consequently decreased daily PA levels, particularly moderate-to-vigorous PA, for boys and girls of all ages. They emphasise further that the focus of pandemic recovery efforts should be on children's activity behaviours (Neville *et al*., 2022). These findings could be partially as a result of education providers prioritising the act of preparing pre-school children for school, which may have meant that children of older ages, such as those analysed in my research, received less attention (Ofsted, 2022a). In other words, there is an ongoing need to concentrate on the primary areas of learning for the children who have been most severely impacted by the pandemic as some children's PD remains behind schedule, according to Ofsted (2022b).

The DfE (2023a) explain that, to lessen the impact of the pandemic on some of the youngest and most vulnerable children, the government is offering a new package worth up to £180 million for workforce training, credentials, and support and advice for the early years sector. They explain that the package includes training in child development, communication and language, early mathematics, and personal, social, and emotional development through the third phase of our professional development programme. It has been intended to serve all sectors of the early years sector. Additionally, it provides leadership of settings, Nuffield Early Language Intervention, and strives to assist caregivers in the home learning environment. As can be seen from above, there has been no explicit mention of a focus on PD within this package. The extent of input given within this package on PD is one module focussing on 'supporting physical development in the early years'. This raises questions of how seriously the impact of the pandemic on the PD of children is being taken by the DfE and what steps are being taken to rectify it.

Firstly, it is important to outline that the COVID-19 pandemic is a contributing factor to low PD levels, not the sole reason. However, to address the pressing issue of low PD levels within young children, educators and carers required help and guidance on how to effectively captivate children in an array of appealing activities that enhance PD in afflicted regions, as shown in my earlier study (Huggett and Howells, 2022). The researcher further recommended that effected children needed a targeted support plan which sought to strengthen both their FMS and GMS over the months to drive them to fulfil additional developmental goals (Huggett and Howells, 2022). Furthermore, efforts and activities to promote both PA and PD must be communicated with childcare workers to ensure that nursery children were adequately prepared and achieving their PD expectations prior to the start of reception in September (Huggett and Howells, 2022). Since this suggestion was made, DfE (2022) have released a 'Help for Early Years providers' document that provides guidance for all practitioners. Within this research a scheme was developed, based upon this document, to test the effectiveness of these suggestions.

Appendix C - What do gross motor skills look like in practice?

According to DfE (2022), it is important for children to have daily access to both indoor and outdoor settings that encourage the growth of their GMS, together with an adult to provide supervision and support. The outside environment is commonly acknowledged in early childhood education as a key and crucial part of the curriculum for young children, with the capacity to encourage and enhance all areas of development (Davies, 2006). The importance of the outdoors for children's development is occasionally overlooked or undervalued by early childhood educators, according to Davies (2006). However, a more recent qualitative study by McClintic and Pretty (2015) discovered that many researchers agree that outdoor play, both at home and at school (Rivkin, 1998; Garrick, 2004; Louv, 2008), is not only necessary for healthy child development but also offers young children a "multi-sensory, movement-based, holistic and stimulating experience" (White, 2011, p. 7).

According to the DfE (2022), it is crucial for parents, teachers, and practitioners to pay close attention to how children are acting physically and make sure that the indoor and outdoor environments are demanding enough for every student, considering their unique physical developmental requirements and for the development of GMS.

Children must take safe risks even when they are engaged in outdoor activities such as climbing, which will be looked at within this study, according to DfE (2022). However, according to the Bridgeway Family Centre (2022), young children who participate in risky play activities such as running, climbing, and balancing, not only help to make children more physically literate, but they also develop their GMS and give children the chance to start understanding how their bodies move. According to Providence Children (2020), children learn a variety of skills via risky play and PA participation, including social skills development, self-confidence, and valuable lessons about their own personal boundaries.

Although outdoor environments provide great opportunities for the development of GMS, indoor environments can do this as well (DfE, 2022). Physical, social, or symbolic contextual qualities attract, facilitate, or hinder reciprocal tuning toward a progressively more sophisticated interactional activity in and with the surrounding environment, according to Bronfenbrenner and Ceci (1993). These reciprocal interactions between the person and environment are necessary for these interactional proximal developmental processes (Bronfenbrenner and Ceci, 1993). Gibson's (1979) idea of affordances is likewise centered on this transactional link between the person and the environment. According to Gibson's (1979) theory of affordances, a person's behavior and learning may be influenced by their physical surroundings. Gibson (1986) and Kyttä (2004), a researcher from Finland, elucidate that all the opportunities that the environment presents are referred to as potential affordances (such as climbing rocks, sprinting or leaping in a large field or playground; all of which develop GMS) or actualized affordances. Children playing football on a football pitch, which provides suitable surroundings for playing that sport, are an example of how actualized affordances are utilised by children (Rutkauskaite *et al.,* 2021). Flôres *et al.* (2019) explains that the two theoretical frameworks offered by Bronfenbrenner and Ceci (1993) and Gibson (1979) enable the conceptualization of motor development as the outcome of proximal processes between the child and his or her immediate environments and the analysis of it through the evaluation of the affordances for motor skills in those same environments. According to Flôres *et al*. (2019), certain places have a larger potential to promote infant development than others because they provide richer affordance landscapes. However, Koller (2004) highlights that just because a child has a specific motor skill opportunity in a particular situation does not indicate that the child will immediately recognise and take advantage of it. Importantly, having access to adjacent environments in the child's home, school, and sporting situations—which best indicate an ecological match—aides the child's motor development (Flôres *et al*., 2019). Therefore, within the SOW, interventions both inside and outside will be utilised.

Appendix D - What do fine motor skills look like in practice?

According to DfE (2022), the environment should offer a variety of rich chances for both big and small movements. Additionally, it is advised that practitioners provide children engaging activities like gardening, cooking and building things to help them improve their FMS (DfE, 2022). Children who participate in sports do not only improve their physical strength, but they improve both their FMS and GMS (AfPE, nd b). The DfE (2022) elaborates on this, stating that it is the responsibility of practitioners to ensure that every child is supported in the development of their FMS and that, in the event that a child encounters difficulties, they are supported by adults who change the materials or activities and offer gentle praise and encouragement.

Appendix E – Activities found within the scheme of work

Warm up activities

Before each assessment circuit and each MC intervention found within the SOW the children took part in one of the following activities as their warmup activity:

- *'Traffic Lights'* - The children respond to orders like 'red light' and 'green light' which improves their spatial placement and control by forcing them to consider and analyse their location and stop or respond accordingly. Their ability to estimate distances and modify their pace to halt on schedule improves their timing, coordination, and spatial judgement.
- *'Stuck in the Mud'* - By navigating the space, children improve their understanding of and ability to navigate around their spatial surroundings. To avoid being caught, they must quickly change directions, which requires agility and positional awareness, and the ability to continuously observe the locations and movements of others. Later during terms 5 and 6 the children played 'Stuck in the mud with a twist. Once stuck then held the crab position, one of their teams' members had to roll a ball (striding forward, using the correct technique) underneath them to 'unstick' them. The incorporation of 'the bridge' to this game aimed to improve the children's balance and core stability.
- *'Simon say's'* – In this classic game, the researcher gave commands such as "Simon says touch your toes" or "Simon says jump forward," requiring the children to follow the instructions while being mindful of their position in space and the movements of others.
- *'Mirror movements'* – In pair the children face each other and take turns mirroring each other's movements. This game promotes spatial awareness as the children are required to synchronise their movements whilst being aware of their own and their partner's position.
- *'Animal crawls'* - This game encourages the children to mimic different animal movements, such as bear crawls, frog hops, or inchworms. These movements engage the core muscles while also promoting coordination and agility.

These warm-up activities are designed to help children develop their spatial and positional awareness, core strength and coordination which were identified key areas where these children didn't perform at the predicted levels in my earlier study (Huggett and Howells, 2022).

Motor competency interventions within the scheme of work

This scheme was evaluated and revised on a constant basis based on data acquired from the previous term, allowing me to directly target the skills in which the children were making the least progress in or finding difficult. The final scheme of work (found below in Appendix D) included eight MC interventions, designed specifically to improve the children's FMS, GMS, core strength, and coordination. Table 1, below, illustrates the interventions that was delivered throughout terms 4, 5, and 6.

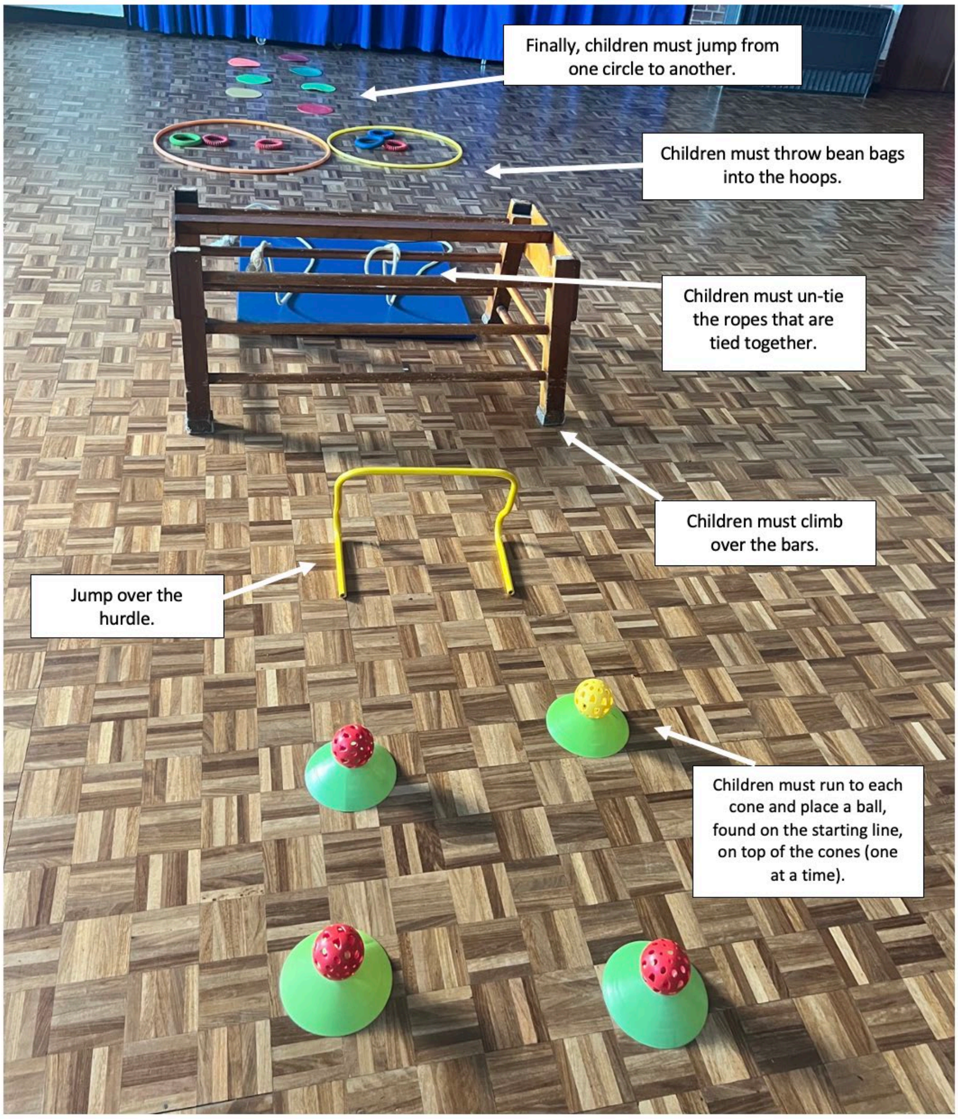
Table 9: Activities found within the scheme of work

	Activities found within each term
Term 4	- Building their own obstacle course: Different terrain obstacle course, boxes, hills, beams, climbing walls. - Baking cookies - Adventurous climbing and swinging (outdoor climbing and swing frames).
Term 5	- Gardening – weeding areas around the school and potting plants - Building their own obstacle course: different terrain obstacle course, boxes, hills, beams, climbing walls. - The use of scissors: cutting shapes
Term 6	- 'Moving house' game where children wrap up items and place them in boxes - Adventurous climbing and swinging – indoor climbing and swing frames. - Making homemade playdough - Building their own obstacle course: Different terrain obstacle course, boxes, hills, beams, climbing walls.

	- Weaving

A debrief of these interventions alongside photographs of the work created within the interventions can be seen below. Following the assessment circuit at the start of term 4, children began by designing their own obstacle courses. This task was performed during each term. The children were given a wide variety of equipment and were asked to use their creativity to navigate their way from one end of the school hall to the other. Figure 2 shows an annotated course, designed and explained by a group of six children.

An annotated example of the children's obstacle courses



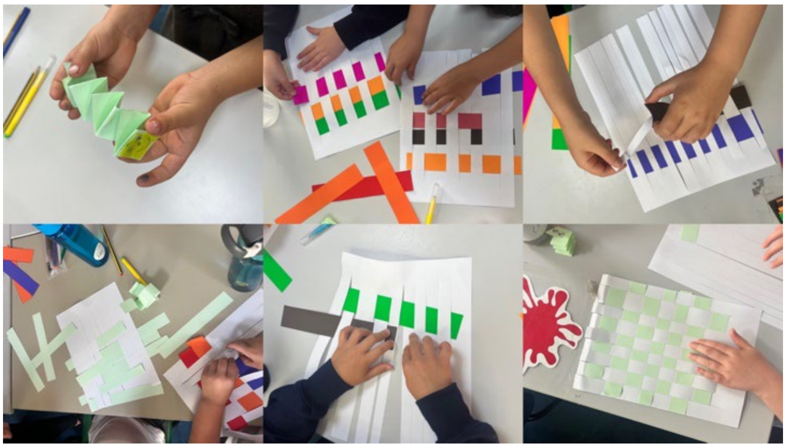
Adventurous climbing improves children's core strength and coordination while simultaneously encouraging them to consider their own security and safety, as well as how to climb or adapt their bodies to balance in order to notice when something feels unsafe (DfE, 2022). Within these sessions the children were able to explore the indoor and outdoor grounds of the school by climbing the few trees we had available outside and utilising out indoor climbing apparatus.

The children also helped to weed the school grounds. Gardening encourages and promotes children's PD muscular strength, FMS and coordination (DfE, 2022). The children were bending over to pull weeds, lifting stones and scooping up soil into a bucket, all of which contribute to core muscle development. Additionally, the joints are reinforced and are therefore made increasingly more flexible. Children, in particular, like the act of digging holes, planting plants in them, and then pushing the soil down to ensure they are in place. Movements like this help to improve core strength and coordination.

The children also took part in cooking sessions such as baking cookies and making their own playdough. DfE (2022) explain that involving young children in food preparation and cooking on a regular basis is a highly motivating way of improving their FMS. Cooking activities found within the baking of cookies and making of playdough such as squeezing, mixing, pouring, and spreading support the development of FMS and hand-eye coordination abilities (DfE, 2022). Specifically, the motion of rolling and flattening a mixture, such as playdough, with the hands or with a rolling pin helps children practice utilising both hands in a coordinated manner. Furthermore, pouring ingredients into bowls is another effective method to develop hand-eye coordination.

After noticing that the children's use of scissors was not making huge amounts of progress by the ET4, more skills-based lessons focussing on the correct way to use scissors were added. Children spent the lesson focussing on the correct way to hold scissors, practice rotating the paper while cutting, and open and close the scissors sufficiently to ensure that they cut the paper rather than tore it.

Weaving was one of the activities that children participated in. This activity enhanced their FMS by supporting children with grasping, establishing their pincer grip, and manipulating various materials (DfE, 2022). The children began the session by folding their own 'caterpillars' and then continued to weave different coloured paper to form a pattern. According to DfE (2022), educators should check for high levels of interest and observe each child’s dexterity as this will advise them if the materials chosen are appropriate and give a degree of challenge. To guarantee that this level of difficulty was present for each child within this intervention, the children utilised varied size strips of paper based on their ability.



The ’moving house’ game required the children to wrap everyday household items in paper (using Sellotape and scissors), place them into a box and move them. The children were then able to unwrap these items once they had ‘moved’ into their new house. Wrapping and moving objects using wrapping paper is a multipurpose form of PA that improves both FMS and GMS. Activities that enhance FMS include cutting paper, measuring and ripping tape, folding and creasing paper and handling the items once wrapped. These activities also help to increase coordination, accuracy, dexterity, and hand-eye coordination. Lifting and carrying the wrapped objects strengthens the children’s arms, shoulders, and torso; balancing improves overall stability; reaching and stretching to place the household objects onto different surfaces also increases flexibility and strength; and walking and navigating with wrapped items improves coordination and spatial awareness. These activities all contribute to the development of the children’s GMS.

Within another MC activity the children had the opportunity to engage in indoor and outdoor adventurous climbing and swinging. This took place on indoor and outdoor apparatus, trees and rope swings. Trees and climbing apparatuses, as well as hanging from ropes, provide the children with ample chance to improve GMS and FMS. Engaging in climbing strengthens the children's arms, legs, and core muscles, as well as improving balance, coordination, strength, and flexibility. Swinging on ropes strengthens the children's core muscles, as well as improving their rhythm and coordination.

Furthermore, tree climbing, hanging on ropes, and using climbing equipment both inside and outdoors provide a wealth of possibilities for the development of FMS by strengthening hand and finger muscles and enhancing grip strength. The exact positioning and adjusting of hands and feet on climbing grips and branches during these exercises improves dexterity and hand-eye coordination. Additionally, by constantly adjusting, particularly during twists and direction changes, swinging on ropes enhances hand coordination and grip.

Cool down activities

After these sessions it was important to incorporate cool-down activities to help the children gradually lower their heart rate, stretch their muscles, and promote a state of relaxation, promoting overall well-being after engagement in PA. The children partook in the following activities as their cool down exercises:

- *'Stretching circle'* – Within this activity the researcher lead the children through a series of gentle stretches in a circle - targeting major muscle groups and promoting flexibility and relaxation. The children had to hold each stretch for 10-15 seconds while focusing on slow, deep breathing which allowed them to release tension and unwind after PA.
- '*Yoga'* – Within this activity the researcher leads the children through simple yoga poses like child's pose, cat-cow stretch, and downward dog which promote muscle relaxation and calmness.
- '*Animal breathing'* - In this activity, the children had to mimic animal sounds whilst taking deep breaths, such as roaring like a lion, hissing like a snake, or spouting like a whale. By engaging in this engaging and playful activity which captured the children's

interests, they were able to focus on their breath and unwind from PA, incorporating mindfulness in a fun and engaging manner. The combination of deep breathing and imaginative play promotes relaxation and helps transition children to a calmer state after PA.

Appendix F – The scheme of work

	Week number	**Activity**
Term 4	**Warm up activities:** *Simon says Animal crawls Mirror Movements*	
	Week 1	*'Mock' assessment circuit Practice run of the circuit to allow teaching assistants to become familiar with observation sheets and expectations.*
	Week 2	*Baseline data collection circuit and FMS observations This week the children will participate in the circuit and baseline data will be collected. Children will be observed using scissors and cutlery and data will be recorded.*
	Week 3	*Building an obstacle course using different terrains, boxes, hills, beams etc. Children to have the chance to build their own obstacle course. Once the obstacle course is constructed children will revisit it. Each time they will become increasingly skilful in negotiating the different spaces, pieces of equipment and the length of the course. Differentiation will be provided by the change is pace.*
	Week 4	*Baking cookies The children will prepare the ingredients, roll and flatten dough with their hands as well as mix, stir, squeeze and spread the mixture. Finally, they will bake their cookies.*
	Week 5	*Adventurous climbing and swinging – outdoor climbing and swing frames. Children will partake in adventurous climbing of outdoor play equipment and trees within the school grounds.*
	Week 6	*End of term 4 assessment circuit Children will participate in data collection circuit for the end of term 4.*
	Cool down activities: *Stretching circle and yoga*	

Term 5	Week number	Activity
	Warm up activities: *Stuck in the Mud (with a twist)* *Traffic Lights* *Animal crawls*	
	Week 1	*Start of term 5 assessment circuit* *Children will participate in data collection circuit for the start of term 5.*
	Week 2	*Use of scissors* *Children to spend an entire lesson on the skill of cutting and how to use and mov their hands.*
	Week 3	*Gardening – weeding areas around the school and potting plants* *Children to participate in weeding the flower beds around the school grounds and then to plant plants.*
	Week 4	*Building an obstacle course using different terrains, boxes, hills, beams etc.* *Children to have the chance to build their own obstacle course. Reflecting upon their previous circuits, children will uplevel and improve their circuits and develop games around them. Each time they will become increasingly skilful in negotiating the different spaces, pieces of equipment and the length of the course. Differentiation will be provided by the change is pace and difficulty of each section of the course.*
	Week 5	*Moving house* *Children to wrap up items and placing them in boxes – ready to move houses! The children will be required to physically pick up and move the boxes and 'furniture'. Using clipboards the children will make lists; checking that all possessions have arrived safely at their new house!*
	Week 6	*End of term 5 assessment circuit* *Children will participate in data collection circuit for the end of term 5.*
	Cool down activities: *Yoga and animal breathing*	

Term 6	Week number	Activity
	Warm up activities: *Stuck in the mud (with a twist)* *Mirror movements* *Simon says*	
	Week 1	*Start of term 6 assessment circuit* *Children will participate in data collection circuit for the start of term 6.*
	Week 2	*Moving house* *Children to wrap up items and placing them in boxes – ready to move houses! The children will be required to physically pick up and move the boxes and 'furniture'. Using clipboards the children will make lists; checking that all possessions have arrived safely at their new house!*
	Week 3	*Building an obstacle course using different terrains, boxes, hills, beams etc.* *Children to have the chance to build their own obstacle course. Reflecting upon their previous circuits, children will uplevel and improve their circuits and develop games around them. Each time they will become increasingly skilful in negotiating the different spaces, pieces of equipment and the length of the course. Differentiation will be provided by the change is pace and difficulty of each section of the course.*
	Week 4	Adventurous climbing and swinging – indoor climbing and swing frames. *Children to utilise the indoor climbing apparatus learning to climb a range of different mediums effectively using accurate foot and hand placement.*
	Week 5	*Homemade playdough* *The children will prepare the ingredients, roll and flatten playdough with their hands as well as mix, stir, squeeze and spread the mixture. Finally, they will bake their cookies. After the children will mould their playdough into shapes.*
	Week 6	*Weaving* *Children will be interlacing two sets of threads or yarns, using right angles to develop a 'snake'. After children will weave strips of paper together to create their own patterns.*
	Week 7	*End of term 6 assessment circuit* *Children will participate in the final data collection circuit, for the end of term 6.*
	Cool down activities: *Stretching circle and animal breathing*	

Appendix G – Observation sheets used for data collection during the circuits.

Circuit– Station one: Hopping

	Did the non-support leg swing forward in pendular fashion to produce force?	Did the foot of non-support leg remain behind the body?	Were the arms flexed and did they swing forward to produce force?	Did the child take off and land three consecutive times on their preferred foot?	Did the child take off and land three consecutive times on their non-preferred foot?
Child A					

Circuit– Station two: Running/Galloping/Sliding

	Running Did the arms move in opposition to legs?	Running Was there a brief period where both feet are on off the ground?	Running Was there narrow foot placement landing on heel or toe (not flat footed)?	Running Was the non-support leg bent approx. 90 degrees?	Galloping Were the arms bent and lifted to waist level at takeoff?	Galloping Did the child step forward with lead foot followed by a step with trailing foot to position adjacent to or behind the lead foot?	Galloping Was there a brief period when both feet are off the floor?	Galloping Did the child maintain a rhythmic pattern for four consecutive gallops?	Sliding Was the child's body turned sideways so shoulders are aligned with the line on the floor?	Sliding Did the sideway step with lead foot followed by a slide of trailing next to leading?	Sliding Did the child execute a minimum of four continuous step-slide cycles to the right?	Sliding Did the child execute minimum of four continuous step-slide cycles to the left?
Child A												

Circuit– Station three: Dribbling ball on the spot / Under hand roll to person opposite

	<u>Dribbling</u> Did the child contact the ball with one hand at around belt level?	<u>Dribbling</u> Did the child push the ball with fingertips (not a slap)?	<u>Dribbling</u> Did the ball contact the surface in front of or to the outside of foot on the preferred side?	<u>Dribbling</u> Did the child maintain control of the ball for four consecutive bounces without having to move feet to retrieve it?	<u>Roll</u> Did the preferred hand swing down and back, reaching behind the trunk whilst the chest faced the cones?	<u>Roll</u> Did the child stride forward with foot opposite the preferred hand towards another child?	<u>Roll</u> Did the child bend knees to lower body?	<u>Roll</u> Was the ball released close to the floor so ball did not bounce more than 4 inches high?
Child A								

Circuit– Station four: Climbing on the apparatus

	Was climbing very rhythmic?	Did the child observe only the direction of climbing?	Did the child mainly use over grip and closed grip?	Did the child often or always use a diagonal reciprocal movement activation pattern?
Child A				

Circuit– Station five: Balance beam

	Was there any upper extremity and torso movement beyond central balance line?	Was the contralateral foot placed onto the ground?	Did the child have good hip control (no dropped hip)?
Child A			

Circuit– Station six: Kicking stationary ball and Catching ball

	<u>Kicking</u> Did the child have a rapid continuous approach to the ball?	<u>Kicking</u> Was there an elongated stride or leap immediately prior to ball contact?	<u>Kicking</u> Was the non-kicking foot placed even with or slightly behind the ball?	<u>Kicking</u> Did the child kick the ball with instep of preferred foot (shoelaces) or toe?	<u>Catching</u> Was there a preparation phase where hands were in front of the body and elbows were flexed?	<u>Catching</u> Were the arms extended whilst reaching for the ball as it arrived?	<u>Catching</u> Was the ball caught by hands only?
Child A							

Appendix H – Elements tested within the general TGMD-2

Skill	Minimum space or line required	8"-10" plastic playground or soccer ball	4" plastic ball	Tennis ball	4"-5" beanbag	2 traffic cones/tape	Plastic bat	Nerf ball	Batting tee
Run	28'					X			
Gallop	16'					X or tape			
Leap	14'				X				
Horizontal jump	10'					X			
Slide	10-15'					X			
Striking stationary ball							X	X	X
Stationary dribble	15 sq ft area	X							
Catch	10'		X						
Kick	10-15'	X			X				
Overhand throw	10-15'			X					
Underhand roll	10-15'			X					

Appendix I – The qualitative variables of climbing proficiency

CLIMBING PROFICIENCY VARIABLES AND CRITERIA	POINTS
CLIMBING RHYTHM	
Climbing includes stops and changes of rhythm	1
Climbing is mainly rhythmic without stops	2
Climbing is very rhythmic	3
LOOKING IN THE DIRECTION OF MOVEMENT	
Child observes floor, hands and feet, child´s look is all around the room	1
Child observes hands and feet, occasionally the direction of climbing	2
Child observes only the direction of climbing	3
GRASPING METHOD	
Child uses undergrip and helps also with other parts of the body	1
Child uses under- or overgrip, the grip is opened or closed	2
Child mainly uses overgrip and closed grip	3
THE USAGE OF A DIAGONAL RECIPROCAL MOVEMENT ACTIVATION PATTERN	
Never – rarely	1
Sometimes	2
Often - always	3
POINTS TOGETHER	4-12

Appendix J – Example GEE outputs for dribbling success criteria

Dribbling SC1

Generalized Linear Models

Model Information

Dependent Variable		RESPONSE[a]
Probability Distribution		Binomial
Link Function		Logit
Subject Effect	1	PART
Within-Subject Effect	1	TIME
Working Correlation Matrix Structure		Independent

a. The procedure models .00 as the response, treating 1.00 as the reference category.

Case Processing Summary

	N	Percent
Included	150	100.0%
Excluded	0	0.0%
Total	150	100.0%

Correlated Data Summary

Number of Levels	Subject Effect	PART	25
	Within-Subject Effect	TIME	6
Number of Subjects			25
Number of Measurements per Subject	Minimum		6
	Maximum		6
Correlation Matrix Dimension			6

Categorical Variable Information

			N	Percent
Dependent Variable	RESPONSE	.00	37	24.7%
		1.00	113	75.3%
		Total	150	100.0%
Factor	TIME	1.00	25	16.7%
		2.00	25	16.7%
		3.00	25	16.7%
		4.00	25	16.7%
		5.00	25	16.7%
		6.00	25	16.7%
		Total	150	100.0%

Goodness of Fit[a]

	Value
Quasi Likelihood under Independence Model Criterion (QIC)[b]	173.308
Corrected Quasi Likelihood under Independence Model Criterion (QICC)[b]	173.308

Dependent Variable: RESPONSE
Model: (Intercept), TIME

a. Information criteria are in smaller-is-better form.

b. Computed using the full log quasi-likelihood function.

Tests of Model Effects

Source	Type III Wald Chi-Square	df	Sig.
(Intercept)	7.703	1	.006
TIME	7.221	3	.065

Dependent Variable: RESPONSE
Model: (Intercept), TIME

Parameter Estimates

			95% Wald Confidence Interval		Hypothesis Test		
Parameter	B	Std. Error	Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-1.658	.5455	-2.727	-.589	9.239	1	.002
[TIME=1.00]	.904	.4287	.064	1.745	4.450	1	.035
[TIME=2.00]	.904	.4287	.064	1.745	4.450	1	.035
[TIME=3.00]	1.083	.4546	.192	1.974	5.673	1	.017
[TIME=4.00]	8.323E-16	.4209	-.825	.825	.000	1	1.000
[TIME=5.00]	4.591E-16	.4209	-.825	.825	.000	1	1.000
[TIME=6.00]	0[a]	.	.	.	.	.	.
(Scale)	1						

Dependent Variable: RESPONSE
Model: (Intercept), TIME

a. Set to zero because this parameter is redundant.

Estimated Marginal Means: TIME

Estimates

TIME	Mean	Std. Error	95% Wald Confidence Interval Lower	Upper
1.00	.32	.093	.17	.52
2.00	.32	.093	.17	.52
3.00	.36	.096	.20	.56
4.00	.16	.073	.06	.36
5.00	.16	.073	.06	.36
6.00	.16	.073	.06	.36

Pairwise Comparisons

(I) TIME	(J) TIME	Mean Difference (I-J)	Std. Error	df	Sig.	95% Wald Confidence Interval for Difference Lower	Upper
1.00	2.00	.00	.000	1	1.000	.00	.00
	3.00	-.04	.039	1	.307	-.12	.04
	4.00	.16[a]	.073	1	.029	.02	.30
	5.00	.16[a]	.073	1	.029	.02	.30
	6.00	.16[a]	.073	1	.029	.02	.30
2.00	1.00	.00	.000	1	1.000	.00	.00
	3.00	-.04	.039	1	.307	-.12	.04
	4.00	.16[a]	.073	1	.029	.02	.30
	5.00	.16[a]	.073	1	.029	.02	.30
	6.00	.16[a]	.073	1	.029	.02	.30
3.00	1.00	.04	.039	1	.307	-.04	.12
	2.00	.04	.039	1	.307	-.04	.12
	4.00	.20[a]	.080	1	.012	.04	.36
	5.00	.20[a]	.080	1	.012	.04	.36
	6.00	.20[a]	.080	1	.012	.04	.36
4.00	1.00	-.16[a]	.073	1	.029	-.30	-.02
	2.00	-.16[a]	.073	1	.029	-.30	-.02
	3.00	-.20[a]	.080	1	.012	-.36	-.04
	5.00	.00	.000	1	.	.00	.00
	6.00	.00	.057	1	1.000	-.11	.11

5.00	1.00	-.16[a]	.073	1	.029	-.30	-.02
	2.00	-.16[a]	.073	1	.029	-.30	-.02
	3.00	-.20[a]	.080	1	.012	-.36	-.04
	4.00	.00	.000	1	.	.00	.00
	6.00	.00	.057	1	1.000	-.11	.11
6.00	1.00	-.16[a]	.073	1	.029	-.30	-.02
	2.00	-.16[a]	.073	1	.029	-.30	-.02
	3.00	-.20[a]	.080	1	.012	-.36	-.04
	4.00	.00	.057	1	1.000	-.11	.11
	5.00	.00	.057	1	1.000	-.11	.11

Pairwise comparisons of estimated marginal means based on the original scale of dependent variable RESPONSE

a. The mean difference is significant at the .05 level.

Overall Test Results

Wald Chi-Square	df	Sig.
7.169	3	.067

The Wald chi-square tests the effect of TIME. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Dribbling SC2

Generalized Linear Models

Model Information

Dependent Variable		RESPONSE[a]
Probability Distribution		Binomial
Link Function		Logit
Subject Effect	1	PART
Within-Subject Effect	1	TIME
Working Correlation Matrix Structure		Independent

a. The procedure models .00 as the response, treating 1.00 as the reference category.

Case Processing Summary

	N	Percent
Included	150	100.0%
Excluded	0	0.0%
Total	150	100.0%

Correlated Data Summary

Number of Levels	Subject Effect	PART	25
	Within-Subject Effect	TIME	6
Number of Subjects			25
Number of Measurements per Subject	Minimum		6
	Maximum		6
Correlation Matrix Dimension			6

Categorical Variable Information

			N	Percent
Dependent Variable	RESPONSE	.00	66	44.0%
		1.00	84	56.0%
		Total	150	100.0%
Factor	TIME	1.00	25	16.7%
		2.00	25	16.7%
		3.00	25	16.7%
		4.00	25	16.7%
		5.00	25	16.7%
		6.00	25	16.7%
		Total	150	100.0%

Goodness of Fit[a]

	Value
Quasi Likelihood under Independence Model Criterion (QIC)[b]	205.967
Corrected Quasi Likelihood under Independence Model Criterion (QICC)[b]	205.967

Dependent Variable: RESPONSE
Model: (Intercept), TIME

a. Information criteria are in smaller-is-better form.

b. Computed using the full log quasi-likelihood function.

Tests of Model Effects

	Type III		
Source	Wald Chi-Square	df	Sig.
(Intercept)	.502	1	.479
TIME	11.705	4	.020

Dependent Variable: RESPONSE
Model: (Intercept), TIME

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-.754	.4287	-1.594	.087	3.091	1	.079
[TIME=1.00]	1.508	.5121	.504	2.511	8.667	1	.003
[TIME=2.00]	.995	.4424	.128	1.862	5.057	1	.025
[TIME=3.00]	.513	.3721	-.217	1.242	1.898	1	.168
[TIME=4.00]	2.367E-16	.2600	-.510	.510	.000	1	1.000
[TIME=5.00]	1.986E-16	.2600	-.510	.510	.000	1	1.000
[TIME=6.00]	0[a]	.	.	.	.	.	.
(Scale)	1						

Dependent Variable: RESPONSE
Model: (Intercept), TIME

a. Set to zero because this parameter is redundant.

Estimated Marginal Means: TIME

Estimates

TIME	Mean	Std. Error	95% Wald Confidence Interval	
			Lower	Upper
1.00	.68	.093	.48	.83
2.00	.56	.099	.37	.74
3.00	.44	.099	.26	.63
4.00	.32	.093	.17	.52
5.00	.32	.093	.17	.52
6.00	.32	.093	.17	.52

Pairwise Comparisons

(I) TIME	(J) TIME	Mean Difference (I-J)	Std. Error	df	Sig.	95% Wald Confidence Interval for Difference Lower	Upper
1.00	2.00	.12	.065	1	.065	-.01	.25
	3.00	.24[a]	.085	1	.005	.07	.41
	4.00	.36[a]	.096	1	<.001	.17	.55
	5.00	.36[a]	.096	1	<.001	.17	.55
	6.00	.36[a]	.111	1	.001	.14	.58
2.00	1.00	-.12	.065	1	.065	-.25	.01
	3.00	.12	.065	1	.065	-.01	.25
	4.00	.24[a]	.085	1	.005	.07	.41
	5.00	.24[a]	.085	1	.005	.07	.41
	6.00	.24[a]	.102	1	.019	.04	.44
3.00	1.00	-.24[a]	.085	1	.005	-.41	-.07
	2.00	-.12	.065	1	.065	-.25	.01
	4.00	.12	.065	1	.065	-.01	.25
	5.00	.12	.065	1	.065	-.01	.25
	6.00	.12	.086	1	.164	-.05	.29
4.00	1.00	-.36[a]	.096	1	<.001	-.55	-.17
	2.00	-.24[a]	.085	1	.005	-.41	-.07
	3.00	-.12	.065	1	.065	-.25	.01
	5.00	.00	.000	1	1.000	.00	.00
	6.00	.00	.057	1	1.000	-.11	.11
5.00	1.00	-.36[a]	.096	1	<.001	-.55	-.17
	2.00	-.24[a]	.085	1	.005	-.41	-.07
	3.00	-.12	.065	1	.065	-.25	.01
	4.00	.00	.000	1	1.000	.00	.00
	6.00	.00	.057	1	1.000	-.11	.11
6.00	1.00	-.36[a]	.111	1	.001	-.58	-.14
	2.00	-.24[a]	.102	1	.019	-.44	-.04
	3.00	-.12	.086	1	.164	-.29	.05
	4.00	.00	.057	1	1.000	-.11	.11
	5.00	.00	.057	1	1.000	-.11	.11

Pairwise comparisons of estimated marginal means based on the original scale of dependent variable RESPONSE

a. The mean difference is significant at the .05 level.

Overall Test Results

Wald Chi-Square	df	Sig.
14.062	4	.007

The Wald chi-square tests the effect of TIME. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Dribbling SC3

Generalized Linear Models

Model Information

Dependent Variable		RESPONSE[a]
Probability Distribution		Binomial
Link Function		Logit
Subject Effect	1	PART
Within-Subject Effect	1	TIME
Working Correlation Matrix Structure		Independent

a. The procedure models .00 as the response, treating 1.00 as the reference category.

Case Processing Summary

	N	Percent
Included	150	100.0%
Excluded	0	0.0%
Total	150	100.0%

Correlated Data Summary

Number of Levels	Subject Effect	PART	25
	Within-Subject Effect	TIME	6
Number of Subjects			25
Number of Measurements per Subject	Minimum		6
	Maximum		6
Correlation Matrix Dimension			6

Categorical Variable Information

			N	Percent
Dependent Variable	RESPONSE	.00	78	52.0%
		1.00	72	48.0%
		Total	150	100.0%
Factor	TIME	1.00	25	16.7%
		2.00	25	16.7%
		3.00	25	16.7%
		4.00	25	16.7%
		5.00	25	16.7%
		6.00	25	16.7%
		Total	150	100.0%

Goodness of Fit[a]

	Value
Quasi Likelihood under Independence Model Criterion (QIC)[b]	215.841
Corrected Quasi Likelihood under Independence Model Criterion (QICC)[b]	215.841

Dependent Variable: RESPONSE
Model: (Intercept), TIME

a. Information criteria are in smaller-is-better form.

b. Computed using the full log quasi-likelihood function.

Tests of Model Effects

Source	Type III Wald Chi-Square	df	Sig.
(Intercept)	.051	1	.821
TIME	5.429	3	.143

Dependent Variable: RESPONSE
Model: (Intercept), TIME

Parameter Estimates

			95% Wald Confidence Interval		Hypothesis Test		
Parameter	B	Std. Error	Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-.241	.4029	-1.031	.549	.358	1	.549
[TIME=1.00]	.647	.3808	-.100	1.393	2.883	1	.090
[TIME=2.00]	.647	.3808	-.100	1.393	2.883	1	.090
[TIME=3.00]	.647	.3808	-.100	1.393	2.883	1	.090
[TIME=4.00]	7.703E-16	.2296	-.450	.450	.000	1	1.000
[TIME=5.00]	7.846E-16	.2296	-.450	.450	.000	1	1.000
[TIME=6.00]	0[a]	.	.	.	.	.	.
(Scale)	1						

Dependent Variable: RESPONSE
Model: (Intercept), TIME

a. Set to zero because this parameter is redundant.

Estimated Marginal Means: TIME

Estimates

TIME	Mean	Std. Error	95% Wald Confidence Interval Lower	Upper
1.00	.60	.098	.40	.77
2.00	.60	.098	.40	.77
3.00	.60	.098	.40	.77
4.00	.44	.099	.26	.63
5.00	.44	.099	.26	.63
6.00	.44	.099	.26	.63

Pairwise Comparisons

(I) TIME	(J) TIME	Mean Difference (I-J)	Std. Error	df	Sig.	95% Wald Confidence Interval for Difference Lower	Upper
1.00	2.00	.00	.000	1	1.000	.00	.00
	3.00	.00	.057	1	1.000	-.11	.11
	4.00	.16[a]	.073	1	.029	.02	.30
	5.00	.16[a]	.073	1	.029	.02	.30
	6.00	.16	.093	1	.084	-.02	.34
2.00	1.00	.00	.000	1	1.000	.00	.00
	3.00	.00	.057	1	1.000	-.11	.11
	4.00	.16[a]	.073	1	.029	.02	.30
	5.00	.16[a]	.073	1	.029	.02	.30
	6.00	.16	.093	1	.084	-.02	.34
3.00	1.00	.00	.057	1	1.000	-.11	.11
	2.00	.00	.057	1	1.000	-.11	.11
	4.00	.16[a]	.073	1	.029	.02	.30
	5.00	.16[a]	.073	1	.029	.02	.30
	6.00	.16	.093	1	.084	-.02	.34
4.00	1.00	-.16[a]	.073	1	.029	-.30	-.02
	2.00	-.16[a]	.073	1	.029	-.30	-.02
	3.00	-.16[a]	.073	1	.029	-.30	-.02
	5.00	.00	.000	1	1.000	.00	.00
	6.00	.00	.057	1	1.000	-.11	.11

5.00	1.00	-.16[a]	.073	1	.029	-.30	-.02
	2.00	-.16[a]	.073	1	.029	-.30	-.02
	3.00	-.16[a]	.073	1	.029	-.30	-.02
	4.00	.00	.000	1	1.000	.00	.00
	6.00	.00	.057	1	1.000	-.11	.11
6.00	1.00	-.16	.093	1	.084	-.34	.02
	2.00	-.16	.093	1	.084	-.34	.02
	3.00	-.16	.093	1	.084	-.34	.02
	4.00	.00	.057	1	1.000	-.11	.11
	5.00	.00	.057	1	1.000	-.11	.11

Pairwise comparisons of estimated marginal means based on the original scale of dependent variable RESPONSE

a. The mean difference is significant at the .05 level.

Overall Test Results

Wald Chi-Square	df	Sig.
5.594	3	.133

The Wald chi-square tests the effect of TIME. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Dribbling SC4

Generalized Linear Models

Model Information

Dependent Variable		RESPONSE[a]
Probability Distribution		Binomial
Link Function		Logit
Subject Effect	1	PART
Within-Subject Effect	1	TIME
Working Correlation Matrix Structure		Independent

a. The procedure models .00 as the response, treating 1.00 as the reference category.

Case Processing Summary

	N	Percent
Included	150	100.0%
Excluded	0	0.0%
Total	150	100.0%

Correlated Data Summary

Number of Levels	Subject Effect	PART	25
	Within-Subject Effect	TIME	6
Number of Subjects			25
Number of Measurements per Subject	Minimum		6
	Maximum		6
Correlation Matrix Dimension			6

Categorical Variable Information

			N	Percent
Dependent Variable	RESPONSE	.00	86	57.3%
		1.00	64	42.7%
		Total	150	100.0%
Factor	TIME	1.00	25	16.7%
		2.00	25	16.7%
		3.00	25	16.7%
		4.00	25	16.7%
		5.00	25	16.7%
		6.00	25	16.7%
		Total	150	100.0%

Goodness of Fit[a]

	Value
Quasi Likelihood under Independence Model Criterion (QIC)[b]	213.544
Corrected Quasi Likelihood under Independence Model Criterion (QICC)[b]	213.544

Dependent Variable: RESPONSE
Model: (Intercept), TIME

a. Information criteria are in smaller-is-better form.

b. Computed using the full log quasi-likelihood function.

Tests of Model Effects

Source	Type III Wald Chi-Square	df	Sig.
(Intercept)	.670	1	.413
TIME	8.088	2	.018

Dependent Variable: RESPONSE
Model: (Intercept), TIME

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval Lower	Upper	Hypothesis Test Wald Chi-Square	df	Sig.
(Intercept)	-.080	.4003	-.865	.705	.040	1	.842
[TIME=1.00]	.655	.3057	.056	1.255	4.595	1	.032
[TIME=2.00]	.655	.3057	.056	1.255	4.595	1	.032
[TIME=3.00]	.655	.3057	.056	1.255	4.595	1	.032
[TIME=4.00]	-1.252E-16	.	.	.	.	1	<.001
[TIME=5.00]	.321	.2188	-.108	.750	2.155	1	.142
[TIME=6.00]	0[a]	.	.	.	.	.	.
(Scale)	1						

Dependent Variable: RESPONSE
Model: (Intercept), TIME

a. Set to zero because this parameter is redundant.

Estimated Marginal Means: TIME

Estimates

TIME	Mean	Std. Error	95% Wald Confidence Interval Lower	Upper
1.00	.64	.096	.44	.80
2.00	.64	.096	.44	.80
3.00	.64	.096	.44	.80
4.00	.48	.100	.30	.67
5.00	.56	.099	.37	.74
6.00	.48	.100	.30	.67

Pairwise Comparisons

(I) TIME	(J) TIME	Mean Difference (I-J)	Std. Error	df	Sig.	95% Wald Confidence Interval for Difference Lower	Upper
1.00	2.00	.00	.000	1	1.000	.00	.00
	3.00	.00	.000	1	1.000	.00	.00
	4.00	.16[a]	.073	1	.029	.02	.30
	5.00	.08	.097	1	.408	-.11	.27
	6.00	.16[a]	.073	1	.029	.02	.30
2.00	1.00	.00	.000	1	1.000	.00	.00
	3.00	.00	.000	1	.	.00	.00
	4.00	.16[a]	.073	1	.029	.02	.30
	5.00	.08	.097	1	.408	-.11	.27
	6.00	.16[a]	.073	1	.029	.02	.30
3.00	1.00	.00	.000	1	1.000	.00	.00
	2.00	.00	.000	1	.	.00	.00
	4.00	.16[a]	.073	1	.029	.02	.30
	5.00	.08	.097	1	.408	-.11	.27
	6.00	.16[a]	.073	1	.029	.02	.30
4.00	1.00	-.16[a]	.073	1	.029	-.30	-.02
	2.00	-.16[a]	.073	1	.029	-.30	-.02
	3.00	-.16[a]	.073	1	.029	-.30	-.02
	5.00	-.08	.054	1	.140	-.19	.03
	6.00	.00	.000	1	.	.00	.00
5.00	1.00	-.08	.097	1	.408	-.27	.11
	2.00	-.08	.097	1	.408	-.27	.11
	3.00	-.08	.097	1	.408	-.27	.11
	4.00	.08	.054	1	.140	-.03	.19
	6.00	.08	.054	1	.140	-.03	.19
6.00	1.00	-.16[a]	.073	1	.029	-.30	-.02
	2.00	-.16[a]	.073	1	.029	-.30	-.02
	3.00	-.16[a]	.073	1	.029	-.30	-.02
	4.00	.00	.000	1	.	.00	.00
	5.00	-.08	.054	1	.140	-.19	.03

Pairwise comparisons of estimated marginal means based on the original scale of dependent variable RESPONSE

a. The mean difference is significant at the .05 level.

Overall Test Results

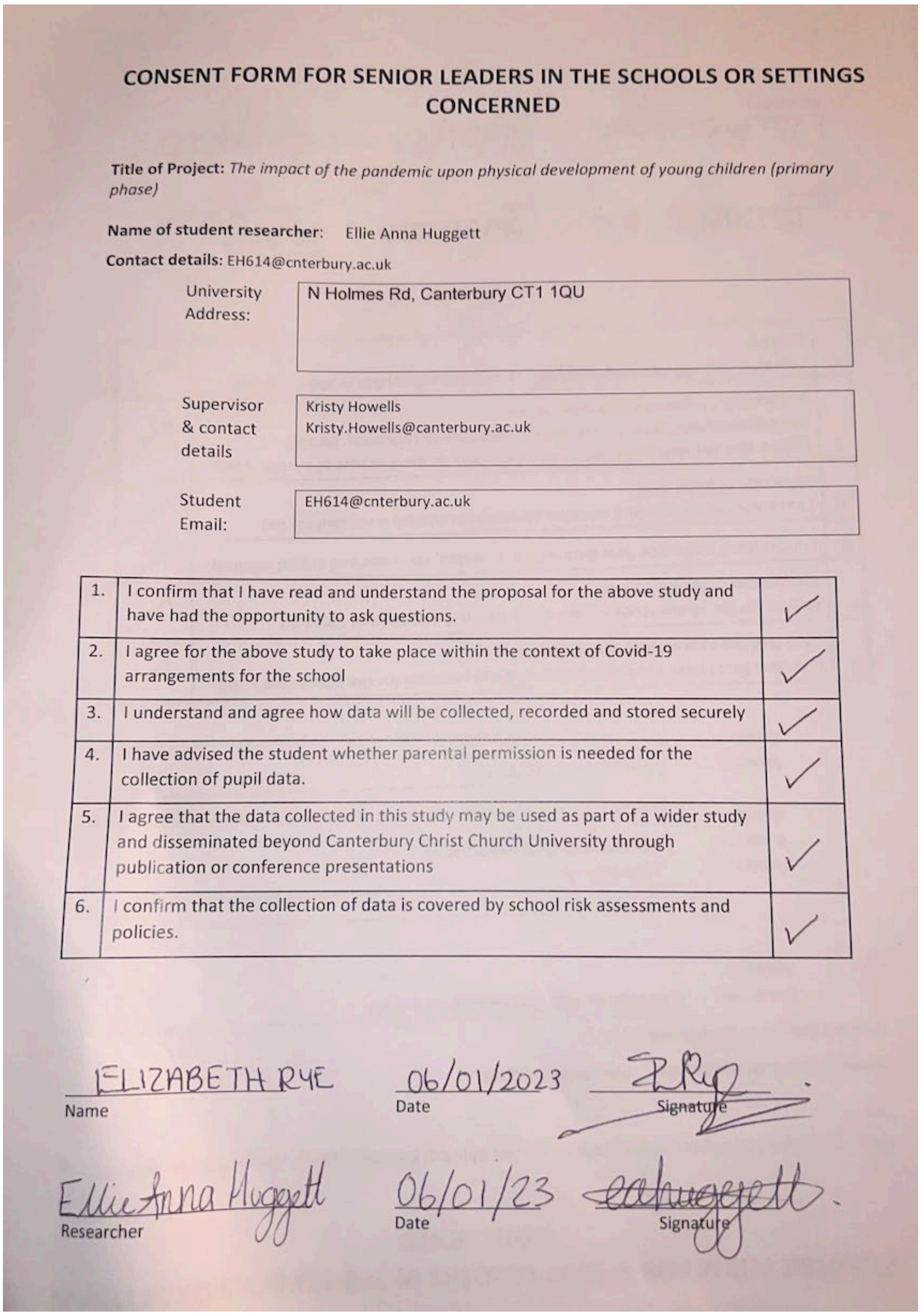
Wald Chi-Square	df	Sig.
7.895	2	.019

The Wald chi-square tests the effect of TIME. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Appendix K – Ethical Considerations

Gatekeeper consent

According to Harger and Quintela (2017), gatekeepers play a significant role in research with children. Shaw, Brady and Davey (2011) state that it is typically important to acquire the consent of the setting's headteacher to conduct the study in the first place, and they must be presented with written information about what is planned so that they are able to seek assurances that the study is valuable and interesting, that it would be performed professionally and ethically, and that it will create a low strain on their staff and participants. It should be noted that prior to undertaking this study the researcher presented my proposed research ideas to the headteacher, to gain their consent (a copy of the gatekeeper consent form can be found below). Although Shaw, Brady, and Davey (2011) emphasised the necessity of the gatekeeper's responsibility, they also emphasised whilst a gatekeepers' participation is frequently required, they should not be the ultimate decision on who may and should not be asked to participate in research. Reflecting upon this, the researcher ensured that they had made the decision on which cohort of children would be taking part within this research.



CONSENT FORM FOR SENIOR LEADERS IN THE SCHOOLS OR SETTINGS CONCERNED

Title of Project: *The impact of the pandemic upon physical development of young children (primary phase)*

Name of student researcher: Ellie Anna Huggett

Contact details: EH614@cnterbury.ac.uk

University Address:	N Holmes Rd, Canterbury CT1 1QU
Supervisor & contact details	Kristy Howells Kristy.Howells@canterbury.ac.uk
Student Email:	EH614@cnterbury.ac.uk

1.	I confirm that I have read and understand the proposal for the above study and have had the opportunity to ask questions.	✓
2.	I agree for the above study to take place within the context of Covid-19 arrangements for the school	✓
3.	I understand and agree how data will be collected, recorded and stored securely	✓
4.	I have advised the student whether parental permission is needed for the collection of pupil data.	✓
5.	I agree that the data collected in this study may be used as part of a wider study and disseminated beyond Canterbury Christ Church University through publication or conference presentations	✓
6.	I confirm that the collection of data is covered by school risk assessments and policies.	✓

ELIZABETH RYE
Name

06/01/2023
Date

E Rye
Signature

Ellie Anna Huggett
Researcher

06/01/23
Date

eahuggett
Signature

Child assent

The acknowledgment of children's and young people's rights to consultation and participation in choices that affect their lives and themselves is a growing global trend (United Nations Convention on the Rights of the Child UNCRC, 1989). Many health care studies and regulations, within Ireland (Department of Health and Children, 2000) in addition to the

United Kingdom, have emphasised the value of communicating with children and taking into account their opinions (Department for Education and Skills, 2003; Department of Health, 2003). New viewpoints in childhood sociology unequivocally support children's capacity to communicate their experiences and place emphasis on their freedom to select whether or not to participate in research (Coyne, 2010). Yet, seeing children as social agents introduces additional challenges and ambiguities to the study process, expands the potential for moral quandaries, and places new duties on researchers, especially when it comes to the permission process (Christensen and Prout, 2002).

Tinson (2009) claims that in studies based upon education, that consent is not commonly obtained directly from the respondents—the children—but rather through educators acting on their behalf. 'Consent is assumed rather than informed' as a result (Homan, 2001, pp. 330). Given this, it was considered crucial that the children knew exactly what they were being asked them to take part in. It was decided that it would be best to explain why the researcher was observing the children and what they would be looking for. In addition to making sure that the child understands the research's purpose and what taking part would involve, Shaw, Brady, and Davey (2011) explain it is the researcher's duty to give pertinent information. Although, it is important to note that Brookes, te Riele and Maguir (2014) explain that teachers undertaking research at their own school need to be extremely careful and ensure that children do not fear repercussions and feel pressured into participating in the research. Taking this into consideration, after an in-depth explanation which emphasised that there would be no repercussions and that they were free to make their own decision, the children had the chance to ask questions. Following this, the children were then given the choice of participating in the study, since every child should be able to opt out if they so desired (Crow *et al.*, 2006) and children are worthy to voice their opinions, in accordance with Article 12 of the United Nations Convention on the Rights of the Child (UNCRC) (1992). The script which was used to gain original consent from the children can be found within below. The UNCRC (1992) emphasise that children's viewpoints shouldn't be discounted because of their age. Graham *et al.* (2015) further add that children can fully grasp the idea of consent, therefore their opinions should be heard and taken seriously, (UNCRC, 1992). According to Flewitt (2005), the concept of 'informed' consent should be replaced with one of 'provisional' consent, which is always being discussed and reviewed with children's assent being often and positively reinforced. In light of this, the researcher ensured that at the beginning of every one of the six circuits within this research the children had the option to participate or to not.

Script used to gain child assent

Today we are going to be trying out a new type of PE lesson. You will be working with me until the end of this year to improve our fine and gross motor skills, does anybody know what they are?

Wait for responses and engage with children.

Fine motor skills are all about the small movements you make with your hands and fingers. It's like when you draw a picture, build with tiny blocks, or even when you tie your shoelaces. Imagine you're using a pencil to write your name—that's using your fine motor skills! Now, gross motor skills are about the big movements you make with your arms, legs, and whole body. Think about when you run, jump, or dance. When you kick a ball or climb on the playground, you're using your gross motor skills.

Let's play a quick game! I'll say an activity, and you can tell me if it's using fine motor skills or gross motor skills. Ready?

How about brushing your teeth?
Children respond.

How about riding a bike?
Children respond.

I have a fun idea, and I need your help! We're going to set up an activity circuit, which is like a series of super fun games and challenges to test how awesome your fine and gross motor skills are. Would you like to hear more about it?

Children respond.

Awesome! So, in this activity circuit, you'll get to do things like balance on beans, climb up the indoor climbing equipment, throw, kick, and roll balls as well as lots of other exciting stuff! We are also going *to do lots of other fun activities over the next few months such as baking cookies, making playdough, creating our own circuits, outdoor climbing etc. Does that sound fun?*

Wait for response.

But before we start, I want to make sure everyone is okay with this plan. There will be adults helping you every week and watching how amazing you are at using your fine and gross motor skills within the fun circuits. It's really important to me that you only join if you want to. If you don't feel like doing it, or you don't want adults to see how awesome your fine and gross motor skills are, that's totally okay too! If you decide you would like to take part but change your mind throughout the next few terms that is also fine, just let an adult know.

Wait for responses and record children who give assent.

Do any of you have any questions about the activity circuit or the activities we are going to do over the next few months?

Answer any questions the children may have.

Due to their social standing and place in society, children are typically portrayed as 'vulnerable' and relatively helpless (Brookes *et al.,* 2014). Brookes *et al.* (2014) elucidate certain ethical concerns that are unduly protective, it has been suggested, merely help to infantilize children through specific manifestations of fragility that signify their powerlessness and lack of understanding. Although the researcher is still ultimately responsible for the decisions made after explaining the research method to the children, by paying attention to and respecting the views of every participant, it may at the very least assist to balance the uneven power dynamics between researcher and researched (Flewitt, 2005). According to Pinter and Zandian (2013), adults should take the time to get to know children and solicit their assistance in an effort to lessen the power disparity between them and children. Taking this into consideration and reflecting upon previous research (Huggett and Howells, 2022) where it was stated that owing to time restrictions, the researcher had a limited chance to develop a rapport or relationship with the children that participated in the research, within this study thew researcher has been able to utilise their role as a class teacher and PE lead within the school to spend time at breaktimes, school events and sports fixtures to get to know them holistically, as individuals. This is crucial according to research conducted in Cameroon, which states that it is irrelevant that there is a significant power imbalance at first between the adult researcher and the children; as long as the adult researcher is willing to engage in developing connections, it is still feasible to obtain the children's perspectives (Kuchah and Pinter, 2012).

Parental consent

According to Coyne (2010), the necessity for parental approval may be viewed as a well-intentioned protection designed to ensure the safety of young children, but simultaneously, this safety may limit children's capacity to willingly engage in research. It should be noted that as a result of this, the parents were not asked to give consent for their children to participate in this research – the headteacher, acting as the gatekeeper, gave consent and advised that parental consent was not needed, and the children themselves gave assent. The need for parental agreement is typically explained by the fact that children can't reliably weigh the advantages and dangers of study participation on their own (McIntosh *et al*., 2000). Coyne (2010) suggest that perhaps very young children have trouble recognising the dangers and rewards of engaging, but it is vital to highlight that not all children have this problem. Coyne (2010) believes that the conversation on children's competence serves as an example of how adults frequently underrate a child's capabilities and see them from a deficiency viewpoint rather than from their advantages. Children just four years old can, as was previously indicated, show a rudimentary comprehension of the study and what will be required of them throughout research endeavours (Alderson *et al*., 2006).

Data protection

New data protection laws were established in Europe in 2018 and are now being examined and strengthened internationally to prevent individuals from having their personal information exploited (Alderson and Morrow, 2020). Adhering to the data protection standards stipulated in the Data Protection Act (Gov.uk, 2018), the researcher has taken steps to guarantee that only pertinent and suitable data regarding the participants was acquired while ensuring no data has been gathered in excess of purpose (Gov.uk, 2018).

Confidentiality

The distinction between confidentiality and anonymity is widely misunderstood, according to Bell and Waters (2018). Although it should be noted that Babey (2020) questioned Bell and Waters' (2018) assertion that ethical concern is not necessary for a 'informal route' of research. According to Babey (2020), obtaining ethical permission has nothing to do with one's morality and everything to do with safeguarding the participants. Abbot and Sapsford (1996, pp.319) explicitly state that 'confidentiality is a promise that you will not be identified or presented in identifiable form, while anonymity is a promise that even the researcher will not be able to tell which responses came from which respondents. As my research is entirely based upon observations of the children, anonymity is impossible. In order to maintain participant confidentiality, it was ensured that the information was handled in accordance with the School General Data Protection Regulation Policy (GDPR) (2023) alongside the GDPR European Union Legislation (2016) once it had been gathered - the findings were then maintained in locked cabinets. The identities of the participants were changed to pseudonyms. In addition to this, it was ensured that unauthorised individuals were unable to access any data and that computers were password protected, as highlighted by Alderson and Morrow (2020) as good practice on confidentiality. However, it is crucial to remember that any study conducted by a public institution, such as a hospital or a school, may be subject to a Freedom of Information Act 2000 request. Nonetheless, Bell and Waters (2018) point out that this happens to be quite uncommon.

Appendix L – Pairwise comparisons

Hopping

Success criteria one: non-support leg swinging forward in pendular fashion to produce force

Within the first success criteria for hopping there was a significant effect of time ($\chi 2$ 17.091, $p<0.001$). Pairwise comparisons demonstrated no significant difference between baseline and the end of term 4 and the start of term 5 ($p>0.05$). Although, significant differences were identified when comparing baseline to the end of term 5 as well as the start and end of term 6 ($p<0.05$). No significant differences were found when comparing the end of term 4 to start of term 5 ($p>0.05$). Contrastingly, when the end of term 4 was compared to the end of term 5 and the start and end of term 6 significant differences were found ($p<0.05$). Similarly, significant differences were evident when the start of term 5 was compared to the end of term 5 alongside the start and end of term 6 ($p<0.05$). Further pairwise comparisons revealed no significant difference between the end of term 5 and the start of term 6 ($p>0.05$) but significant differences between the end of term 5 and 6 ($p<0.05$). No further significant differences were found when comparing the start and end of term 6 ($p>0.05$).

Success criteria two: foot of non-support leg remaining behind the body

Similarly, a significant effect of time was apparent within the second success criteria for hopping ($\chi 2$ 8.620, $p=0.035$). Pairwise comparisons revealed no significant differences when comparing baseline to end of term 4 as well as the start and end of term 5 ($p>0.05$). However, when baseline was compared to the start and end of term 6 significant differences were evident ($p<0.05$). No significant differences were found when comparing the end of term 4 to start and end of term 5 ($p>0.05$) but significant differences could be seen when comparing the end of term 4 to the start and end of term 6 ($p<0.05$). Further pairwise comparisons demonstrated no significant differences when comparing the start of term 5 to the end of term 5 and start of term 6 ($p>0.05$). Contrastingly when comparing the start of term 5 to the end of term 6 significant differences were identified ($p<0.05$). No significant differences were found when comparing the end of term 5 to the start of term 6 ($p>0.05$). Although significant differences were found when comparing the end of term 5 to the end of term 6 ($p<0.05$). No further significant differences were found when comparing the start and end of term 6 ($p>0.05$).

Success criteria three: arms flexed and swing forward to produce force

The third success criteria for hopping also shows that there was a significant effect of time ($\chi2$ 22.730, $p<0.001$). Although pairwise comparisons demonstrated no significant difference between baseline and the end of term 4 ($p>0.05$), significant differences were seen when comparing baseline to the start and end of terms 5 and 6 ($p<0.05$). Similarly, no significant differences were found when comparing the end of term 4 to the start and end of term 5 ($p>0.05$). Although significant differences were found when comparing the end of term 4 to the start and end of term 6 ($p<0.05$). Contrastingly when comparing the start of term 5 to the end of term 5 no significant differences were evident ($p>0.05$). Despite this, significant differences were found between the start of term 5 and the start and end of term 6 ($p<0.05$), as well as between the end of term 5 and the start and end of term 6 ($p<0.05$). Furthermore, a significant difference was evident when comparing the start and end of term 6 ($p<0.05$).

Success criteria four: takes off and lands three consecutive times on preferred foot

The fourth success criteria for hopping shows no significant effect of time ($\chi2$ 7.786, $p=0.051$).

Success criteria five: takes off and lands three consecutive times on non-preferred foot. A significant effect of time ($\chi2$ 18.756, $p=0.002$) was evident within the final success criteria for hopping. Pairwise comparison revealed a significant difference when comparing baseline to the end of term 4 as well as the start and end of terms 5 and 6 ($p<0.05$). Similarly, when comparing the end of term 4 to the start and end of terms 5 and 6, significant differences were evident ($p<0.05$). On the other hand, when the start of term 5 was compared to the end of term 5 and the start of term 6 no significant differences were identified ($p>0.05$). Although significant differences were found when comparing the start of term 5 to the end of term 6 ($p<0.05$). Further pairwise comparisons revealed no significant differences when comparing the end of term 5 to the start and end of term 6 ($p>0.05$). Comparably, no significant differences were evident when comparing the start and end of term 6 ($p>0.05$).

Running

Success criteria one: arms move in opposition to legs

A significant effect of time ($\chi2$ 14.561, $p=0.006$) was evident within the first success criteria for running. Pairwise comparisons revealed no significant difference when comparing baseline to the end of term 4 and the start of term 5 ($p>0.05$). However, significant differences were identified when comparing baseline to the end of term 5 and the start and end of term 6 ($p<0.05$). No significant differences were found when comparing the end of term 4 to the start of term 5 ($p>0.05$), but there were significant differences found when comparing the end of term 4 to the end of term 5 and the start and end of term 6 ($p<0.05$). Further pairwise comparisons demonstrated significant differences when comparing the start of term 5 to the end of term 5 and the start and end of term 6 ($0<0.05$). Conversely, no significant differences were found when comparing the end of term 5 to the start and end of term 6 ($p>0.05$). This was also the case when the start of term 6 to end of term 6 were compared ($p>0.05$).

Success criteria two: brief period where both feet are on off the ground

Within the second success criteria for running a significant effect of time was evident ($\chi2$ 13.216, $p=0.04$). Significant differences were apparent when comparing baseline to the end of term 4 and the start and end of terms 5 and 6 ($p<0.05$). No significant difference between the end of term 4 and the start of term 5 ($p>0.05$) but contrastingly a significant difference between the end of term 4 and the end of term 5, start of term 6 and end of term 6 ($p<0.05$) were detected. Similarly, pairwise comparisons revealed a significant difference between the start of term 5 and the end of term 5 ($p<0.05$), as well as the start and end of term 6 ($p<0.05$). Contrarily, when comparing the end of term 5 to the start and end of term 6 no significant differences were found ($p>0.05$). Similarly, no significant differences were found when start of term 6 to end of term 6 were compared ($p>0.05$).

Success criteria three: narrow foot placement landing on heel or toe (not flat footed)

A significant effect of time ($\chi 2$ 9.957, p=0.019) was discovered within the third success criteria for running. Although no significant differences were evident when comparing baseline to the end of term 4 (p>0.05), significant differences were identified between baseline and the start and end of terms 5 and 6 when compared (p<0.05). Similarly, no significant differences were found when the end of term 4 and the start of term 5 were compared (p>0.05). However, when the end of term 4 was contrasted with the end of term 5 and the start and end of term 6, further significant differences became apparent (p<0.05). Further significant differences became apparent as the start of term 5 was compared to the end of term 5 alongside the start and end of term 6 (p<0.05). No significant differences were found between the end of term 5 and the start and end of term 6 (p>0.05). Similar findings were also evident when the start of term 6 to end of term 6 were compared (p>0.05).

Success criteria four: non-support leg bent approx. 90 degrees

No significant effect of time ($\chi 2$ 8.677, p=0.070) was identified within the fourth success criteria for running.

Galloping

Success criteria one: arms bent and lifted to waist level at take-off

The first success criteria for galloping shows that there was a significant effect of time ($\chi 2$ 15.008, p=0.005). When looking at pairwise comparisons between baseline and the end of term 4 and the start of term 5, no significant differences were evident (p>0.05). On the contrary, when comparing baseline to the end of term 5, along with the start and end of term 6, a significant difference was apparent (p<0.05). No significant differences were found when comparing the end of term 4 to the start of term 5 (p>0.05). However, when comparing the end of term 4 to the end of term 5, alongside the start and end of term 6, a significant difference was found (p<0.05). Pairwise comparisons further identified that significant differences were found between the start of term 5 and the end of term 5, start of term 6 and the end of term 6 ($p<0.05$). No significant differences were found between the end of term 5 and the start and end of term 6 ($p>0.05$). Lastly, no significant differences were found between the start of term 6 and the end of term 6 ($p>0.05$).

Success criteria two: stepping forward with lead foot followed by a step with trailing foot to position adjacent to or behind the lead foot

Within the second success criteria for galloping there was a significant effect of time ($\chi2$ 17.692, $p=0.03$). Pairwise comparisons demonstrated no significant difference between baseline and the end of term 4 and start of term 5 ($p>0.05$). Conversely, a significant difference between baseline and at the end of term 5 was evident ($p<0.05$). When the start and end of term 6 were compared to baseline, there were also no significant difference ($p>0.05$). A significant difference between the ends of term 4 and 5 ($p<0.05$) but contrastingly no significant difference between the end of term 4 and the start of term 5, start of term 6 and end of term 6 ($p>0.05$) were detected. No significant differences were found between the start of term 5 and the end of term 5, the start of term 6 or the end of term 6 ($p>0.05$). Similarly, when comparing the end of term 5 to both the start and end of term 6 there were no significant differences in success criteria 2 for these time periods ($p>0.05$). This was also the case when the start of term 6 to end of term 6 were compared ($p>0.05$).

Success criteria three: brief period when both feet are off the floor

A significant effect of time ($\chi2$ 10.151, $p=0.038$) was evident within success criteria three. However, when comparing baseline to the end of term 4 and the start of term 5 no significant difference was found ($p>0.05$). Contrarily, significant differences were found when baseline was compared to the end of term 5 and the start and end of term 6 ($p<0.05$). When comparing the end of term 4 to the start of term 5, no significant differences were identified ($p>0.05$). Pairwise comparisons revealed that significant differences were found ($p< 0.05$) when comparing the end of term 4 to the end of term 5, as well as the start and end of term 6. When the start of term 5 was contrasted with the end of term 5 and the start and end of term 6, further significant differences became apparent ($p<0.05$). No significant differences were perceived when comparing the end of term 5 to both the start and end of term 6 ($p>0.05$). This was also the case when the start of term 6 to end of term 6 were compared ($p>0.05$).

Success criteria four: maintaining a rhythmic pattern for four consecutive gallops

The last of the four success criteria for galloping was also found to have a significant effect of time ($\chi 2$ 10.151, $p=0.038$). Specifically, when looking at pairwise comparisons, no significant differences were identified when comparing baseline to the end of term 4 and the start of term 5 ($p>0.05$). Nevertheless, significant differences were found when the end of term 5 alongside the start and end of term 6 were compared to baseline ($p<0.05$). Furthermore, no significant differences were found when comparing the end of term 4 to the start of term 5 ($p>0.05$). Significant differences were, however, found when comparing the end of term 4 to the end of term 5 as well as the start and end of term 6 ($p<0.05$) but no significant differences were found between the start and end of term 5 ($p>0.05$). Significant differences between the start of term 5 and the start and end of term 6 were also evident ($p<0.05$). There were no significant differences between the start and end of term 6 and term 5 ($p>0.05$). Correspondingly, when comparing the start of term 6 to the end of term 6, no significant differences were perceivable ($p>0.05$).

Sliding

Success criteria one: body turned sideways so shoulders are aligned with the line on the floor

The first of the four success criteria for sliding were found to have a significant effect of time ($\chi 2$ 9.578, $p=0.048$). Pairwise comparisons demonstrated no significant difference between baseline and the end of term 4 and start of term 5 ($p>0.05$). Conversely, significant differences were evident when comparing baseline to the end of term 5 and both the start and end of term 6 ($p<0.05$). No significant differences were found when comparing the end of term 4 to the start of term 5 ($p>0.05$). Although, further significant differences were seen when comparing the end of term 4 to the end of term 5 as well as the start and end of term 6 ($p<0.05$). Significant differences were apparent when comparing the start of term5 to the end of term 5, start of term 6 and end of term 6 ($p<0.05$) but no significant differences were found when comparing the end of term 5 to the start and end of term 6 ($p>0.05$). Furthermore, no significant differences were found when comparing the start of term 6 to the end of term 6 ($p>0.05$).

Success criteria two: sideways step with lead foot followed by a slide of trailing next to leading

A significant effect of time ($\chi2$ 12.362, $p=0.015$) was identified within the second success criteria of sliding. When comparing baseline to the end of term 4, using pairwise comparisons, it was shown that there was no significant difference ($p>0.05$) whereas there was a significant difference between baseline and the start and end of terms 5 and 6 ($p<0.05$). When comparing the end of term 4 to the start of term 5, there was no significant difference ($p>0.05$), nevertheless there was a significant difference between the end of term 4 and the end of term 5 alongside the start and end of term 6 ($p<0.05$). The end of term 5 and both the start and end of term 6, when compared to the start of term 5, show that a significant difference was evident ($p<0.05$). However, when comparing the end of term 5 to the start and end of term 6, alongside the comparison of the start of term 6 to the end of term 6, no significant differences are perceivable ($p>0.05$).

Success criteria three: a minimum of four continuous step-slide cycles to the right

The third success criteria for sliding were found to have a significant effect of time ($\chi2$ 17.109, $p=0.002$). When comparing baseline to the end of term 4 and the start and end of term 5 and 6, a significant difference was evident ($p<0.05$). Contrarily, there was no significant difference found between the end of term 4 and the start of term 5 ($p>0.05$), but a significant difference was identified between the end of term 5 and the end of term 5, as well as the start and end of term 6 ($p<0.05$). Further pairwise comparisons found a significant difference between the start of term 5 and the end of term 5 and start of term 6 ($p<0.05$). However, no significant difference was evident when comparing the start of term 5 to the end of term 6 ($p>0.05$) or when comparing the end of term 5 to the start and end o term 6 ($p>0.05$). Likewise, when comparing the start of term 6 to the end of term 6 no significant difference was found ($p>0.05$).

Success criteria four: a minimum of four continuous step-slide cycles to the left

The final success criteria for sliding shows that there was no significant effect of time (chi-square 8.445, $p=0.77$).

Dribbling

Success criteria one: contacts ball with one hand at around belt level

No significant effect of time ($\chi 2$ 7.221, $p=0.065$) was found within the first success criteria for dribbling.

Success criteria two: pushes ball with fingertips (not a slap)

Within the second success criteria for dribbling there was a significant effect of time ($\chi 2$ 11.705, $p=0.020$). Pairwise comparisons demonstrated that there was no significant difference between baseline and the end of term 4 ($p>0.05$) but contrastingly a significant difference between baseline and the start and end of term 5 and 6 ($p<0.05$). No significant differences were found when comparing the end of term 4 to the start of term 5 ($p>0.05$). Nonetheless, significant differences were found when the end of term 5 alongside the start and end of term 6 were compared to the end of term 4 ($p<0.05$). No further significant differences were identified when comparing the start of term 5 to the end of term 5 and the start and end of term 6 ($p>0.05$) alongside when the end of term 5 was compared to the start and end of term 6 ($p>0.05$). Lastly, no significant differences were evident when the start of term 6 was compared to the end of term 6 ($p>0.05$).

Success criteria three: ball contacts surface in front of or to the outside of foot on the preferred side

The third success criteria of dribbling shows that there was also no significant effect of time ($\chi2$ 5.429, $p=0.143$).

Success criteria four: maintaining control of the ball for four consecutive bounces without having to move feet to retrieve it

The final success criteria of dribbling shows that there was a significant effect of time ($\chi2$ 8.088, $p=0.018$). When comparing baseline to the end of term 4, the start of term 5 and the start of term 6 no significant differences were found ($p>0.05$). Although, significant differences were clear when baseline was compared to the end of term 4 and 6 ($p<0.05$). No further significant differences were identified when comparing the end of term 4 to the start of term 5 or 6 ($p>0.05$). Contrastingly, significant differences could be seen when comparing the end of term 4 to the end of term 5 and 6 ($p<0.05$). Further pairwise comparisons revealed that there was a significant difference when comparing the start of term 5 to the end of term 5 and 6 ($p<0.05$) but no significant difference was evident when the start of term 5 was compared to the start of term 6 ($p>0.05$). Comparatively, there was no discernible difference between the end of term 5 and the start or end of term 6 ($p>0.05$), or between the start and end of term 6 ($p>0.05$).

Underhand roll

Success criteria one: preferred hand swings down and back, reaching behind the trunk while chest faces cones

No significant effect of time ($\chi2$ 2.116, $p=0.347$) was evident for the first success criteria for a roll of the ball.

Success criteria two: strides forward with foot opposite the preferred hand towards another child

When success criteria two was considered, a significant effect of time was apparent ($\chi2$ 12.594, $p=0.013$). The comparison of baseline to the end of term 4 and the start of term 5 revealed no significant differences ($p>0.05$). Although when baseline was compared to the end of term 5 and the start and end of term 6 significant differences were identified ($p<0.05$). When comparing the end of term 4 to the start of term 5, there were no significant differences ($p>0.05$), but further comparisons revealed significant differences between the end of term 4 and the end of term 5, as well as between the start and end of term 6 ($p<0.05$). Additional comparisons unveiled a significant difference when comparing the start of term 5 to the end of term 5 and the start and end of term 6 ($p<0.05$). In contrast, when the end of term 5 was compared to the start and end of term 6 no significant differences were identified ($p>0.05$). Similar results were found when the start of term 6 was compared to the end of term 6: no significant differences were evident ($p>0.05$).

Success criteria three: bend knees to lower body

A significant effect of time was evident within the third success criteria for rolling a ball ($\chi2$ 13.825, $p=0.003$). Pairwise comparisons revealed that when comparing baseline to the end of term 4 and the start and end of term 5 no significant differences were identified ($p>0.05$). Although, when baseline was compared to the start and end of term 6, significant differences were seen ($p<0.05$). Although, further pairwise comparisons revealed no significant differences found between any of the following time points: when the end of term 4 was compared to the start and end of term 5 and 6, the start of term 5 when it was compared to the end of term 5 and the start and end of term 6, the end of term 5 when it was compared to the start and end of term 6 and finally the start of term 6 when it was compared to the end of term 6 ($p>0.05$).

Success criteria four: releases ball close to the floor so ball does not bounce more than 4 inches high

For the final success criterion for a ball roll, there was no discernible effect of time ($\chi2$ 1.037, $p=0.309$).

Climbing

Success criteria one: climbing is very rhythmic

The first success criteria for climbing found no significant effect of time ($\chi2$ 1.039, p=0.308).

Success criteria two: child observes only the direction of climbing

Similarly, no significant effect of time was apparent within the second success criteria of climbing ($\chi2$ 2.147, p=0.342).

Success criteria three: child mainly uses over grip and closed grip

A significant effect of time was evident within the third success criteria for climbing ($\chi2$ 11.544, p=0.042). Pairwise comparisons showed that when baseline was compared to all other time points (the end of term 4 and the start and end of term 5 and 6) a significant effect of time was apparent ($p<0.05$). However, when comparing the end of term 4 to the start and end of term 5, and the start of term 6, no significant differences were identified ($p>0.05$). Although, a significant difference was found when comparing the end of term 4 and the end of term 6 ($p<0.05$). Further pairwise comparisons show no significant differences when comparing the start of term 5 to the start and end of term 6 ($p>0.05$), or when comparing the end of term 5 to the start and end of term 6 ($p>0.05$). Comparably, no significant differences were found when comparing the start and end of term 6 ($p>0.05$).

Success criteria four: the child often or always uses a diagonal reciprocal movement activation pattern

Within the final success criteria for climbing a significant effect of time was identified ($\chi2$ 12.611, p=0.013). Pairwise comparisons show no significant difference between baseline and the end of term 4 as well as the start and end of term 5 and the start of term 6 ($p>0.05$). When comparing the baseline to the end of term 6, however, significant differences were discovered ($p<0.05$). Further comparisons reveal no significant difference when comparing the end of term 4 to the start and end of term 5 and the start of term 6 ($p>0.05$). In contrast, a significant difference was identified when comparing the end of term 4 to the end of term 6 ($p<0.05$). When comparing the start of term 5 to the end of term 5 and start of term 6 no significant differences were found ($p>0.05$) but there were significant differences between the start of term 5 and the end of term 6 ($p<0.05$). When the end of term 5 was being compared to the start of term 6, no significant differences were evident ($p>0.05$). Although when the end of term 5 was compared to the end of term 6, significant differences were be seen ($p<0.05$). Lastly, a significant difference was seen when comparing the start of term 6 and the end of term 6 ($p<0.05$).

Balance

Success criteria one: no upper extremity and torso movement beyond central balance line

The first success criteria for balancing found no significant effect of time ($\chi2$ 7.254, $p=0.064$).

Success criteria two: the contralateral foot was not placed onto the ground

Similarly, no significant effect of time was identified within the second success criteria for balancing ($\chi2$ 7.453, $p=0.189$).

Success criteria three: good hip control (no dropped hip)

A significant effect of time was apparent within the final success criteria for balancing ($\chi2$ 11.818, $p=0.019$). Pairwise comparisons revealed that when baseline was compared to the end of term 4 and 5 as well as the start of term 5 and 6 significant differences were evident ($p<0.05$). Contrastingly, when baseline was compared to the start of term 5, no significant differences were identified ($p>0.05$). A significant difference between the end of term 4 and the end of term 5 and start of term 6 was evident ($p<0.05$). When the start of term 5 and end of term 6 were compared to the end of term 4, there were no significant differences ($p>0.05$). Further pairwise comparisons revealed that when comparing the end fo term5 and the start and end of term 6 to the start of term 5, significant differences were evident ($p<0.05$). No further significant differences were identified when comparing the end of term 5 to the start and end of term 6 ($p>0.05$) or when comparing the start of term 6 to the end of term 6 ($p>0.05$).

Kicking

Success criteria one: rapid continuous approach to the ball

A significant effect of time was apparent within the final success criteria for balancing ($\chi 2$ 9.887, $p=0.020$). Pairwise comparisons demonstrated that when baseline was compared to the end of term 4, alongside the start and end of terms 5 and 6, significant differences were apparent ($p<0.05$). Contrastingly, when the end of term 4 was compared to the start of term 5 no significant differences were seen ($p>0.05$). Although, when the end of term 4 was compared to the end of term 5, start of term 6 and end of term 6 significant differences were seen ($p<0.05$). Further significant differences are evident when comparing the start of term 5 to the end of term 5, alongside the start and end of term 6 ($p<0.05$). Albeit, no significant difference between the end of term 5 and the start of term 6 and end of term 6 ($p>0.05$) were detected. Lastly, no significant differences were identified when comparing the start and end of term 6 ($p>0.05$).

Success criteria two: an elongated stride or leap immediately prior to ball contact

Within the second success criteria for kicking a significant effect of time was evident ($\chi 2$ 14.381, $p=0.006$). Pairwise comparisons demonstrated no significant difference between baseline and the end of term 4 and start of term 5 ($p>0.05$). Conversely, a significant difference between baseline and the end of term 5, start of term 6 and end of term 6 was identified ($p<0.05$). When the end of term 4 and start of term 5 were compared there were also no significant differences revealed ($p>0.05$). Although, when the end of term 5 and the start and end of term 6 were compared to the end of term 4 significant differences were apparent ($p<0.05$). Further significant differences are evident when comparing the start of term 5 and end of term 5, start of term 6 and end of term 6 ($p<0.05$). Contrastingly no significant differences between the end of term 5 and the start and end of term 6 ($p>0.05$)

were detected. No significant differences were found between the start of term 6 and the end of term 6 ($p>0.05$).

Success criteria three: non-kicking foot placed even with or slightly behind the ball

The third success criteria for kicking revealed a significant effect of time ($\chi2$ 12.353, $p=0.002$). The comparison of baseline to the end of term 4 and start of term 5 revealed no significant differences ($p>0.05$). Although further pairwise comparisons identified a significant difference between baseline and the end of term 5, start of term 6 and the end of term 6 ($p<0.05$). A significant difference between the end of term 4 and the end of term 5, start of term 6 and end of term 6 were detected ($p<0.05$). Contrastingly, no significant difference between the end of term 4 and the start of term 5 ($p>0.05$) was identified. However, when comparing the start of term 5 to the end of term 5, alongside the start and end of term 6, significant differences are evident ($p<0.05$). No significant differences were found between the end of term 5 and the start and end of term 6 ($p>0.05$). Lastly, when comparing the start of term 6 to the and of term 6 there were no significant differences ($p>0.05$) identified.

Success criteria four: kicks ball with instep of preferred foot (shoelaces) or toe

Finally, no significant effect of time was evident within the last success criteria for kicking $\chi2$ 3.297, $p=0.192$).

Catching

Success criteria one: preparation phase where hands are in front of the body and elbows are flexed

The first success criteria for catching found no significant effect of time ($\chi2$ 3.265, $p=0.353$).

Success criteria two: arms extend while reaching for the ball as it arrives

Likewise, no significant effect of time was identified within the second success criteria for catching ($\chi2$ 1.032, p=0.310).

Success criteria three: ball is caught by hands only

Finally, no significant effect of time was evident within the last success criteria for catching ($\chi2$ 5.854, p=0.119).

The use of scissors

Success criteria one: hold the scissors in dominant hand with the correct fingers

No significant effect of time was found within the first success criteria for the use of scissors ($\chi2$ 4.182, p=0.124).

Success criteria two: open and close the scissors when cutting in oppose to tearing the paper

The second success criteria for the use of scissors also found no significant effect of time ($\chi2$ 6.839, p=0.145).

Success criteria three: cut in a straight line

A significant effect of time was found within the third success criteria for the use of scissors ($\chi2$ 14.543, p=0.006). Pairwise comparisons revealed no significant difference between baseline and the end of term 4 and start of term 5 ($p>0.05$). Although, when baseline was compared to the end of term 5 and start of term 6 significant differences were made ($p<0.05$). No further significant differences were found when comparing the end of term 4 to the start and end of term 5 and the start of term 6 ($p>0.05$). Similarly, when comparing the start of term 5 to the end of term 5 and start of term 6 ($p>0.05$). Lastly, no significant differences were found when comparing the end of term 5 to the start of term 6 ($p>0.05$).

Success criteria four: rotate the paper whilst cutting

Finally, no significant effect of time was found within the final success criteria for the use of scissors ($\chi 2$ 5.802, $p=0.055$).

The use of cutlery

Success criteria one: hold fork in non-dominant hand and knife in dominant hand

The first success criteria for the use of cutlery found no significant effect of time ($\chi 2$ 3.917, $p=0.271$).

Success criteria two: index finger pointing down the back of the knife and fork towards the prongs and the blade

No significant effect of time was evident within the second criteria for the use of cutlery ($\chi 2$ 3.890, $p=0.143$).

Success criteria three: stab food with a fork

Similarly, no significant effect of time was found within the third criteria for the use of cutlery ($\chi 2$ 0, $p=1$).

Success criteria four: cut the food with knife and fork

Comparably, the fourth criteria for the use of cutlery revealed no significant effect of time ($\chi 2$ 3.917, $p=0.271$).

Success criteria five: take food to his/her mouth accurately

Finally, no significant effect of time was identified within the last criteria for the use of cutlery ($\chi 2$ 0, $p=1$).

Appendix M – Percentages of children who have met each criterion throughout term 4, 5 and 6.

Hopping

	Non-support leg swings forward in pendular fashion to produce force	Foot of non-support leg remains behind body	Arms flexed and swing forward to produce force	Takes off and lands three consecutive times on preferred foot	Takes off and lands three consecutive times on non-preferred foot
Baseline	**0%** **0/25**	**52%** **13/25**	**16%** **4/25**	**60%** **15/25**	**40%** **10/25**
End of Term 4	**4%** **1/25**	**52%** **13/25**	**24%** **6/25**	**64%** **16/25**	**56%** **14/25**
Start of Term 5	**28%** **7/25**	**60%** **15/25**	**36%** **9/25**	**72%** **18/25**	**72%** **18/25**
End of Term 5	**52%** **13/25**	**60%** **15/25**	**36%** **9/25**	**72%** **18/25**	**84%** **21/25**
Start of Term 6	**56%** **14/25**	**72%** **18/25**	**64%** **16/25**	**92%** **23/25**	**84%** **21/25**
End of Term 6	**72%** **18/25**	**80%** **20/25**	**80%** **20/25**	**92%** **23/25**	**88%** **22/25**

Running

	Running Arms move in opposition to legs	Running Brief period where both feet are on off the ground	Running Narrow foot placement landing on heel or toe (not flat footed)	Running Non-support leg bent approx. 90 degrees
Baseline	**40%** **10/25**	**48%** **12/25**	**56%** **14/25**	**48%** **12/25**
End of Term 4	**40%** **10/25**	**64%** **16/25**	**64%** **16/25**	**48%** **12/25**
Start of Term 5	**44%** **11/25**	**76%** **17/25**	**76%** **19/25**	**52%** **13/25**
End of Term 5	**80%** **20/25**	**92%** **23/25**	**96%** **24/25**	**68%** **17/25**
Start of Term 6	**76%** **19/25**	**92%** **23/25**	**96%** **24/25**	**72%** **18/25**
End of Term 6	**80%** **20/25**	**92%** **23/25**	**96%** **24/25**	**76%** **19/25**

Galloping

	<u>Galloping</u> Arms bent and lifted to waist level at takeoff	<u>Galloping</u> A step forward with lead foot followed by a step with trailing foot to position adjacent to or behind the lead foot	<u>Galloping</u> Brief period when both feet are off the floor	<u>Galloping</u> Maintains a rhythmic pattern for four consecutive gallops
Baseline	**28%** **7/25**	**28%** **7/25**	**24%** **6/25**	**24%** **6/25**
End of Term 4	**28%** **7/25**	**32%** **8/25**	**36%** **9/25**	**32%** **8/25**
Start of Term 5	**36%** **9/25**	**36%** **9/25**	**32%** **8/25**	**36%** **9/25**
End of Term 5	**64%** **16/25**	**60%** **15/25**	**52%** **13/25**	**48%** **12/25**
Start of Term 6	**56%** **14/25**	**52%** **13/25**	**52%** **13/25**	**56%** **14/25**

Sliding

	Sliding Body turned sideways so shoulders are aligned with the line on the floor	Sliding Sideways step with lead foot followed by a slide of trailing next to leading	Sliding A minimum of four continuous step-slide cycles to the right	Sliding A minimum of four continuous step-slide cycles to the left
Baseline	**60%** **15/25**	**52%** **13/25**	**40%** **10/25**	**60%** **15/25**
End of Term 4	**68%** **17/25**	**60%** **15/25**	**60%** **15/25**	**68%** **17/25**
Start of Term 5	**72%** **18/25**	**68%** **17/25**	**68%** **17/25**	**72%** **18/25**
End of Term 5	**88%** **22/25**	**88%** **22/25**	**88%** **22/25**	**84%** **21/25**
Start of Term 6	**88%** **22/25**	**88%** **22/25**	**88%** **22/25**	**84%** **21/25**
End of Term 6	**92%** **23/25**	**92%** **23/25**	**88%** **22/25**	**88%** **22/25**

Dribbling

	<u>Dribbling</u> Contacts ball with one hand at around belt level	<u>Dribbling</u> Pushes ball with fingertips (not a slap)	<u>Dribbling</u> Ball contacts surface in front of or to the outside of foot on the preferred side	<u>Dribbling</u> Maintains control of ball for four consecutive bounces without having to move feet to retrieve it
Baseline	**68%** **17/25**	**32%** **8/25**	**40%** **10/25**	**36%** **9/25**
End of Term 4	**68%** **17/25**	**44%** **11/25**	**40%** **10/25**	**36%** **9/25**
Start of Term 5	**64%** **16/25**	**56%** **14/25**	**40%** **10/25**	**36%** **9/25**
End of Term 5	**80%** **20/25**	**68%** **17/25**	**56%** **14/25**	**52%** **13/25**
Start of Term 6	**80%** **20/25**	**68%** **17/25**	**56%** **14/25**	**44%** **11/25**
End of Term 6	**80%** **20/25**	**68%** **17/25**	**56%** **14/25**	**52%** **13/25**

Underarm roll

	Roll Preferred hand swings down and back, reaching behind the trunk while chest faces cones	Roll Strides forward with foot opposite the preferred hand towards other child	Roll Bend knees to lower body	Roll Releases ball close to the floor so ball does not bounce more than 4 inches high
Baseline	**12% 3/25**	**8% 2/25**	**72% 18/25**	**80% 20/25**
End of Term 4	**12% 3/25**	**12% 3/25**	**84% 21/25**	**80% 20/25**
Start of Term 5	**8% 2/25**	**16% 4/25**	**84% 21/25**	**80% 20/25**
End of Term 5	**8% 2/25**	**44% 11/25**	**80% 20/25**	**76% 19/25**
Start of Term 6	**12% 3/25**	**44% 11/25**	**92% 23/25**	**80% 20/25**
End of Term 6	**16% 4/25**	**48% 12/25**	**92% 23/25**	**80% 20/25**

Climbing

	Climbing is very rhythmic	Child observes only the direction of climbing	Child mainly uses over grip and closed grip	The child often or always uses a diagonal reciprocal movement activation pattern
Baseline	**72%** **18/25**	**80%** **20/25**	**48%** **12/25**	**36%** **9/25**
End of Term 4	**72%** **18/25**	**76%** **19/25**	**68%** **17/25**	**44%** **11/25**
Start of Term 5	**68%** **17/25**	**72%** **18/25**	**72%** **18/25**	**44%** **11/25**
End of Term 5	**68%** **17/25**	**72%** **18/25**	**72%** **18/25**	**48%** **12/25**
Start of Term 6	**68%** **17/25**	**72%** **18/25**	**76%** **19/25**	**56%** **14/25**
End of Term 6	**72%** **18/25**	**72%** **18/25**	**80%** **20/25**	**72%** **18/25**

Balance

	No upper extremity and torso movement beyond central balance line	The contralateral foot was not placed onto the ground	Good hip control (no dropped hip)
Baseline	**52%** **13/25**	**56%** **14/25**	**44%** **11/25**
End of Term 4	**64%** **16/25**	**56%** **14/25**	**60%** **15/25**
Start of Term 5	**64%** **16/25**	**60%** **15/25**	**60%** **15/25**
End of Term 5	**72%** **18/25**	**56%** **14/25**	**80%** **20/25**
Start of Term 6	**72%** **18/25**	**72%** **18/25**	**80%** **20/25**
End of Term 6	**76%** **19/25**	**80%** **20/25**	**80%** **20/25**

Kicking

	Kicking Rapid continuous approach to the ball	Kicking An elongated stride or leap immediately prior to ball contact	Kicking Non-kicking foot placed even with or slightly in back of the ball	Kicking Kicks ball with instep of preferred foot (shoelaces) or toe
Baseline	**0%** **0/25**	**8%** **2/25**	**40%** **10/25**	**92%** **21/25**
End of Term 4	**16%** **4/25**	**12%** **3/25**	**40%** **10/25**	**92%** **21/25**
Start of Term 5	**20%** **5/25**	**16%** **4/25**	**40%** **10/25**	**72%** **18/25**
End of Term 5	**44%** **11/25**	**52%** **13/25**	**76%** **19/25**	**76%** **19/25**
Start of Term 6	**44%** **11/25**	**52%** **13/25**	**72%** **18/25**	**76%** **19/25**
End of Term 6	**48%** **12/25**	**52%** **13/25**	**76%** **19/25**	**76%** **19/25**

Catching

	<u>Catching</u> Preparation phase where hands are in front of the body and elbows are flexed	<u>Catching</u> Arms extend while reaching for the ball as it arrives	<u>Catching</u> Ball is caught by hands only
Baseline	**80%** **20/25**	**84%** **21/25**	**20%** **5/25**
End of Term 4	**80%** **20/25**	**84%** **21/25**	**28%** **7/25**
Start of Term 5	**84%** **21/25**	**84%** **21/25**	**28%** **7/25**
End of Term 5	**88%** **22/25**	**88%** **22/25**	**32%** **8/25**
Start of Term 6	**88%** **22/25**	**88%** **22/25**	**32%** **8/25**
End of Term 6	**92%** **23/25**	**88%** **22/25**	**40%** **10/25**

Use of scissors

	Hold the scissors in dominant hand with the correct fingers	Open and close the scissors when cutting in oppose to tearing the paper	Cut in a straight line	Rotate the paper whilst cutting
Baseline	**76%** **19/25**	**72%** **18/25**	**72%** **18/25**	**56%** **14/25**
End of Term 4	**76%** **19/25**	**76%** **19/25**	**80%** **20/25**	**60%** **15/25**
Start of Term 5	**76%** **19/25**	**76%** **19/25**	**76%** **19/25**	**60%** **15/25**
End of Term 5	**92%** **23/25**	**84%** **21/25**	**88%** **22/25**	**76%** **19/25**
Start of Term 6	**92%** **23/25**	**88%** **22/25**	**88%** **22/25**	**76%** **19/25**
End of Term 6				

Use of cutlery

	Hold fork in their non-dominant hand and their knife in their dominant hand	Index finger point down the back of the knife and fork towards the prongs and the blade	Stab food with a fork	Cut food with knife and fork	Can table food to their mouth
Baseline	**37.5%** **3/8**	**25%** **2/8**	**87.5%** **7/8**	**37.5%** **3/8**	**87.5%** **7/8**
End of Term 4	**37.5%** **3/8**	**25%** **2/8**	**87.5%** **7/8**	**50%** **4/8**	**87.5%** **7/8**
Start of Term 5	**37.5%** **3/8**	**25%** **2/8**	**87.5%** **7/8**	**50%** **4/8**	**87.5%** **7/8**
End of Term 5	**50%** **4/8**	**50%** **4/8**	**100%** **8/8**	**50%** **4/8**	**100%** **8/8**
Start of Term 6	**62.5%** **5/8**	**50%** **4/8**	**100%** **8/8**	**62.5%** **5/8**	**100%** **8/8**
End of Term 6	**75%** **6/8**	**50%** **4/8**	**100%** **8/8**	**75%** **6/8**	**100%** **8/8**