The effect of a physically active academic intervention on physical fitness and academic performance of Grade 1 learners

Carynne Alison Fisher

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Supervisor: Dr Eileen Africa

Department of Sport Science

Faculty of Medicine and Health Sciences

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DECLARATION

By submitting this thesis, I hereby, declare that the entirety of this thesis contained is my own original work and, that I am the owner, and that I have not previously submitted it in it's entirely or partially to obtaining any qualification.

The co-author of the two articles that form part of this Master's thesis, Dr Eileen Africa (supervisor), hereby give consent to the candidate, Mrs Carynne Fisher, to include these two articles in this thesis. The involvement of the co-authors was within limits, ensuring the candidate to submit this thesis for examination purposes. This thesis, therefore, serves as completion of the requirement for the degree Master of Science at Stellenbosch University.

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Mrs Carynne Fisher

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Dr Eileen Africa

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SUMMARY

The importance of Physical Education (PE) has been well established over the years; however, it is no longer viewed as vital aspect of the South African school curriculum. In a South African context, the curriculum does not meet the time of 60 minutes of physical activity (PA) per day recommended by the World Health Organisation (WHO). Teachers no longer find the time to conduct PA lessons because of the emphasis placed on academic subjects by the Department of Education (DoE). With that said, the link between academic achievement and PA has been extensively researched over the years and it was found PA has beneficial effects on academic achievement, such as time on task, attention, memory and improvements in academic subjects such as reading, spelling, mathematics and the sciences. However, limited research has been conducted to determine how including physical fitness (PF) into academic lessons can benefit PF and academic achievement. Recent research has found that combining PA into academic lessons improved academic achievement and PF. Nevertheless, because this field of study is still in its infancy and findings are inconsistent because of various factors.

Furthermore, in a South African context little is known as to whether these types of intervention have been beneficial. The main aim of the current study was to determine the effects of an intervention integrating PF and into academic lessons on academic achievement and PF of Grade 1 learners. The study also studied gender differences and the role gender played in academic performance and physical fitness. This thesis followed a research article format with precise aims studied in each article. Research article one studied the effects that a physically active academic intervention had on mathematical performances and physical fitness of Grade 1 learners. The effects of a physically active academic intervention on reading and spelling performance, physical fitness and gender differences of Grade 1 learners were the aims of research article two.

Research article one found that after a 16- week physically active academic intervention the experimental group's strength improved significantly compared to the control group, which was similar to findings of other studies. Other than the control group, the mathematical skills of the experimental group improved significantly, which is also in agreement with findings in literature. These findings suggest a strong association between PF and mathematics achievement, which is suggested by other studies and proves to be an effective way to address the low mathematical achievement and PF in South African schools.

Research article two found that after the 16-week physically active academic intervention the experimental group's reading and strength improved significantly in comparison to the control group. This is in agreement with previous studies. Findings suggested there were no significant differences between gender, PF and academic achievement. This revealed that current type of intervention was effective regardless of gender in young children and therefore, it is ideal to address low PF and academic achievement that can be enjoyable for learners and teachers. This is in agreement with studies that have been conducted in countries outside of Africa.

These findings indicate the beneficial effects of combining PF with academic lessons in a South African context. It is cost effective, contributes to the findings of this field of study and solidifies the association between physical fitness and academic achievements in learners. The fact that gender played no significant role indicates that the current intervention can be beneficial to all Grade 1 learners. The findings of the current study can guide future research and education programmes into new ways to teach academics skills, while increasing PF inside and outside the walls of school classrooms.

Keywords: Grade 1 learners, physical activity, physical fitness, academic performance.

OPSOMMING

Die belangrikheid van Liggaamlike Opvoeding (LO) as skoolvak is oor die jare heen goed gevestig, alhoewel dit nie meer langer as ŉ belangrike komponent van die Suid-Afrikaanse skool kurrikulum beskou word nie. In ŉ Suid Afrikaanse konteks, haal die huidige kurrikulum nie die minimum vereiste van 60 minute fisieke aktiwiteit (FA) per dag, wat deur die Wêreld Gesondheidsorganisasie (WGO) aanbeveel word, nie. Tans vind onderwysers nie die tyd om LO lesse aan te bied nie, aangesien die klem op akademiesae prestasies val. Met hierdie in gedagte, is die verband tussen fisieke fiksheid (FF) en akademiese prestasie reeds breedvoerig oor die jare heen nagevors. Daar is tot die gevolgtrekking gekom dat FF voordelige gevolge vir akademiese prestasie inhou. Dit behels voordele vir geheue, tyd-op-taak, aandagspan en verbeterings in akademiese vakke, soos lees, spel, wiskunde en die wetenskappe. Onlangse navorsing het bevind dat deur FF in akademiese lesse te inkorporeer dit akademiese prestasie en fisieke fiksheid verbeter. Die studieveld is egter nog in die babajare en die bevindings is inkonsekwent as gevolg van verskeie faktore.

Daar is egter min bekend of hierdie tipes intervensies in ŉ Suid-Afrikaanse konteks voordele sal inhou. Die kern doel van hierdie studie was om die impak van ŉ fisiek-akademiese intervensie op FF en akademiese prestasie van Graad 1 leerders te bepaal. Die huidige studie het ook geslagsverskille bestudeer en die rol wat geslag in FF en akademiese prestasie speel. Die tesis is gebaseer op ŉ artikel formaat met spesifieke doelwitte wat in elkeen ondersoek word. Artikel een het die impak van ŉ fisiek-aktiewe intervensie op FF en wiskundige prestasie van Graad 1 leerders bestudeer. Die effekte van ŉ fisiek-aktiewe akademiese intervensie op FF, akademiese prestasie en geslagsverskille by Graad 1 leerders was die doelwitte van navorsingsartikel twee.

Navorsingsartikel een het bevind dat na afloop van ŉ 16-week fisiek-aktiewe akademiese intervensie die eksperimentele groep se krag, in vergelyking van die kontrole groep,

betekenisvol verbeter het. Die bevinding is soortgelyk aan ander studies in die literatuur. In vergelyking met die kontrole groep het die eksperimentele groep se wiskundige vaardighede betekenisvol verbeter wat ook ooreenstem met ander studies se bevindings. Hierdie resultate toon die sterk skakel tussen FF en akademiese prestasie wat deur die literatuur ondersteun word en blyk om ŉ effektiewe manier te wees om lae wiskundige prestasie en FF vlakke in ŉ Suid-Afrikaanse konteks aan te spreek.

Navorsingsartikel twee het bevind dat na die 16-week fisiek-aktiewe, akademiese intervensie die eksperimentele groep se lees, wiskundige vaardighede en krag betekenisvol verbeter het in vergelyking met die kontrole groep. Hierdie resultate stem ooreen met vorige studies. Geen betekenisvolle verskille tussen geslag, FF en akademiese prestasie is gevind nie. Hierdie bevindinge toon dat die tipe intervensie effektief is ongeag die geslag van die jong kinders en daarom is dit ideaal om lae vlakke van FF en akademiese prestasie aan te spreek wat vir leerders en onderwysers genotvol kan wees. Die bevindinge is in ooreenstemming met studies wat in lande buite Afrika onderneem is.

Hierdie bevindinge toon die voordele om FA met akademiese lesse te kombineer in ŉ Suid-Afrikaanse konteks. Dit is koste effektief, dra by tot die bevindinge van hierdie studieveld en konsolideer die verband tussen FF en akademiese prestasie by kinders. Die feit dat geslag geen betekenisvolle rol gespeel het nie, toon dat hierdie tipe intervensie voordelig vir alle Graad 1’s mag wees. Die bevindinge van die huidige studie kan toekomstige navorsing en opvoedkundige programme begelei na nuwe maniere om akademiese vaardighede te onderrig en terselfdertyd FF vlakke binne en buite die mure van die klaskamer te verhoog.

Sleutelwoorde: Graad 1 leerders, fisieke aktiwiteit, fisieke fiksheid, akademiese prestasie.

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LIST OF ABBREVIATIONS

PA	Physical activity
PE	Physical education
PF	Physical fitness
WHO	World Health Organisation
DoE	Department of Education
CAPS	Curriculum Policy Statement
PAAC	Physical activity across the curriculum
ASK	Active Smarter Kids
SA	South Africa
BMI	Body Mass Index
MVPA	Moderate to – Vigorous physical activity
DCD	Developmental coordination disorder
HFZ	Health Fitness Zone
N	Total numbers of participants
SD	Standard deviation
M	Mean
%	Percentage

APPENDICES

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CHAPTER ONE

INTRODUCTION AND PROBLEM STATEMENT

Referencing within Chapter One, two three, and six and the list of references at the end of these chapters were in accordance with the guidelines of the South African Journal of Research in Sports, Physical Education and Recreation and the Department of Sport Science, Stellenbosch University.

INTRODUCTION

In schools, worldwide, physical activity (PA) have decreased over the years and the focus shifted to academic performance and the acquisition of academic skills (Mullender-Wijnsma *et al.*, 2016). According to Pica (2011) learners are required to engage in academic tasks from an early age, but the early acquisitions of motor skills are apparently not as important as academic knowledge. Furthermore, Fredericks *et al*. (2006) suggests that movement programmes' influence on cognitive skills and academic achievements are often overlooked by society. Various researchers indicated that PA benefits physical development and cognitive abilities (Coyle *et al*., 2011; Andersen *et al*., 2015; Donelly *et al*., 2016). Hansen *et al*. (2017) found that physical fitness (PF) could have a significant impact on academic achievement, especially for those who are less physically fit.

Holistically, PA plays an important role in early childhood because it benefits a child's social, emotional and cognitive learning systems (Madigan, 2009). According to Gallahue and Donelly (2003) overall motor development between two and seven years of age is very important. This phase is referred to as the fundamental movement phase and consists of three stages, namely: initial; elementary; and mature stages. Gallahue and Donelly (2003) suggests that this phase is considered the ideal time to master basic stability, locomotor and manipulative skills known as the fundamental movement phase. At the age of six and seven years, children progress toward the mature stage of the fundamental movement phase. In this stage, children's movements become more coordinated, efficient and mechanically correct (Gallahue & Donelly, 2003; Pienaar, 2014). This stage is, therefore, important because mastered fundamental movement skills form the base for complex motor skills (Gallhue & Donelly, 2003). Thus, targeting this age group to engage in regular PA and physical fitness (PF) can be crucial for further physical and cognitive development.

Mandigan (2011) suggests that movement forms the foundation for learning because motor learning forms the framework for motor patterns used in academic tasks such as reading. These motor patterns include balance, stability and coordination that facilitate learning of academic tasks. Other motor skills such as directionality, laterality, midline crossing and inter-hemispheric integration will have a negative impact on learning if it is not acquired (Cheatum & Hammond, 2000; Krog & Kruger, 2011). Laterality refers to the internal awareness that the body consists of two parts, left and right, which work independently and together. Directionality is acquired after laterality and refers to a child's knowledge and awareness of space and how the body can move in space (Pheloung, 2003). These skills are essential for executing scholastic tasks because they require a child to write at the top of the page and fold paper (Krog, 2015). Perceptual-motor activities that can be done in a class setting such as laterality activities, place great focus on competency of directionality and laterality (Coetzee *et al*., 2015) to enhance academic performance.

Engaging in regular PA promote not only physiological changes of the body and the brain, but positively affects academic achievement and cognitive functions (Tomporowski *et al*., 2008; Chang *et al*., 2012). Cognitive function or cognition refers to mental processes that assists intellect, perception and memory (Donelly *et al*., 2016). Researchers (Hillman *et al*., 2009) have found associations between physical fitness (PF) and cognitive function in children. Research further states that PA combined with mental engagement requiring high cognitive effort and/or skill learning, is beneficial for academic achievement and physiological changes as compared to more repetitive movements requiring minimal skill and less cognitive effort (Pesce *et al*., 2015).

Research has shown that PA influences parts of the brain that contribute to cognitive functions in a positive way, as well as academic success (Tomporowski *et al*., 2008; Best, 2010). According to Holmes (2006), changes in the brain critical for memory and learning occur when engaged in regular PA. However, research on rodents and humans concluded that motor activities that are complex caused structural changes in the brain, while simpler motor activities during regular PA did not (Holmes, 2006; Hillman *et al.*, 2008; Van Praag, 2009). According to Pereira *et al*. (2007) these changes can furthermore benefit scholastic performance. A recent study indicated that although PA is beneficial to children's thinking and academic achievement, these benefits could differ when it comes to quantitative or qualitative PA interventions (Pesce *et al*., 2015).

Quantitative PA interventions require minimal skill and involves repetitive movement task that focus on cardio-respiratory function that require very little cognitive effort. Qualitative interventions require high cognitive effort or skill acquisition such as multi-limb coordination and learning strategy games, based on mental engagement (Pesce *et al*., 2015). Research have implemented physically active academic lessons that integrate PA and academics in order to improve academic achievement. Physically active academic lessons are defined by De Greef (2016:69) as "types of educational lessons aim[ed] at incorporating physical activities with a moderate-to-vigorous intensity into the teaching of academic lesson content". Mullender-Wijnsma et al. (2016) conducted a three-year longitudinal study with Grade 2 and 3 learners in the Netherlands. They implemented PA academic lessons of 15 to 30 minutes three times a week. The authors concluded that there were no improvements in mathematics, spelling and reading after the intervention in the first year, but significant improvements in mathematics, spelling and reading occurred after the second year. There were no significant improvements in cardiovascular fitness.

According to the literature most interventions have been conducted with learners from Grade 2 and upwards with a lack of research on Grade 1 learners. Van Deventer *et al*. (2014) conducted an 8-week intervention with Grade 2 learners consisting of three 30 minutes sessions per week. They compared a physically active academic programme to an intensive physical programme and found that reading, spelling and mathematics improved. Improvements in spelling and reading were higher in the intensive physical programme and mathematics scores were higher in the physically active academic programme. The findings, however, were not significant. This was inconsistent with McCormick *et al*. (1968) who found significant improvements in reading scores after a 7-week perceptual motor training programme amongst Grade 1 learners. However, the study of McCormick and co-workers (1968) did not include a physically active academic intervention programme. Improvements found in the above-mentioned studies, whether statistically significant or not, were specific to mathematics, reading and spelling (Van Deventer *et al*., 2014). Both studies did not assess the physical fitness levels of the children and whether it had an impact on the results of the interventions.

Mullender-Wijnsma *et al*. (2015) claims improved performances found in their intervention study may have been because of the intermittent nature of the physically active academic lessons because learners had to vary aerobic exercises between academic tasks. Donnelly and Lambourne (2011) again looked at the effects of classroom-based PA interventions on cognition and academic performance. They concluded that academic lessons combined with PA of moderate to vigorous intensity, enhanced overall performance on standardised tests of academic subjects, namely the Wechsler Individual Achievement Test-2nd Edition, which assesses reading, spelling, verbal language skills, mathematics and writing. Activities included curricular content, such as mathematics where the learning of fractions was conducted by separating the class into groups and asking learners to solve mathematics problems by running into groups to indicate the answer. This affirms other notions that children who engage in regular moderate to vigorous PA interventions can benefit because it promotes physiological changes (Spengler & Wholly, 2013). However, a recent systemic review including 63 articles from five databases indicate that there are many inconsistencies regarding the effects of lessons combining PA into academics on PA and academic achievement (Donelly *et al*., 2017).

In South Africa (SA), Physical Education (PE), Health and Environment and Arts fall under Life Orientation (LO), a compulsory subject from Grade 1 to 12 (DOE, 2011). LO is allocated two hours per week according to the Curriculum and Assessment Policy Statement (CAPS) that needs to encompass all three components of LO for Grade 1. However, many teachers fail to implement PE in the school environment (Blaydes, 2001; Van Deventer *et al.*, 2014). Children typically spend five to eight hours in the school per day; therefore, this is an optimal environment to promote physical activity and active lifestyle. If implemented, physically active academic lessons can be the ideal space to shift the focus of traditional teaching to physically active academic teaching to enhance academic performance (Mullender-Wijnsma *et al*., 2016) and increase PF.

From the literature it can, therefore, be derived that there is more research needed on physically active academic interventions and the effects it may have on academic achievement and PF. Although studies have shown improvements in academic achievement over long periods, little research has shown the short-term effects and many inconsistencies have been noted.

PROBLEM STATEMENT

The Curriculum and Assessment Policy Statement (CAPS) of South Africa indicates that children should achieve 120 minutes of moderate to vigorous-intensity PA per week during school hours. At the same time, they should receive a high standard of teaching focused on improving their academic proficiencies, for example mathematics, reading and spelling. PA levels in schools are currently low because teachers fail to implement the national policy of 120 minutes per week of PE and children are not meeting the curriculum requirements. Therefore, the ability to combine PA with academic proficiency learning may assist to improve PA levels and academic achievement, which is important for physical development and to meet the academic requirements.

AIM OF THE STUDY

The main aim of the current study was to determine the effect of a 16-week combined PA and academic intervention programme on mathematics, reading, spelling and physical fitness of Grade 1 learners.

Objectives

The following objectives supported the main aim of the study:

- To determine whether there was a statistically significant difference in physical fitness levels between the children who participated in the intervention programme and the attentional control group by using the Fitnessgram.

- To determine if statistically significant difference existed in mathematical, reading and spelling performances between the experimental and attentional control group by using the VASSI mathematics proficiency test and the ESSI reading and spelling tests for Grade 1 learners.
- To determine whether any statistically significant gender differences existed pre and post the intervention between the experimental and attentional control group regarding physical fitness, mathematics, reading and spelling.

It was hypothesised that a 16-week physical active intervention programme would improve the physical fitness, mathematics, reading and spelling of Grade 1 learners.

MOTIVATION OF THE STUDY

Research have found that PA can positively affect academic performance (Best, 2010; Chang *et al*., 2012). Other studies, such as Best (2010) and Van Deventer *et al*. (2014) suggest that PA interventions and physically active academic lessons lead to better acquisition of skills and academic learning in children who are more active than those who are not (Donnelly & Lambourne, 2011). Theoretically, this should influence academic achievement (Mullender-Wijnsma *et al*., 2016), however, conclusions from research is still inconclusive and present many inconsistencies. The inconclusiveness and inconsistencies include varying results because of different durations of studies, different intervention methods and different intensity levels of the interventions (Norris *et al*., 2015). Not all studies found consistent results in all the desired academic subjects. Further research is necessary on this topic to determine consistent results and better understand the influence of an integrated intervention programme focusing on physical fitness, health outcomes and academic performance can have.

STRUCTURE OF THE THESIS

The current thesis was presented in article format. The articles were written accordance to the guidelines of the selected journals. Therefore, different referencing methods were used in different chapters.

Chapter One: Introduction and Problem Statement: The chapter was written according to the referencing guidelines of the South African Journal of Research in Sports, Physical Education and Recreation and the Department of Sport Science, Stellenbosch University.

Chapter Two: Theoretical Background: The chapter was written in according to the guidelines of the South African Journal of Research in Sports, Physical Education and Recreation and the Department of Sport Science, Stellenbosch University.Chapter Three: Methodology: The chapter was written according to the guidelines of the South African Journal of Research in Sports, Physical Education and Recreation and the Department of Sport Science, Stellenbosch University.

Chapter Four: Research article one: The chapter was written according to the author guidelines of the European Journal of Sport Science.

Chapter Five: Research article two: The chapter was written according to the author guidelines of the Journal of Paediatrics.

Chapter Six: Presents the summary and conclusions.

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CHAPTER TWO

THEORETICAL BACKGROUND

INRODUCTION

Globally Physical Education (PE) in schools have declined over the years (Donelly & Lambourne, 2011; Van Deventer *et al*., 2014). In the school environment children, spend five to eight hours daily in a sedentary state (Donelly & Lambourne, 2011; Holt *et al*., 2013; Van Deventer *et al*., 2014; Norris *et al*., 2015; Mullender-Wijnsma, 2016). In South Africa (SA) PE is a component of the subject Life Orientation (Van Deventer *et al*., 2014; Tian *et al*., 2017). PE is only allocated two hours per week according to the DoE (2011a) for Grade 1 in the Foundation Phase. This is to ensure the development of children's fine and gross motor skills, however, in many schools teachers do not find the time to include PE into their daily school programme (Tian *et al*., 2017; Silva *et al*., 2018), because emphasis is placed on the achievement of academic skills. However, schools are the ideal spaces to increase physical activity (PA) (Donnelly & Lambourne, 2011; Andersen *et al*., 2015; Norris *et al*., 2015; Martin & Murtagh, 2017) and physical fitness (PF), not only through PE, but by integrating PA with academic content (Mullender-Wijnsma *et al*., 2016). From the literature reviewed there is a consensus that the ideal setting to integrate PA and academic content is the school environment to increase PA levels and improve academic achievement without reducing instructional time. However, there is limited evidence to support how PF and academic achievement are related in children as most fully developed research has been done on adults (Donelly *et al*., 2016; Syvaoja *et al*., 2019). This leaves room for further exploration and research.

Donelly *et al*. (2016) defines PA as "Any bodily movement produced by skeletal muscles that requires energy expenditure" [p.2] and PF is defined as "[a] physiological state of well-being that reduces the risk of hypokinetic disease; a basis for participation in sport; good health, which enable a person to complete the tasks of daily life. Components include cardio-respiratory endurance, muscle strength, flexibility and body composition" [p.3]. This is important to note, as many of the studies that included physically active academic interventions only measured PA and not PF, therefore, there is a gap that could possibly provide more consistent results if explored (Bezold *et al*., 2014).

BENEFITS OF PHYSICAL ACTIVITY AND PHYSICAL FITNESS

The benefits of regular PA are widely known. This includes the development of new brain cells in the hippocampus, which is known as neurogenesis. However, these effects on young children still need to be explored vigorously (Diamond, 2011). Regular PA is known to enhance brainpower, reasoning, attention, long-term memory and problem-solving skills (Krog, 2015). Medina (2014) signposts an analogy that for that reason regular PA should be considered mental candy. In order for peak performance of the brain, the body needs to work hard (Ratey & Hagerman, 2008). This reiterates that humans are holistic beings where body and mind are one entity and should be not be considered as separate dualistic entities. However, the South African school curriculum echo's that the mind and body are separate entities. By combing PA and academics, the body and the mind are both working hard to reach peak performance as suggested by Ratey and Hagerman (2008).

The association between PA and the effects it has on academic achievement has been vastly explored over the years. However, the effect of PF on academic achievement has received less attention (Donelly *et al*., 2016; Syvaoja *et al*., 2019). According to Chaddock *et al*. (2016), there is growing evidence of positive associations between PF and improved academic performance. This indicates there is a need for more research in this area (Syvaoja *et al*., 2019). Buck *et al*. (2008) found that fitness was a predictor of cognitive performance in the Stroop colour, word and colour-word tasks when BMI, age and IQ were controlled and measured.

Increasing PF in children has shown to causes increases to blood flow leading to improved brain vascularization, which could lead to academic achievement (Garcia-Hermoso *et al*., 2014). Bezold *et al*. (2014) conducted a 2-year longitudinal study and found that a higher composite of three fitness tests (aerobic capacity, muscle strength and endurance) was related with improved academic scores inf nine to 15 year-old learners in New York, US.

THE IMPORTANCE OF PHYSICAL ACTIVITY AND PHYSICAL FITNESS FOR YOUNG CHILDREN

According to Pica (2011), young children need to participate in regular PA to form healthy habits of being active early on because it is the ideal time to learn and master fundamental movement skills (FMS) that form the base for complex movement skills (Gallahue & Donelly, 2003). Regular PA not only forms healthy habits from a young age, but also develops the child's emotional well-being and stimulate emotional safety through positive feedback with groups and partners. It can improve motivation, cooperation, self-esteem and communication (Maghigan & Hess, 2009; Pica, 2011). During these early years neural pathways develop through myelination (Krog, 2015), which refers to process whereby the protein sheath develops around the neural pathways of the central nervous system, assisting impulse conduction of the nerves and improves speed of neural transmission (Thompson, 2008). Regular PA can, therefore, contribute to this process because it contributes to dendrite and synapse development, which could lead further development of these neural pathways (Leppo *et al*., 2000). Although the benefits of regular PA regarding brain plasticity and cognition are well known, how would this affect the academic performance of young children?

PF is beneficial for children as it reduces the risk of cardiovascular disease, obesity, bone and musculoskeletal function (Lippincott *et al*, 2006). It also has shown to have psychological effects, such as reducing depression, anxiety, stress and improving self-confidence and quality of life, which could predict improved academic performance. Increasing PF is also associated with increased PA levels (Lippincott *et al*., 2006). However, Garcia-Hermoso *et al*. (2014) mentions that PA and PF could affect academic achievement differently and further research is needed to find conclusive results. The components of PF that can potentially improve health are muscular strength, motor ability and cardiorespiratory fitness, which all may have different effects on the brain (Ruiz *et al*., 2011).

Chaddock *et al*. (2012) revealed from their study that fit children maintained accuracy in incongruent trials of the Flanker trials. The Flanker test is a cognitive test that consists of congruent and incongruent trials. Two arrows are shown between a target and participants have to decide whether the arrows are either in the same direction (congruent) or opposite (incongruent) to the target (Barker *et al*., 2019). According to Chaddock *et al*. (2012) no change in brain activity were observed in unfit children, there was a decrease, however, in Flanker accuracy. This revealed that unfit children had higher cognitive control demands, which was influenced by higher fatigue levels. Fit children displayed greater basal ganglia volumes, which is associated with positive Flanker task performance (Chaddock *et al*., 2010a). Fit children also had greater hippocampus volumes, which was associated with positive performances on memory tasks (Chaddock *et al*., 2010b). These results propose that PF is advantageous for executive functioning, memory and increases in basal ganglia and hippocampus volumes (Voelcker-Rehage & Niemann, 2013). These finding suggest that fitter children tend to perform better in memory tasks and have more grey matter volumes. Although the benefits of PF are well known, little is known of how integrated PF with academic content can improve PF and academic achievement in young children.

MOTOR DEVELOPMENT IN CHILDREN

According to Puckett and Black (2005) children first begin to move during pregnancy and once they are born, movement is reflexive until it becomes voluntary and purposeful. As an infant learns to control the reflexes movement becomes more purposeful leading to meaningful exploration of the surroundings (Puckett & Black, 2005). By doing this, a mental structure of the environment gradually develops, helping the child organise and interpret information (Puckett & Black, 2005). These reflexes are an important part of development and growth because they are the motivators of movement during the early years (Krog, 2015). Researchers have indicated that reflexes are critical to learning readiness (Goddard, 2002; Krog, 2010). Puckett & Black (2005) suggest that reflex activities provide a foundation for cognitive development later, and therefore, are important to learn to read and write.

Primitive reflexes exist during the first months of infancy, which include swallowing, sucking, coughing, sneezing and crying, as well as arm and head reflexes. These primitive reflexes are essential for survival and are not voluntary. As these primitive reflexes become integrated, skilled voluntary movements can occur, such as rolling, creeping, sitting, crawling and walking (Cheatum & Hammond, 2000). If these reflexes do not integrate and remain present, learning and emotional disorders, clumsiness and ambidexterity can cause weakness in the central nervous system, which could all effect a child's everyday functioning (Goddard, 2002; Kokot, 2006). The importance of movement should never be overlooked, starting from infancy throughout the young child's developmental years, and therefore, various movement experiences should be provided.

Movement is important because it allows the infant to explore and engage in their environment. This leads to further learning about the environment and the abilities of the body (Madigan and Hess, 2009; Pica, 2011; Van Deventer *et al*., 2014). Interaction between the environment and the child's brain that lead to brain development are complex (Thompson, 2008). Through the complex interaction between the environment and the brain, important connections are made (De Jager, 2009; Krog & Kruger, 2011). Hannaford (2005) suggest that learning is dependent on the whole body (holistic) and not only the mind. Therefore, the importance of movement for young children should not be overlooked, especially because children have the natural desire to move. Ratey and Hagerman (2008) support the idea that inactivity in the early childhood has a direct influence on development.

Research findings have found that PA provides a supreme stimulus creating an environment where the brain is readily able to learn (Ratey & Hagerman, 2009). Thompson (2008) suggests that through a range of experiences, the brain becomes a more advanced, capable organ and neural networks associated with language, intellect for a child's everyday functions, are strengthened In the limited research available health-related physical fitness has been shown to have positive benefits to development because of increased blood flow to the brain, which may lead to positive cognition effects (Hillman *et al*., 2008).

From infancy, children use movement to explore their environment. This exploration is primarily through the process of sensory information and movement abilities. The sensory-motor system is the network connecting the child to the surrounding environment (De Jager, 2009). Leppo *et al*. (2000) suggests that a sensory-enriched environment will influence the learning abilities of a child. Researchers have suggested that PA is the foundation for learning and memory when formed by a movement from a conducive learning environment (Kokot, 2006; Madigan & Hess, 2009). Therefore, creating a rich sensory environment that is age appropriate is important for young learners to influence their development of learning and overall growth.

Children can learn through direct movements, which was suggested by Piaget (Pienaar, 2014), because all actions are the foundation of human learning. From an educational point of view, Piaget's theory of learning is important. As suggested by Piaget children between the ages of two to seven years are in the Preoperational phase (Pienaar, 2014). During this phase, there is a rapid increase in mental representation, acquisition of language and play, specifically symbolic or pretend play. During this stage cognitive reasoning is still developing. Children's thinking at this stage is egocentric and thinking lacks the capacity for thought conservation. This indicates the ability to understand quantities can remain equal regardless of appearance changes. This is an important skill to develop for children to understand mathematical concepts, such as mass and volume. According to Gallahue and Donnelly (2003), motor development of young children is very important, specifically between the ages of two to seven years. They described this as the fundamental phase, the ideal time and phase to master basic stability, locomotor and manipulative skills.

FUNDAMENTAL MOVEMENT SKILLS

The Fundamental Movement Phase consists of three phases, namely: initial; elementary; and the mature phase. The initial phase describes uncoordinated attempts of goal-orientated movements. These attempts generally indicate movement without proper rhythm, uncoordinated and mechanically insufficient. During this stage, between ages two to three years, children are still learning to control their bodies and movements. As they develop, they move into the elementary phase. This phase displays more controlled, rhythmic and more coordinated movements. This is largely because of maturation between ages four to five years. Therefore, in order to reach the mature phase; children require instruction, practise and motivation. Between the ages of two and seven years, children's movements become mechanically efficient, controlled, coordinated and fluid. They have now reached the mature stage of the movement development phase and move towards more complex movements, such as sport specific movements and concepts (Madigan & Hess, 2009).

This age group (two to seven year) should be encouraged to engage in regular PA. However, very few studies that have integrated PA and academics have done so with other age groups (Reed *et al*., 2010). Donnelly *et al*. (2009) conducted their Physical Activity Across the Curriculum (PAAC) intervention with seven to nine-year-old learners and Reed *et al*. (2010) conducted their research of integrating activity into core curriculum subject with nine- to 11-

year-old learners. This is comparable to the research by Riley *et al*. (2014) who conducted the EASY Minds Study with 10 to12- year old learners. Although Lui *et al*. (2007) conducted the Happy 10 intervention with six- to 12- year-old learners and Mahar *et al*. (2006) introduced the Energizer interventions to five- to 11- year old leaners, it was not specific to the ages of six- to eight-year-old learners where the maturation phase usually occurs (Gallahue & Donnely, 2003).

PHYSICAL ACTIVITY INTERVENTIONS

Various research has been done on PA breaks, the acute and chronic effects on PA alone or academic achievement alone. However, many of these interventions are unrelated to educational outcomes. Many studies have focused on increasing PA and academic achievement and have assessed PA in young children only (Best, 2010; Erwin *et al*., 2011; Goh *et al*., 2014; Reznik *et al*., 2015). Other studies only determined health outcomes, facilitators-of-learning and assessing learning from the implementation of interventions (Li *et al*., 2010; Finn & McInnis, 2014). Finn and McInnis (2014) found that teacher enjoyment and approval and learner enjoyment was an influential factor on the success of the intervention (Donelly & Lambourne, 2011). Research on the influence of integrating PA with school subjects is still growing, and therefore, studies have produced various results indicating the benefits it could have (Martin & Murtagh, 2017). However, further research is required to determine the influence on integrating PF with school subjects as this body of research is still limited (Bezold *et al*., 2014). Further research is required to provide results that are more consistent and to determine how the various component of PF impacts academic performance.

According to De Greef, (2016) integrating PA into the curriculum has many benefits especially for primary school children that not only include health and physical outcomes. Mullender-Wijnsma *et al*. (2016) indicated that this type of intervention could improve academic achievement and executive functions in young children. This is coherent with findings from

Donelly and Lambourne (2011) and Best (2010). The above-mentioned intervention type could cause physiological changes in the brain because of the improvement in PF leading to further enhancements in academic achievement. Previous longitudinal studies have shown that physically fit adolescents have higher academic achievement scores compared to unfit adolescents. (London *et al*., 2011; Wittberg *et al*., 2012).

Although this field is receiving more attention on the possible impact on children's PA levels or PF and scholastic achievement, the results indicate many inconsistencies (Martin & Murtagh, 2017). This is due to various reasons, such as the limited number of studies concluded and published, very few studies included a theoretical frame work in the development of their interventions and some researchers have not provided information on their respective interventions for replication to occur (Norris *et al.*, 2015; Martin & Murtagh, 2017). Most studies were conducted in the US; therefore, the results cannot be generalised to other populations. Therefore, this field has room for improvement and more vigorous research, especially in the South African context, to affirm the benefits of combining PF into the school curriculum.

INTERVENTION PROGRAMMES CONDUCTED IN SOUTH AFRICA

In South Africa, there is currently a distressing and increasing awareness that many school learners are not performing academically. Teaching methods are outdated, classrooms are overcrowded, teachers are unqualified, many schools in the country lack facilities and resources and teachers lack the appropriate knowledge and skills regarding the curriculum (Van Deventer, 2009; Curry, 2011; Van Deventer *et al*., 2014). New ideas and methods are needed with the ever-changing child and society.

In South Africa there is limited research on incorporating PF with academic content, however, there have been studies that implement perceptual-motor and PA to determine its' impact on children's academic content between the ages of four and eight years old . The study of Coetzee *et al*. (2015) included learner's ages five to eight-years old in their perceptual-motor programme aimed at learners with Development Coordination Disorder (DCD). Krog (2015) conducted Speed Stacking research with Grade 1 learners, six to eight years old. This age group was targeted because perceptual-motor problems are usually revealed within the first year of formal schooling (Krog, 2015). These studies support the notion that targeting this age group is important and can be beneficial for learner's physical and academic skills.

In South Africa, few studies have been found on such interventions being implemented in the school environment. Krog and Kruger (2011) conducted a 10-week movement intervention to determine its effectiveness on learning readiness of Grade 2 learner with learning difficulties. Krog and Kruger (2011) made use of an IQ test to determine intellectual abilities, the Bender-Gestalt II to determine motor and perceptual development and four basic academic tests to assess reading, addition, subtraction and spelling. Various movement proficiency tests were used to assess neurological functions, specifically the Mann test, One-leg test, Angel in the snow, Rhomberg test, Reciprocal limitations, skin touch tactile awareness, Visual tracking assessment, Asymmetrical tonic reflex, Symmetrical tonic reflex and Body concept test. The movement intervention formulated on the development order of movements through infancy, proprioception, laterality, directionality and crossing the midline, muscle tone and integrating reflex lasted 10 weeks with 30-minute sessions per day (Krog & Kruger, 2011).

The intervention required the teacher to implement five additional minutes per day which was progressive. The intervention was designed to increase in difficulty throughout its course. Their findings suggest that there were significant results in some of the neurological function tests, namely: the IQ test; body awareness; perception test; and muscle tone. However, only subtraction test scores had a significant difference (Krog & Kruger, 2011). The authors state that because of the small sample (N=14) these scores must be interpreted with caution. Krog and Kruger (2011) found significant improvements in learners' perceptual skills and language abilities. Due to the small sample size, these results cannot be generalised to all populations in SA, therefore, more rigorous, larger samples (Mullender-Wijnsma *et al*., 2015) and high-quality research is needed in SA (Norris *et al*., 2015; Martin & Murtagh, 2017).

Krog and Kruger's (2011) findings coincide with another study conducted in SA, which implemented a perceptual-motor programme for Grade 1 learners will DCD. The intervention was implemented over 10 weeks with two sessions of 30 minutes per week (Coetzee *et al*., 2015). The Movement Assessment Battery for Children-2 (MABC-2), age-band one, assed the motor proficiency of the learners. The MABC-2 consists of three components, namely: (1) manual dexterity; (2) balance; and (3) aiming and catching. After the programme, a significant difference was found in the balance component of the MABC-2 scores, while manual dexterity, aiming and catching showed no significant changes. Thus, the overall motor proficiency levels of the learners did not improve over the 10 weeks. The researchers concluded that the results could have been because of the control group being exposed to PE lessons and because the majority of learners turned seven years-old they should have been tested on age-band two of the MABC-2 (Coetzee *et al*., 2015). This coincides with findings from Martin and Murtagh (2017) that studies used various assessment tool limiting comparability between studies, and therefore, adding to these inconclusive results.

Pienaar *et al*. (2011a) assessed perceptual motor skills and cognitive function of four- to six-year-old children in the North West Province, South Africa. The experimental group was participated in a perceptual-motor programme, while the control group received no programme. The programme included an hour session weekly for seven months. The programme incorporated activities to improve perceptual skills such as body awareness, balance, coordination, spatial awareness, bilateral integration and locomotor skills. The authors used Peabody Developmental Motor Scales-2 (PDMS-2) to measure motor skills and the Junior

South African Individual Scale (JSAIS) to measure cognitive development. The results after the seven-month intervention indicated that two of the five tests of PDMS-2 (locomotor and visual skills), showed significant difference and one significant difference in one subtest of the JSAIS, namely the block patterns. The authors concluded that the intervention programme succeeded in its' goals and contributed towards their school-readiness. One should take note that it was assumed that maturation was observed in the results because there were decreases in the number and quantity of subtests in both the experimental and control groups (Pienaar *et al.*, 2011a). These findings are important because it demonstrates that a well-designed, consistent movement programme is beneficial for early development and is the building blocks for motor development, sensory integration and perceptual development. This is important for the learning process when they enter the formal school environment (Madigan & Hess, 2009; Pica, 2011).

Interventions integrating PA and academic content has been conducted across the US (Norris *et al.*, 2015; Martin & Murtagh, 2017). According to the literature, no studies that combine PA or PF and academic content to improve PA or PF levels and academic achievement of Grade 1 learners have been conducted in SA. Gall *et al*, (2018) found that a 20-week physical activity intervention including PE, dancing and PA classroom breaks, contributed to the maintenance of academic performance among socio-economically deprived school children between the ages of eight and 13 years old in Port Elizabeth, South Africa.

Van Deventer *et al*. (2014) conducted an eight-week intervention with Grade 2 learners to determine the impact of an integrated programme versus an intensive programme. The integrated academic skills and perceptual-motor skills programme focused on sensory- and perceptual-motor skills. The activities included were: midline crossing; laterality; directionality; spatial awareness; body awareness; and bilateral coordination. The intensive programme was developed to focus on moderate to strenuous activities, strength and resistance, stretching and aerobic activities. Mathematical performance was assessed using the VASSI Mathematics Skill Test and reading and reading and spelling was assessed using ESSI Reading and Spelling Test. The results were statistically insignificant. However, results indicated that the boys in the integrated programme showed improvements in the VASSI Mathematical Skill Test. Girls who participated in the intensive programme and boys from the integrated programme both showed more improvements in ESSI Reading and Spelling Skills Test (Van Deventer, 2014). These findings support Reed *et al*. (2010) where no significant results were found after a three-month integrated intervention, which focused on Mathematics, English and Science. Further research is needed in the South African context to determine how these types of interventions impact PA or PF and academic performance.

INTERVENTION PROGRAMMES CONDUCTED INTERNATIONALLY

Donelly *et al*. (2009) and Donelly and Lambourne (2011) directed an intervention titled: "Physical activity across the curriculum" (PAAC), over a three-year period which consisted of 90 minutes of moderate to vigorous PA (MVPA) per week to evaluate the impact of the intervention on BMI and academic achievement. They found that the programme positively influenced changes in BMI, spelling, reading, mathematics and composite scores. Interestingly, they also found that the influence of teachers affected the learner's attitudes towards participating in the programme. The teacher's involvement was believed to be an influencing factor on the intervention (Donelly *et al*., 2011). This coincides with findings from Finn and McInnis (2014) whereby teacher approval and enjoyment were a significant influencer on the success of the programme.

Andersen *et al*. (2015) conducted a seven-month, cluster-randomised parallel group-controlled trial with fifth graders in Norway titled: Active Smarter Kids (ASK). The intervention consisted of physically active academic lessons for 30 minutes, three times per week, consisting of physically active breaks during academic lessons for five minutes per day and PA homework for 10 minutes daily. The intervention included the mandatory 90 minutes of PE lessons per week. The findings indicated that ASK positively influenced the academic performance of learners and that the school environment was the ideal environment to promote health initiatives that are achievable and flexible. This argument concurs with Donelly and Lambourne (2011), who found that the school environment is the supreme site for physically active academic interventions because learners spend most of their time at school, the interventions are cost effective and enjoyable for both the teacher and learner. Most importantly, this type of intervention can promote an increase in PA, reduce sedentary time and improve academic performance (Donelly & Lambourne, 2011).

There have been few studies in the last few years incorporating interventions into the school setting to promote PA and academic success (Li *et al*., 2010; Reed *et al*., 2010; Finn & McnInnes, 2014; Reznik *et al*., 2015). However, the results of these studies seem to be inconclusive. This is because of many different reasons. Firstly, school and classroom-based studies seem to be difficult to implement and some assessment tools were not validated tests (Andersen *et al*., 2015). Secondly, Martin and Murtagh (2017) found that too few studies have been conducted for conclusive deductions, based on the review of the effect of lessons combining PA and academic content on PA, health outcomes and academic achievement. Thirdly, they indicated that not many studies included theoretical frameworks in the development of such interventions. Fourthly, replication or full examination of the interventions was not possible because of limited information regarding the interventions implemented (Norris *et al*., 2015; Martin & Murtagh, 2017). Lastly, the evidence to support the effectiveness of combining PA and academic content has shown to be inconclusive. This is possibly because many studies were too short, not randomised or had small sample sizes disallowing generalisations (Andersen *et al*., 2015).

Inconsistencies have been noted because of many reasons, one being the duration of the interventions. Studies that assimilated PA and academic content indicated various durations. Donnelly *et al*. (2009) conducted a three-year programme titled: PAAC of two to 10 minutes of PA each day with seven to nine-year old learners. This study differs from the "Fit en Vaardig" (FV) intervention conducted by Mullender-Wijnsma *et al*. (2016:1) over two years, 22 weeks per year for 20 to 30 minutes three times per week. It could be argued that the latter deemed more significant results because the primary focus was on academic achievement, therefore, the intervention was developed to increase academic performance primarily, as well as to increase PA levels and scholastic performance (Mullender-Wijnsma *et al*., 2016; Martin & Murtagh, 2017). Therefore, it seems that the nature and primary focus of the intervention should be greatly considered when formulating intervention programmes to improve PA and academic achievement. The strength of this type of intervention is the cluster-randomised controlled trail design and the large sample size (N=814) (Mullender-Wijnsma *et al*., 2016). Finding from the following studies Donelly *et al*. (2009), Reed *et al*. (2010), Donelly and Lambourne (2011) and Mullender-Wijnsma *et al*. (2016), suggest that integrated PA and academic content could increase the PA level of learners greatly and have a beneficial influence on academic performance. Although, these benefits can differ in terms of the length of the intervention, the design, the assessment tools used and the nature of the intervention implemented, PA was measured and not PF.

Donelly *et al*. (2016) conducted a systematic review on PA, PF, cognitive function and academic achievement in children. They found that the effects of PA on learning, cognitive performance and brain function is important and may be the building blocks for improved academic achievement. Donelly and co-workers found that most studies assessing PF used the PACER test to place participants in a low or high fitness, determine the average VO_2 Max and the average number of laps run in the PACER test (Donelly *et al*., 2016).

Buck *at al*. (2008) found that PF was a predictor of cognitive performance in seven to 12-year old children. The participants PF was assessed using the Fitnessgram and cognition was asses using the Stroop test. Their findings showed that when challenged with attentional tasks that were goal-directed it required, organisation, planning, working memory and problem solving (Buck *at al*., 2008). The researchers found that those who were more fit performed better with lower reaction times and accuracy in the Stroop tasks conditions (Buck *at al*., 2008).

Hansen *et al*. (2014) conducted a three-year trial to determine the linear and non-linear associations of PA and aerobic fitness with academic performance with US children in Grades 3 and 5. They found that increased PF had a greater impact on spelling and mathematics when learners scored between 22 to 28 laps on the PACER test. This indicated that the better the aerobic capacity, the more improvements occurred in academic achievement (Hansen *et al*., 2014).

Garcio-Hermoso *et al*. (2017) conducted a study to determine the association of muscular strength and cardiorespiratory PF components with academic achievements. They measured mathematics and language performance using standardised tests. Cardiorespiratory fitness was measured using the 20m shuttle run and the standing long jump was used to measure muscular strength. BMI, waist circumference and waist circumference to height ratio were also calculated (Garcio-Hermoso *et al*., 2017). The found that fit and low-fatness adolescents had significantly higher chances for better language and mathematical performance. Linear regression models suggest a partial or full mediation of PF in the association of fatness variables with academic achievement (Garcio-Hermoso *et al*. (2017). The afore-mentioned study found a positive association between PF and academic performance, however, there were no interventions including PF and academic lessons. The systematic review on PA, PF, cognitive function and academic achievement conducted by Donelly *et al*., (2016), found that the body of literature is only able to provide correlational evidence between PF and academic achievement. The researchers stated that this indicated that children with higher levels of PF show significantly better cognitive performance. They found the same was true for participants with higher levels of PA (Donelly *et al*. 2016).

GENDER DIFFERENCES

Although the benefits of PA and PF on children are well known, a body of knowledge on gender-based differences indicate that girls tend to be less active than boys (Hallal *et al*., 2012; Costill *et al*., 2016). Telford *et al*. (2016) explored the differences between girls and boys at age eight and 12, from 29 schools in Australia to determine gender differences in PA using individual, social and environmental variables. Cardiovascular fitness, perceived competence in PE and body composition were measured to determine the individual levels (Telford *et al*., 2016). Parental support for PA and parental education levels was used to determine the social levels. The influence of the schools on their learners and extracurricular sport clubs were used to determine the environmental levels (Telford *et al*., 2016). The research found that girls, compared to boys, were 19% less active, which was associated with weaker influences at the environmental and social levels and reduced participation in extracurricular sport clubs. The eight-year-old girls performed less on the individual level because they had 18% lower cardiorespiratory fitness, 44% lower eye-hand coordination, 9% lower perceived competence in PA and a higher body fat percentage (28% vs 23%) (Telford *et al*., 2016). Participation of the boys in extracurricular sport at age eight and 12 was strong against declines in PA over the time period, whereas as not the same applied to the girls. They concluded that the differences could be explained against the background of individual, social and environmental factors and if these factors could be manipulated it could bridge the gap between gender difference in PA (Telford *et al*., 2016).

Similarly, according to Eckelund *et al*. (2012) many studies found that girls in Europe between the ages of four- and 18-years-old participated on average 17% less in daily PA than boys.

Various studies have provided different reasons for these differences, such as: girls receive less encouragement and support; a lack of enjoyment; and biological differences. Biological reasons may be a contributing factor to gender differences for regarding participation in PA. Different PA levels between boys and girls have found to reduce after sexual maturity. This suggest that lower PA levels in girls could be associated with maturing at an earlier age (Eckelund *et al*. (2012).

Various studies have found varying results regarding the differences in PF between girls and boys. Drollette *et al*. (2015) found poorer performance on working memory in girls compared to boys when controlling socio-economic status and fitness. Kwak *et al*. (2009) determined that PF was associated with academic performances in boys but not in girls. However, other studies have determined a strong association in girls (Van Dusen *et al*., 2011; Liao *et al*., 2013). These results indicate that findings are inconsistent and further research is required especially to determine the effect between girls and boys.

Eveland-Sayers *et al*. (2009) found that the time in a 15-mile run test was negatively associated with performances in reading, language and mathematics in girls in comparison to boys. Van Dusen *et al*. (2011) found that the association between cardiorespiratory fitness and reading skills had a higher effect size (0.17). Pienaar *et al*. (2011) found a stronger relationship between PF components (knee push-ups, wall sitting and strength), and academic performance among girls. These findings add to the notion that the results are inconsistent and further research is needed to bridge the gap between gender difference in PA (Telford *et al*., 2016).

THE IMPORTANTANCE OF EARLY INTERVENTION

Early intervention is critical for young children because the immature brain is an exceedingly adaptive organ, capable of captivating a great diversity of influences and experiences (Thompson, 2008). Therefore, this is why early childhood presents the ideal chance for learners to develop their motor skills (Ratey & Hagerman, 2009). Early interventions are preventative and could be beneficial (Lalongo *et al*., 2019). If an intervention is implemented early enough, it can prevent certain occurrences like delayed brain and cognitive development, delayed numeracy and literacy, language movement and perceptual skills that later affect reading, spelling and mathematics. Therefore, implementing an intervention at the first year of formal schooling can be very beneficial and understood as a means of preventative measure compared to a treatment for poor physical performance, academic performance and, overall health and development. Therefore, targeting this age group is crucial as a preventative measure (Birch & Ventura, 2009).

Various assessment tools seemed to cause inconsistent results. Norris *et al*. (2015) purports that in many studies (Mahar *et al*., 2006; Erwin *et al*., 2011a), only pedometers were used to assess PA, however, pedometers do not measure the intensity of an activity or PF. Therefore, it is suggested that accelerometers, for example, should be used to measure PA intensity. Dyrstad *et al*. (2018) emphasise the barriers regarding the implementation of interventions combining PA and academic content. These barriers include the difficulty and time consumption of lesson planning; instruction and explanation prior to interventions that are insufficient, insufficient facilities and lessons that were too long (45 minutes).

PERCEPTUAL-MOTOR SKILLS

Krog (2015) describes that a lack of movement programmes in schools disadvantages many learners who would not benefit from holistic learning. Academic acquisition is the primary focus over PE or movement programmes, despite the great evidence of the link between PA and learning. Krog (2015) goes further to state that the critical importance of movement for learning and development lies in early childhood.

Perceptual-motor development makes use of sensory input and integration, motor interpretation, movement activation and feedback (Gallhue & Ozman, 2006). Perceptual-motor skills are important for learning (Jahani *et al*., 2017). Certain perceptual-motor skills are crucial in facilitating movement. When learners develop spatial awareness, they become aware of their bodies in relation to object near and around them (Krog, 2015. This is a paramount skill when learners must identify letters and symbol orientation on a page, for example, knowing the discrepancy between the letters b, d and p (Krog, 2015). This not only affects letter discrimination but also reading and spelling abilities. Writing between lines on a page is affected by spatial awareness abilities (Krog, 2015), therefore, developing a strong spatial awareness through movement during early childhood is critical (Pienaar *et al*., 2011; Krog, 2015).

Visual integration and ocular focus are important for learning to read, write, spell and do mathematics. Learners need to have the ability to focus on a singular stimulus, such as two-dimensional letters on a page. Tracking is the ability of the eyes to follow words on a page. It has a direct influence on reading fluently (Goddard, 2002; Krog, 2015), and should be a focus of movement programmes. Krog (2015) emphasise movement as a crucial aspect to develop learning readiness because movement develops the sensory-motor systems (Krog, 2010; Krog & Kruger, 2011), and assist in developing the abilities for academic learning (Pheulong, 1997). Krog (2015) indicates that movement should not be excluded from the curriculum; however, this happens more often because of a lack of facilities, equipment, knowledge and PA receives less attention because the primary focus is on academic subjects.

According to McEwing (2011) incorporating music and singing is crucial for the development of phonological and phonemic awareness and to explore rhythms and stories that assist vocabulary acquisition, narratives and comprehensive skills. Therefore, incorporating these ideas with movement could lead to an improvement in these literacy skills of young children.

McEwing (2011:29) developed a programme, "Gotta Move!", that incorporates music, movement and early literacy to help develop talking, singing, playing, writing and reading for two- to five-year old children. Including music and singing into movement programmes can be beneficial for children's literacy skills in the first year of formal schooling and should be considered when designing movement programmes (McEwing, 2011).

EDUCATIONAL OUTCOMES IN SOUTH AFRICA

Reading and spelling acquisition requires various prerequisites, such as phonological processing and phonological awareness (Moll *et al*., 2014). Apfelbaum *et al*. (2012) states that because of the complexity of phonology, many students struggle to acquire basic reading and spelling skills. Naidoo *et al*. (2017) indicate that SA faces many challenges regarding education that has a direct impact on the literacy of children. Socio-economic challenges, educators not being proficient in English and large class sizes (Van Deventer *et al*., 2014), contribute to low literacy levels in SA. The reading performance of South African learners has proven the seriousness of the literacy problems and the need for solutions (Mzimane & Mantlana, 2017). Because this is an ongoing issue and as the first formal year of schooling in SA focus on literacy and numeracy there needs to be a focus on physically active academic interventions.

According to the DoE (2011) seven to eight hours are allocated to home language and seven hours to mathematics per week. This makes up 14 to 15 hours of the 23 hours allocated for instruction time in Grade 1. Hauser *et al*. (2015) assert that in order to enhance mathematical learning opportunities an inclusive environment is crucial to adhere to the diverse education needs of learners (Hauser *et al.*, 2015). Hauser *et al*. (2015) proclaims that play-based learning (board and card games) can be a strong influential tool for learning. According to Hauser and co-workers (2015), educators found that six-year old children were less bored during the play-based intervention, whereas a training session (instructional exercises), produced many concerns regarding the length of time learners had to sit and listen. This implies that incorporating play or PA into academic lessons could enhance learning because of learners' engagement and decreased boredom.

The study by Vetter *et al*. (2014) implemented a programme that combined numeracy and PA for children aged nine- to 10-years-old. The programme consisted of three, 20 minutes sessions per week, for six weeks. Two groups were created: PA-ST (physical activity while seated); and ST-PA (learning on the playground). The intervention programme included aerobic exercises combined with math games in and outside the classroom. The results showed greater improvements in multiplication skills and PF in the ST-PA group. The research further supports the notion that combining PF with academic lessons in the school environment could improve children's mathematical skills (Vetter *et al*., 2014). Therefore, there is a need to investigate the benefits of these programmes on six- to eight-years-old learners to determine whether similar improvements would occur.

The Curriculum Assessment and Policy Statement (CAPS) (DoE, 2011), indicate the specific mathematical skills in the Foundation Phase (Grades R to 3) that need to develop mathematical vocabulary, numbers vocabulary, number concepts, calculation and application skills. Learners need to develop listening, communicating, thinking and reasoning skills competently and be able to apply this in everyday life. Mathematical skills taught are to analyse, investigate and interpret information and to ask questions. Learners are taught these skills to develop problem-solving skills and the role that mathematics plays in every-day life.

The focus areas set out by the CAPS (DoE, 2011) for the Foundation Phase are: (i) numbers, operations and relations; (ii) patterns, functions and algebra; (iii) space and shape (geometry); (iv) measurement; and (v) data handling. For Grade 1, numbers, operations and relations focuses on the development of counting concrete objects up to at least 50. Counting forwards and backwards in ones up to 100 and number recognition, identification and the ability to read number symbols and number names are other focus areas. It focuses on developing the ability to compare, describe, order objects and numbers and use ordinal numbers to indicate place, position or order (Cozens & Thomas, 2012). The focus is on developing skills to recognise place value of two-digit numbers from one to 99 and to solve problems using various techniques, such as number lines, doubling, halving, drawing and making use of concrete tools. Furthermore, learners have to develop skills to answer word problems involving addition and subtraction with answers up to 99. This develops the solving of word problems using repeated addition and later multiplication with answers up to 50. Grouping and sharing word problems are the foundation for division with answers of up to 50 that can incorporate remainders. Learning about money, developing the tools to recognise and identify local currency of coins and notes and solving word problems relating to money form part of the Foundation Phase. Mental Mathematics skills to rapidly recall make calculations and the concept of numbers are also taught (DoE, 2011; Cozens & Thomas, 2012).

Learners are taught to copy, extend and describe patterns with the use of objects and drawings whilst in Grade 1. They learn to create their own patterns and identify geometric patterns in their physical space and in nature. Furthermore, they have to be able to describe, copy and extend number patterns ranging up to 100. They are taught skills to describe and identify shape, position and orientation of one object in relation to another. Learning about three-dimensional objects that include the features of the objects and building three-dimensional object is another focus area. Learners learn to describe, name and build two-dimensional shapes. Other focus areas include time, developing abilities to talk about the passing of time, compare lengths of time and use the correct vocabulary (DoE, 2011; Cozens & Thomas, 2012). Telling of time requires the learner to describe when something happens, name weekdays and be able to place birthdays on a calendar. Measurement includes learning about length, mass and capacity/ volume and the ability to compare order and estimate numbers. Data handling is a focus area in which learners learn collect and sort objects and present what they found through the drawing of pictures. They learn to discuss and report on the sorted objects collected, ask questions and provide answers of the objects collected and explain the method used to sort objects. The ability to collect and organise data, analyse and present it is the last focal content area within the mathematical curriculum for Grade 1 learners according to the CAPS (DoE, 2011; Cozens & Thomas, 2012). These outcomes would, therefore, be important in the South African context as it paves the way when designing interventions to incorporate PF into mathematical lessons.

A recent study by Feza (2015) aimed to determine the knowledge of South African teachers regarding teaching five- and six-year-old learners how to count. In the study of Feza (2015), 17 teachers participated in a scenario-based questionnaire to determine their understanding of how learners learn to count, what it means to know how to count and various assessments that can be used to determine a better interpretation of whether learners can count. The results indicated that teachers had shallow knowledge of counting concepts for learning, partially understood assessment and misused assessment jargon (Feza, 2015). Furthermore, a limited number of teachers used the CAPS as a reference to determine the content learners need to be taught (Feza, 2015). Therefore, because knowledge is lacking it increases the need for interventions that can help teachers to better understand how to teach mathematics to further improve the mathematical performance of learners.

Krog (2015) led an intervention in Grade 1 classes, using speed-stacking cups to enhance academic learning. The intervention was across three Grade 1 classes in Gauteng Province, SA. It lasted for eight weeks with 20-minutes sessions each day. Group A participated in the intervention from week one to eight, followed by eight weeks of normal classroom activities. Group B started with normal classroom activities for the first eight weeks and then participated in the intervention from week eight to 16. The results indicated an overall improvement in both groups in addition, subtraction, one-minute reading and a one-minute reading Afrikaans test.

However, Group A that started in week one to eight produced more improvements. These improvements according to the researchers could be ascribed to the timing of the exposure to the speed stacking activity (Krog, 2015). Although it did not include any PF components, the intervention included perceptual skills, such as laterality, directionality, crossing the midline, sequencing, patterning and perceptual- and visual-motor skills. It is well known that improving these skills can improve learning (Madigan & Hess, 2009; Krog & Kruger, 2011; Pienaar *et al.*, 2011; Coetzee, 2015).

Syvaoja *et al*. (2019) conducted a 2-year follow-up study to examine the longitudinal association of PF components with academic achievement of nine to 15-year-old learners in Finland. The 20m shuttle run was used to measure aerobic fitness, the curl-up and push-up were used to measure muscular fitness (Syvaoja *et al.*, 2019). The 5-leap test, throwing and catching was used to measure motor skills. They found changes in muscular fitness were associated with positive changes in academic scores. Better academic achievement in year one predicted better motor skills, aerobic fitness and muscular fitness. Better motor skills in year two independently were found to predict better academic achievement one year later (Syvaoja *et al.*, 2019).

In Grade 1, learners enter formal education for the first time. Here they are introduced to formal demands of cognitive instruction and understanding (Gallahue & Donnelly, 2003). During this time, they are taught concepts of numeracy, real time, money and to read at a basic level. During early childhood development, play is the primary method in which children acquire knowledge about the environment, their bodies and movement abilities. This can facilitate cognitive learning and the development of gross and fine motor skills (Gallahue & Donnelly, 2007). Therefore, intervention methods and approaches are important in determining the development of an intervention.

INTERVENTION APPROACHES

Of the various studies integrating PA and academic content, a variety of intervention approaches and methods have been used (Martin & Murtagh, 2017). However, many studies conducted on this topic have not included a theoretical framework for the implemented interventions (Norris *et al*., 2015; Martin & Murtagh, 2017). The process-oriented approach, otherwise identified as the bottom up approach, emphasises the underlying processes that have not developed fully (Pienaar, 2014; Coetzee *et al*., 2015). A bottom-up approach intervention focus on integrating underlying processes, such as: sensory functions; planning and attention; and perceptual-motor learning (Winnick & Poretta, 2000; Pienaar, 2014; Coetzee *et al*., 2015). This intervention approach (bottom up) is largely used in many therapies to improve sensory integration, perceptual-motor learning and movement execution (Auxter *et al*., 2005; Sugden *et al*., 2008; Pienaar, 2014).

The bottom-up approach differs largely from cognitive or task-oriented approaches, otherwise known as the top-down approach. The top-down intervention approach emerged later because of poor backing for the bottom-up approach (Sugden *et al*., 2008; Coetzee *et al*., 2015). The top-down approach is task-specific and founded on motor learning concepts. Motor learning is based on the knowledge of the underlying processes involved to execute a movement, while the cognitive approach is based on the direct teaching of a skill. Therefore, the top-down intervention approach focuses on the direct teaching of a specific skill that can also be generalised to other environments (Sugden *et al*., 2008; Pienaar, 2014; Coetzee *et al*., 2015).

Because of differences in opinions regarding the afore-mentioned approaches, some researchers, such as Sugden and Chambers (1998), decided to integrate the above-mentioned intervention approaches (Sugden & Chambers, 1998; Sugden & Chambers, 2003; Sugden & Chambers, 2008; Pienaar, 2014).

Sugden and Chambers (1998) found success with this approach when treating children with (DCD), because there was no single method to treat them (Dewey & Wilson, 2001; Sugden & Chambers, 2003). This approach has seen success in interventions conducted by Davidson and Williams (2002), who combined sensory and perceptual-motor therapy for a 10-week intervention for children. Their results from the Movement Assessment Battery for Children-total, indicated statistical improvements in hand skills (Davidson & Williams, 2002). Ernst (2004) combined the bottom-up and top-down approach in an 8-week programme conducted on children with DCD. The intervention combined perceptual-motor, sensory integration and task-orientated components. Results of the programme had a beneficial outcome on balance; however, hand skills did not have long lasting effects, but balance improvement did. Ernst *et al*. (2004) also found that children who performed poorer had more serious underlying complex neurological problems than the children who improved. (Ernst, 2004; Pienaar, 2014). These findings suggest that a combined intervention approach could lead to improvements in perceptual-motor skills and sensory integration of children because there is no single method that works with learners who have various abilities (Sugden & Wright, 1996; Pienaar, 2014).

Erwin *et al*. (2011) suggests a teacher-directed intervention that allows teachers to conduct the lessons by combining PA into core school subjects. Reznik *et al*. (2015) also suggests a teacher-delivered PA intervention as an approach to incorporate PA into the classroom. Mullender-Wijnsma *et al*. (2016) supports this teacher-directed intervention approach because teacher's approval of PA during instructional time is required (Martin & Murtagh, 2017). When designing interventions that combine PF and academic lessons teacher-directed interventions should be considered (Norris *et al*., 2015).

The Constraints Model of Newell (1989) discusses three constraints to action or movement, namely: the individual/organism; the environment; and the task. This model recognises that contact between the constraints of individuals, the task and the environment produce movement. All three constraints influence the child's motor performance; however, teachers, coaches, specialists can manipulate these constraints to improve the motor development of children. Individual constraints include heredity characteristics, past experiences, individual characteristics, such as emotions, intentions, memory and decision-making (Glazier & David, 2009). Task constraints include demands of the task, rules, task difficulty and equipment. The environmental constraints include teacher skills, knowledge and behaviour, socio-cultural characteristics and weather (Glazier & David, 2009). When the instructor knows the learner's capabilities and understands the complexity of the task, it can be taught by breaking the task into appropriate stages, while ensuring the environment is conducive. Therefore, when manipulating the constraints, the desired movement and skill acquisition can occur (Newell *et al*., 1989; Glazier & David, 2009).

PERCEPTUAL-MOTOR SKILLS LINKED TO ACADEMIC LEARNING

The benefits of regular PA are widely known, however, there are still many different theories on how this affects learning, executive function, cognitive function and academic achievement (Best, 2010; Diamond, 2011; Pica, 2011;). It is important to ask what the underlying processes and skills are that can impact academic achievement in young children? According to Krog (2010) optimal learning requires efficient understanding and internalisation of laterality, directionality, visual tracking, crossing the midline, inter-hemispheric integration, sequencing, patterning, attention and being able to focus on a task (Gallahue & Ozman, 2006; Coetzee *et al*., 2015; Krog, 2015).

Laterality

Laterality refers to the internal awareness that the body has two sides and they are different (Cheatum & Hammond, 2000). Laterality serves as the foundation for directionality and both these components have a direct impact on reading. In order to read correctly, the learner must be able to recognise and understand that words are made up of letter combinations, to be able to read from one side to the other and how to hold the book correctly (Cheatum & Hammond, 2000; Krog, 2010), and where to write on the page (Krog, 2015). According to Pheloung (2006) midline crossing can occur once lateral preference has been established. The ability to cross the midline is required for many academic tasks, such as reading and movements, such as being able to cross body parts to reach for an object and for writing skills (Krog, 2015).

Directionality

Once laterality is developed and a child understands that the body consists of two sides that work autonomously and simultaneously, directionality will develop (Phelong; 2003; Krog, 2010; Krog, 2015). Directionality has a direct effect on especially reading and writing skills (Krog, 2015). In the beginning of literacy, directionality can be a problem in knowing where to write on a page or where to start reading from a text (Krog, 2015). Until children gain control over directionality, they are likely to experience new difficulties, such as following instructions. Regular movement can assist in the development of directionality, which could lead to better reading and writing skills and should be considered in perceptual-motor activities performed in the classroom (Krog; 2015).

Crossing the midline

Maquire (2001) indicates that being able to cross the midline is necessary to become a successful reader because one dominant eye is used for focusing and the other eye is used for blending. The visual fields in the brain overlap when crossing the midline, while reading (Maquire, 2001). These skills are, therefore, crucial to develop and strengthen through perceptual-motor activities to ensure that optimal learning can occur (Krog, 2015). This theory is supported by the study conducted by Krog (2015), where speed-stacking cups were used in an eight-week intervention with Grade 1 learners. The study showed improvements in reading speed tests, reading Afrikaans for Group A. Group B demonstrated better improvements in subtraction and addition. These differences are assumed to be because of the time of the exposure of the intervention between the groups (Krog, 2015). Developing and strengthening these underlying skills are important for young children to better their contribution in academic acquisition and should be considered when wanting to conduct interventions to enhance the scholastic performance of children.

Body awareness

Movement facilitates the development of body awareness, which refers to self- concept (body image) and the intrinsic knowledge of the body (body schema). Adequate movement opportunities, experiences and success will aid in the development of body awareness. A positive body image and self-concept, which is an emotional advantage and encourages children to feel safe and in control of their movements (Honig, 2019). The lack of movement and failure could result in a negative body image, as well as not understanding how their body can move and what it can do (Krog, 2015). These are important skills during early childhood development in order to function optimally in a classroom environment because these skills help them feel good to learn and understand what their bodies need and can do in a learning environment.

Spatial awareness

Movement can assist young children in developing spatial awareness. Through movement, children gain knowledge on where his or her body and its parts are in a specific space and where parts are in relation surrounding objects. This is particularly significant when dealing with letter recognition and orientation of symbols on a page (Krog, 2015). The ability to write in between lines is reliant on satisfactory spatial awareness. Movement needs to occur for learners to develop these spatial concepts because they need to perceive objects in relation to their bodies and its parts before they can project this knowledge onto the orientation of objects (Burn, 2007; Nel *et al.*, 2013). Regular PA should be non-negotiable in an educational environment for young children in the development of underlying motor skills that benefits learning.

Visual skills

Visual skills are important for learning and movement. Binocular fusion refers to being able to move the eyes simultaneously. This impact reading ability, following movement in the class, following a moving object or completing a mathematical problem, such as number patterns and mathematical equations (Cheatum & Hammond, 2000; Kokot, 2006). Regular participation in activities such as hand-eye coordination or hand-foot coordination can better improve coordination of the eyes. During movement, direction, body, head and eye position changes, which lead to improvements of visual skills because of the association between the proprioceptive and vestibular system. Therefore, incorporating directionality, hand-eye coordination, balance and motor planning into lessons could reinforce visual skills (Kranowitz, 2005).

Proprioception skills

Proprioceptive skills are essential for learning and for control, fluidity and accuracy of movement (Chu, 2017). Proprioception refers to the conscious and subconscious knowledge of position of the body in space (Cheatum & Hammond, 2000; Chu, 2017). Proprioception largely derives from proprioceptors in the joint receptors, muscles spindles and Golgi tendon organs. Messages from proprioceptors are processed at various levels of the body (Chu, 2017). The vestibular and proprioceptive system work together to keep the body in balance and produce coordinated movements (Howe *et al*., 2017). Integrating information regarding the vestibular system, the joints from the proprioceptive system, balance can be maintained without visual feedback (Chu, 2017). Children that have proprioceptive difficulties tend to have difficulty with motor coordination and planning and tend to have poor postural control and balance (Chang *et al*., 2012). These children tend to bump into things and play roughly with others because of finding it difficult to discern between force variations when playing with others and objects (Parham & Ecker, 2007). Difficulty with proprioception has a negative impact on coordination (Fatoye *et al*., 2010), handwriting (Falk *et al*., 2010) and difficulty with the learning of new motor skills, which later lead to motor delays (Chu, 2017).

Vestibular system

The vestibular system is significant for balance control and gait. The vestibular system provides information on head orientation and allows for postural adaptation (Kingma, 2016). Movement and spatial awareness depend greatly on the vestibular system. To maintain balance and orientation, vestibular and visual information is used (Magnusson, 2016). Vestibular problems could lead to poor balance, coordination, balance and body control, which could affect young children's learning abilities and the learning of motor skills. These findings suggest that by stimulating and strengthening the vestibular system through movement could assist in postural control, balance, motor skills and learning (Pienaar, 2014; Madnusson, 2016).

LEARNING READINESS

During the fundamental phase of development, children's motor characteristics develop (Gallahue & Donnely, 2007). According to Gallahue and Donnely (2007) young children's perceptual-motor skills develop rapidly; however, difficulty exists with laterality, directionality, body awareness, spatial and temporal awareness. Control of movements is developing, as well as gross motor skills. At a cognitive level, children articulating themselves vocally and creativity is developed, and children use this to imitate actions or symbols learnt. Children are learning to identify right from wrong and the development of self, self-image and self-concept develops rapidly (Gallahue & Donnely, 2007).

The significance of early childhood movement is well known and should not be disregarded. This could be linked to the classroom environment and the impact teachers could have on children's PA. Often teachers do not have the knowledge regarding the impact of movement on young children (Krog, 2015), because of a lack of knowledge and training. From birth, children have the desire to move, while the schooling system is designed to have children sitting in a sedentary position for hours in the day. According to Hynes-Dusel (2002), many teachers believe that learning can only occur seated at desk.

Deprivation of a suitable environment appropriate for learning experiences can be detrimental to learning and could affect the development of the brain negatively (Leppo *et al*., 2000). Early childhood experiences are crucial to develop the child holistically (Krog, 2015). These experiences consist of neurological development and perceptual-motor development. This means the body is the nucleus for all intellectual processes of the knowledge acquired. Through the sensory-motor responses from the body, learning and organising in the brain can occur (Cheatum & Hammond, 2000; Goddard, 2002). This information indicates that creating movement opportunities in early childhood is crucial for motor development and learning. The school environment is the ideal setting for implementing movement opportunities (Donnelly & Lambourne, 2011; Andersen *et al*, 2015; Martin & Murtagh, 2017).

Children should be engaging in PA every day at a moderate-to-vigorous intensity to improve PA and improve academic outcomes (WHO, 2003; Coe *et al.*, 2006; Donelly & Lambourne, 2011). However, the impact of PF is not highlighted as to how it can affect health and academic achievement. Regular moderate-to-vigorous physical activity (MVPA) is well known to increase blood flow and improving oxygenation of the prefrontal cortex, which is important for cognition (Kato *et al.*, 2008). It causes increases in dopamine and norepinephrine that have immediate effects on enhancing attention and cognitive performance (Best, 2010). After observing levels of MVPA of two preschool children Larson *et al*. (2013) suggests that children were most active when collaborative play was on adult interaction contingent on MVPA.

Mullender-Wijnsma *et al*. (2015) indicated that MVPA should be a requirement to find positive results on cognition. The notion that learners with higher MVPA levels have significantly better grades than those with less or no MVPA is greatly supported (Tomporowski *et al*., 2008; Trudeau & Shephard, 2008). The Physical Activity Across the Curriculum (PAAC) programme consisted of regular MPVA over three years and found that the experimental group increased their learning performances significantly by 6% in comparison to the 1% decrease in the control group (Donelly & Lambourne, 2011; Martin & Murtagh, 2017). In a study by Andersen *et al*. (2015) the control group participated in regular MVPA and no effect was found in academic performance. Findings in the experimental group indicated improvements in those who had the weakest performance at baseline in numeracy, compared to the control group (Andersen *et al*., 2016). The intensive PA programme in the study of Van Deventer *et al*., (2014) included MPVA and although the results were not significant, improvements were found in the literacy and numeracy skills of the learners. According to Norris *et al*. (2015) there is limited studies suggesting that lessons incorporating PA into academic lessons increases MVPA. However, MVPA is critical for enhancing various health outcomes. Norris *et al*. (2015) goes on to suggest that the limited conclusions on MVPA indicated that physically active academic lessons could provide health benefits. Because many studies stressed the importance of the intensity of intervention programmes, it can be concluded that when designing and implementing an intervention programme the intensity is crucial for the effectiveness of the study outcomes.

Of all the physically active classroom studies that have been conducted, various study designs have indicated various results (Norris *et al*., 2015; Martin & Murtagh, 2017). Donelly *et al*. (2016) compiled a review on physically active studies and found mixed results. The study by Donelly *et al*. (2009) made use of a three-year cluster-controlled trial, which indicated significant results regarding reading, spelling and mathematics. Other studies that made use of a randomised cluster-controlled trail (Hollar *et al*., 2010; Erwin *et al*., 2013; Mullender-Wijnsma *et al*., 2016), all indicated improvements in areas of mathematics and/or reading and spelling. According to Donelly *et al*. (2016) and Martin and Murtagh (2017) studies that applied this design produced the best results and should be considered for future research.

There is a variety of support indicating the influence that PA could have on executive functions, physical fitness and scholastic performance. However, evidence of the effects on young children's reading, mathematics and spelling is still in its infancy. This is because of many inconsistencies in this field, and therefore, there is room for further meaningful research. Pesce *et al*. (2015) suggests that PA and cognitive training could be used as a means for intervention strategies for childhood and adulthood. The suggestion is based on shifting the focus from quantitative to qualitative interventions. By shifting to qualitative interventions, the skills taught require a higher cognitive effort or skill acquisition, such as in strategy games (Pesce *et al*., 2015). This notion can be used when implementing interventions combining PA and academic content because the exercises would require PA engaging with the academic content being taught. This differs from quantitative interventions that require minimal skill and repetitive exercises with the focus on cardiovascular function. Minimal cognitive effort is required for this type of intervention programmes. By combining PA and academic content, learners will be required to engage at a higher cognitive level (Pesce *et al*., 2015) during PA, which has shown to have positive outcomes on scholastic performance (Donelly *et al*., 2016).

THE EFFECTS OF PHYSICAL ACTIVITY COMBINED WITH ACADEMICS ON CHILDREN FROM DIFFERENT COMMUNITY BACKGROUNDS

It is essential to mention that numerous studies conducting class-based PA interventions have occurred in the US (Martin & Murtagh, 2017), and have included predominantly white children (Norris *et al*., 2015). Many studies have failed to include socio-economic status (SES), racial or socio-demographic knowledge regarding the children in these studies (Benjamin Neelon *et al*., 2018). Although Mullender-Wijnsma *et al*. (2016) did not comment on the ethnic or socio-demographic information of the children in their study, it is assumed that their parents were white, given the northern Netherlands geographic location (Benjamin Neelon *et al*., 2018). This is similar to the PAAC programme in the US by Donelly and Lambourne (2011), where 77% of the children were white (Benjamin Neelon *et al*., 2018). Both large-scale studies have indicated there are positive effects on academic achievement.

An earlier pilot study of Mullender-Wijnsma *et al*. (2015) found that their intervention positively affected time-on-task in both children without a social disadvantage and socially disadvantaged children. However, this is the only study and cannot be generalised to a wider population. Although poverty and social disadvantages are well known to have negative impacts on cognition, brain development and overall health, PA combined with academics in interventions could still be beneficial to children who are socially disadvantaged (Benjamin Neelon *et al*., 2018). This includes improving academic performance, PA and overall health. However, additional research is required to determine the potential positive influences on larger populations and inequalities in academic performance, overall health and PA levels (Benjamin Neelon *et al*., 2018). Further research is needed to determine how PF combined with academic subjects can influence academic performance and the PF of children who are socially disadvantaged.

Poverty and social disadvantages are known to negatively influence brain development, such as low neurocognitive functioning, as well as negatively impacting on executive function, language ability and recall by children (Benjamin Neelon *et al*., 2018). It can also manifest hostile home environments, such as violence at home and food deprivation (Chilton *et al*., 2007). It is suggested that children from lower income homes tend to show more behavioural problems (Dike, 2017). Bezold *et al*. (2008) found that the effects of the changes in fitness on changes in academic performance were stronger in high-poverty students in Grades K-12 in New York. This can affect children's overall health and ability to benefit from lessons combining PA and academic content.

It is known that poverty is associated with poor brain development and educational outcomes (Hair *et al*., 2015). Research has assumed that this is because of social and environmental factors, however, recent research has indicated the adverse effects poverty has on brain development (Hair *et al*., 2015). Research by Hair *et al*. (2015) measured the grey matter in the brain and found that children residing in poverty-stricken areas had lower developmental scores and lower volumes of grey matter. The research of Hair *et al*. (2015) in the US found that poverty mostly affects regions of the brain that are correlated with learning and cognitive development. Poverty stricken areas can, therefore, benefit from early interventions because these children are already in an environment that is not beneficial for their cognitive development and learning. Young learners in poverty-stricken areas should be exposed to as much learning interventions and environments to benefit their brain and overall development.

Poverty in SA has increased over the years (Meth & Dias, 2004), however, recent research has indicated that poverty has diminished since the early 2000s (Von Fintel *et al*., 2016). Many children are caught in a poverty trap in SA (Von Fintel *et al*., 2016). Hall and Sambu (2015) found that 54.3 % of all children in SA lived in homes that were not considered wealthy in 2013. Poverty has been linked to higher walking rates to school according to Su *et al*. (2013), which many times affect their absenteeism rate. Many children are kept out of school because of their home environments and responsibility of looking after ill family members (Boyes *et al*., 2015). In SA, many children in poverty-stricken areas must deal with social disadvantages, such as hostile home environments, violence, abuse and poor health care (Boyes *et al*., 2015). Poverty affects learners' mental and physical health (Lipina & Posner, 2012).

Recent reviews by Hackman *et al*. (2010) and Raizada and Kishiyama (2010) indicate that executive function processes and language are mostly influenced by SES. The learning environment plays an important role according to Bronfenbrenner's ecological systems model, which explores a variety of environmental factors, their intricacies and how these may affect child development or response in different situations (Keating *et al*., 2019). The exposure to motor, sensory, social stimulation are areas of plasticity that are affected by poverty (Sale *et al*., 2008; Lipina & Colombo, 2009). These studies suggested that excitement in the above-mentioned areas indicate changes in non-neural and neural mechanisms when associated with a deprived environment, therefore, suggesting the environment causes great changes to the functioning of these components. Studies with adult rodents found that enhancement improves neurogenesis linked with learning (Shors *et al*., 2001). This is contrary to stressful environments that seem to reduce neurogenesis (Gould *et al*., 1997); however, improvements can be seen if exposed to an enriched environment (Rieder, 2015). It is, therefore, important to enrich the environment of learners living in poverty to induce beneficial effects on their learning and development.

In SA, poverty is rampant, and many children are affected by it. Implementing early interventions into these communities can benefit their learning, academic performance, PF and overall health should, therefore, be considered important.

It is clear that many areas in this field of study needs investigation to provide conclusive results regarding the effect of integrating PF and academic content. More research is needed for the specific age group used in the current study. Many similar studies did not focus on this age group and development phase. Furthermore, more research is needed in SA on how PF can influence PF and academic success.

SUMMARY

Children in schools are not receiving the required amount of PA according to the WHO (WHO, 2005), and the DoE (DOE, 2011). Simultaneously, young children in SA are not reaching the academic requirements in formal schooling. Previous research has shown the beneficial association between PA and academic success (Tomporowski *et al*., 2008; Chang *et al*., 2012). There is a need to address these issues and to highlight the importance of PF for children and the benefits it could have on academic achievement. New interventions are needed to address these shortcomings (Mullender-Wijnsma *et al*., 2016). According to Donelly and Lambourne (2011) and Mullender-Wijnsma *et al*. (2015), physically active academic interventions have proven to be beneficial to increase PA and academic success in children in the US and Netherlands. However, few studies were conducted in SA that have shown significant results in combining PF in academic lessons to improve PF and numeracy and literacy. Therefore, more research is needed in SA on the benefits of physically active academic programmes on PF and academic achievements especially in younger children because of it being an unexplored field in the SA context.

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CHAPTER THREE

METHODOLOGY

RESEARCH DESIGN

The current study used a quasi-experimental design because the participants were not randomly selected. Quasi-experimental designs are defined as studies including pre-post interventions (Harris *et al*., 2006). According to Harris *et al*. (2006), such a design seeks to determine cause and effect between an intervention programme and the results. This study made use of an intervention (independent variable), to determine whether the specific outcome (dependent variable [fitness and academic performance]) occurred because of the intervention.

PARTICIPANTS

Grade 1 boys and girls (Table 1), aged 6, 7 and 8 years old, were invited to participate. Participants were selected from two local schools in Cape Town, Western Cape Province, South Africa, for financial and logistical reasons. Participants were not randomly selected because of the disruption it may have caused for the schools and teacher's programmes. Therefore, a sample of convenience was used. Two classes were randomly selected from all Grade 1 classes at the respective schools. Out of these two classes two groups were selected randomly in an attentional control (n=27 [girls]; n=24 [boys]) and an experimental group (n=32 [girls]; n=36 [boys]). The classes were listed, and two classes were randomly selected by choosing a random letter between A and E. Both schools where no-fee schools (Quintile 1), as classified by the Department of Basic Education (DoE) and English was the language of instruction. Quintile 1 indicate that these schools are in the poorest poverty ranking. Table 1 indicates the descriptive analysis of the participants from the selected schools. The attentional control group (n=51) was asked to participate in the pre- and post-tests but did not take part in the intervention programme. The attentional control group participated in a colouring-in activity, provided by the researcher, instead of the physically active academic lessons. The experimental group (n=68) participated in the pre- and post-tests, as well as the physically active academic programme. The intervention programme was presented to the attentional control group after post-testing. One participant from the experimental group was lost because of the learner changing schools and one participant was excluded from the control group because of absenteeism.

TABLE 1: **PARTICIPANTS**

GROUPS	BOYS	GIRLS	TOTAL	MEAN AGE (YRS)
Control	24	27	**51**	6.47
Experimental	26	32	**68**	6.48
TOTAL	**50**	**59**	**119**	

Inclusion criteria

- Learners had to be in Grade 1 at the time of data collection.
- Learners needed to attend the chosen schools.
- Parental consent needed to be provided.
- Learners needed give verbal consent and completed the assent forms.

Exclusion criteria

- If learners had any medically diagnosed learning delays, such as Developmental Coordination disorder, the parent/legal guardian had to confirm the condition.
- When he or she did not attend 20 out of 24 sessions or (90.9%).
- Learners refused to participate.
- Learners were sick and could not participate in the intervention.

PROCEDURES

CONSENT AND ASSENT

Parents/legal guardians received the consent forms two weeks before the intervention programme commenced, and their children were asked to return it to the teacher within the same week. Parents/legal guardians were literate in English and Afrikaans and were provided the contact details of the researcher for them to make contact for any clarification. The researcher explained the study and went through the assent form with the children to ensure good understanding. The children completed the assent forms after parental/legal guardian consent was received. This took place two weeks before the intervention began, and the assent forms were collected on the same day. The researcher returned to the schools every week to collect parent/legal guardian consent forms and to get assent from any child that was previously absent. In addition, the researcher obtained verbal consent in the classroom from each child to participate when assent forms were obtained. Each child was given an opportunity to ask questions.

MEASUREMENT TOOLS

FITNESSGRAM

The Fitnessgram was initially designed by Charles Sterling in 1977 (Meredith *et al*., 2006) as a physical fitness assessment and later it was referred to as a "report card". It is based on research and is dedicated to health-related physical fitness (Meredith *et al*., 2006). It is a standardised test battery devoted to delivering good quality physical fitness measurement tools and activity encouragement. It can be used as a feedback system to encourage incorporating physical activity (PA) into daily life and healthy PA across lifespan (Plowman & Meredith, 2013). The Fitnessgram was used in the current study for the pre- and post-tests to assess the PA levels of the selected participants.

TABLE 2: **FITNESSGRAM ITEMS (Meredith & Welk, 2010)**

		MUSCULAR STRENGTH, ENDURANCE AND FLEXIBILITY			
Aerobic Capacity:	**Body Composition:**	**Abdominal Strength and endurance:**	**Trunk Extensor and Flexibility:**	**Upper Body Strength and Endurance:**	**Flexibility:** (optional)
The PACER*	Skinfold measurements*	Curl-up*	Trunk-lift*	90° push-up*	Back-saver sit and reach

One-mile run	Body mass index			Modified pull-up	Shoulder stretch
The walk test				Pull-up	
				Flexed arm hang	

*Recommended activities

The Fitnessgram uses health standards to interpret physical fitness. These criterion-referenced standards are used to emphasise personal fitness for health goals instead of comparing learners according to group norms. These standards have been broadly validated over time (Plowman & Meredith, 2013). Reliability and validity are crucial for interpreting the results and trusting the outcomes. The Fitnessgram has classification consistency, intra- and inter-rater reliability (Plowman *et al*., 2013). Classification consistency relates to how the learner is classified into a category (e.g. pass/fail), on repeated administrations of a test. Inter-reliability refers to the consistency between two different testers administering the same test. Inter-reliability is achieved when two testers approve the analysis of test results. Intra-reliability refers to the one tester observing the performance of a learner and placing him or her in the same category every time (Jackson *et al*., 2010; Plowman & Meredith, 2013). Various studies indicate moderate to high r-coefficients for the Fitnessgram. Beets and Pitetti (2006) found an r-coefficient of 0.64 to 0.68 between 13- to 18-year-old learners, while Leger *et al*. (1988) found an r-coefficient of 0.89 between 6- to 16-year-old learners for the PACER test.

Validity is determined where there is a criterion to base the results on. Therefore, if a learner passed, he or she would have had to meet the criterion categorised as a pass and the same applies when a learner failed (Plowman & Mereidith, 2013). Liu *et al*. (1992) found a validity coefficient of 0.69 between 12- to 15-year-old learners for the PACER test, whereas other studies on adults have found validity coefficients between 0.83 to 0.93 (Brewer *et al*., 1988; Leger & Gadoury, 1989).

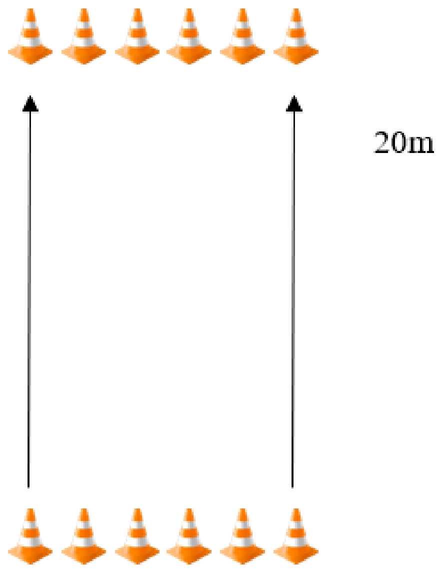
The Fitnessgram is scored per sub-category. The PACER assesses aerobic capacity and the score depends on the total number of laps completed. Skinfold measurements were excluded because of their invasive nature. BMI was used to assess body composition. The World Health Organization (WHO) (WHO, 2006), defines BMI as a simple measurement of weight-for-height ratio that is used to categorise overweight and obesity in adults. For children the weight-for-height ratio is also used and the combined standing height and body mass was used to calculate the BMI of each participant as per the formula, weight in kilograms divided by height in metres squared (Cole *et al*., 2000). The curl-up was used to measure abdominal strength and endurance and the number of correct curl-ups performed, with 75 being the maximum, was scored (Meredith & Welk, 2010). Learners could stop at any time. The trunk-lift was used to determine trunk extensor strength and flexibility of the erector spinae. These muscles are often weak in young children because they are still learning how to isolate them during PA (Plowman *et al*., 2015), and requires core strength in order to perform the trunk lift. This was scored by the distance in centimetres from the bottom of the chin to the ground, with the maximum score being 30.48cm (Meredith & Welk, 2010). The 90° push-up test was used to measure upper body strength. The learner needed to bend his or her elbows 90° parallel to the floor and scoring was based on the number of correct push-ups performed (Merdith & Welk, 2010). To measure flexibility the back-saver sit-and-reach test, and shoulder stretch tests were used. The back-saver sit-and-reach test measured centimetres on the left and right side. The score was taken to the nearest 1.27cm reached with a maximum of 30.48cm (Meredith & Welk, 2010). The shoulder stretch test was scored with a yes when the participant could touch the fingertips of both hands behind his or her back on both sides of the body and a no if they were unable to touch the fingertips of both hands (Meredith & Welk, 2010).

Jackson *et al*. (2010) conducted a study to test the reliability and validity of the Fitnessgram. They found it to be significantly reliable for the BMI $r > 0.90$, aerobic capacity $r > 0.80$ and r

> 0.70 for musculoskeletal fitness. According to Jackson *et al*. (2010) the validity of the Fitnessgram was found to be statistically significant because the indication of support suggests that teachers found results similar to the experts, namely: 0.85 for aerobic capacity; 0.96 for BMI; 0.64 for the curl-up; 0.76 for the push-up test; 0.93 for the shoulder stretch; 0.73 for the back-saver sit and-reach and lastly 0.71 for the trunk-lift.

In the current study, participants underwent a through a warm-up consisting of dynamic stretches and a light run about the court before completing the PACER 20, the aerobic capacity category of the Fitnessgram. The PACER test was explained to participants and the PACER test audio was played to all the participants before the test. Participants were allowed to ask questions about the test.

FIGURE 1: **THE PACER**



Participants had to begin running on the word start of the audio. They had to run from their starting cone to the 20m cone and wait for the audio tone signalling them to run again. Participants were allowed two failed laps before their lap count was completed (Meredith & Welk, 2010). Participants could stop the test whenever they wanted but were encouraged to do their best.

Participants meeting the inclusion criteria completed the anthropometric measurements, which included height and weight during week one and week 16. Height was taken barefoot with the learner standing against the wall with feet right up against the wall (Meredith & Welk, 2010). Height was taken using a standard tape measure. Weight was taken barefoot, and the participants had minimal clothing on. Participants had to stand still on the scale calibrated to 1kg. A standard scale was used to the nearest 1kg. BMI was then calculated and recorded on the Fitnessgram scoresheet. The Fitnessgram BMI charts were used to determine the Health Fitness Zone.

The curl-up, to test abdominal strength, was then demonstrated to the participants. Participants were told that they could stop the test whenever they wanted to; however, they were encouraged to do their best. Participants' curl-ups were recorded until they stopped or until they could not complete the curls-ups correctly after two corrections were given by the researcher. The correct amount of curl ups was recorded on the Fitnessgram sheet for each learner.

The researcher demonstrated the 90º push-up to the learners. Participants push-ups were recorded until they stopped or until they could not complete the push-ups correctly after two corrections. Participants were told they could stop the test at any time; however, they were encouraged to give their best efforts (Meredith & Welk, 2010). The correct number of push-ups was recorded on the Fitnessgram sheet.

The trunk lift was demonstrated to the learners and explained that it was to test their back muscles (erector spinae) and their trunk flexibility. Learners were asked to raise their chin as high off the ground as they could; measurement (cm) was taken from the distance on the ground to the chin with the use of a ruler (Meredith & Welk, 2010). The result was scored and recorded on the Fitnessgram scoresheet and the maximum score recorded was 30.48cm as per the standard criterion.

Flexibility of the hamstrings was measured with the sit-and-reach test. This test was demonstrated to the learners and emphasis was placed on the correct form being maintained throughout the test (Meredith & Welk, 2010). The sit-and-reach box were used for this test. Results were recorded on the Fitnessgram sheet and the maximum score recorded was 30.48cm as per the standard criterion.

The shoulder flexibility test was demonstrated to the learners. If learners' fingertips could touch on both the left and the right side, a yes was recorded. If fingertips could not touch, a no was recorded (Meredith & Welk, 2010).

VASSI Mathematical Proficiency Test

The VASSI is a South African test, administered in English, Afrikaans and Sesotho. It can be administered by educators or psychologists. The test was developed originally for diagnostic purposes (Vassiliou, 2003). The test is applicable for learners in Grades 1to 3 (Foundation Phase) and for Grade 4 to 7 (Intermediate Phase) learners. The test determines whether a learner experiences difficulty with mathematics, and if so, in which area the problems lies, such as: mathematical calculations, measurement, addition or number patterns (Vassiliou, 2003). The test can determine whether learners meet curriculum expectations and indicate which areas needs further assistance (Vassiliou, 2003). These cognitive processes refer to receiving, interpreting, organising, implementing, memory and problem-solving skills that are required for mathematical tasks (Vassiliou, 2003).

The norms are available per term to ensure that tests can be used at any time of the year. The test can be administered in groups or individually. The Grade 1 test was used in the current study and consisted of 20 questions. A 1 was allocated to each question if answered correctly and 0 for an incorrect answer. When part of the answer was wrong, the entire answer was marked as incorrect and received a 0. On some occasions, a unit (number) could be used to indicate an answer. If a learner wrote the number only, without the unit, a 1 was awarded if correct. Raw scores were summated from the correct marks. These scores were changes into a stanine and percentile rank using the given norm table and was completed at the bottom of the answer sheet for future reference (Vassiliou, 2003).

The Kruder-Richardson reliability coefficients for Grade 1 is 0.85. For Grades 1 and 3 the reliability is both greater than 0.85, indicating an excellent reliable score. The coefficients, therefore, indicate the test is reliable and measures consistently (Vassiliou, 2003). The test-retest reliability measures the test's stability. This is done when a test is administered at two separate times. According to Vassiliou (2003) the correlations for Grade 1 is 0,530 at p> 0.0001 between the initial and next administration of the test. These scores are greater indicating that the test-retest reliability was significant for Grade 1.

Prediction validity is calculated by correlating the obtained mark on the mathematics proficiency test at the beginning of the study with the latest school mathematics mark. Correlation coefficients for Grade 1 were 0.38 because p<0.001 indicated a medium effect size according to Steyn (1999), because it was above 0.1. Content validity is the degree in which test items are representative in terms of the curriculum and teaching objectives. This was determined through experienced educators in the field and the Mathematical Science Learning Facilitator of the Free State Education Department (Vassiliou, 2003).

During week 2, the learners in the current study completed the VASSI Mathematics Proficiency Test in their respective classrooms. The VASSI Mathematics test was completed at the same time for all learners in a classroom. The questions were read out to the learners and they had to write down their answer on the answer sheet. All forms were collected, and raw scores and stanines were recorded on the answer sheet. The answer sheets were all marked afterwards. A 1 was scored if an answer was correct and 0 for an incorrect answer. The raw scores and stanines were recorded to indicate the performances (Vassiliou, 2003).

ESSI Reading and Spelling Skills Test

The ESSI Reading and Spelling Skills Test is an assessment tool designed for diagnostic purposes in South Africa. This test was designed for the Grades 1to 3 (Foundation Phase) and

Grades 4 to 7 (Intermediate Phase) and is available in English and Afrikaans. The rationale for this test is based on the belief that reading and writing ability has an influence on academic achievement in language subjects. Therefore, assuming that if learners' experience difficulty in their reading and writing abilities, they too will experience other learning difficulties; thus, affecting their overall academic performance (Esterhuyse, 1997).

The spelling test was scored by allocating a 1 for a correct answer and 0 for an incorrect answer. All correct answers were summated to determine a raw score. This process follows for the reading test. The raw sore is then converted into a stanine (a normalised nine-point standard scale) by using the necessary norm table to interpret the results (Esterhuyse, 1997).

The Kuder-Richardson 20- reliability coefficient is used to calculate the different reading and spelling tests. If the coefficients are higher than 0.85, the tests may be accepted as reliable and implies internal consistency (Esterhuyse, 1997). For Grade 1, the r-coefficient for spelling is 0.79 and for reading it is 0.85 (Esterhuyse, 1997).

Taking the reading and spelling scores of the pre-test and correlating it with the end of term examination marks determined predictive validity. Experienced support teachers determined content validity and the preliminary word lists were submitted to experts before the lists were finalised (Esterhuyse, 1997).

During week 2, the learners completed the ESSI Spelling Test in their respective classrooms, which was administered by a teacher. The ESSI Spelling test was completed at the same time for all learners in the classroom. The words were read out to the learners and they needed to write down their answers on the answer sheet. All forms were collected, and raw scores and stanines were recorded on the answer sheet. The answer sheets were all marked afterwards. A 1 was scored if an answer was correct and 0 for an incorrect answer. The raw scores and stanines were recorded to indicate the performances (Esterhuyse, 1997).

After the completion of ESSI Spelling Test, each learner completed the reading test one at a time in their respective classrooms. The learners were provided a 15-word list and was asked to read out the words one by one, starting with number 1. A 1 was scored if the learner could read the word correctly and 0 if the learner could not read the word correctly. The raw scores and stanines were recorded to indicate the performances.

PROCEDURES ON TESTING DAYS

During week 1, participants were given a brief and simplified explanation of how weight and height will be measured. A clear explanation was given to the learners regarding the Fitnessgram test battery, the ESSI Reading and Spelling Test and the VASSI Mathematical Proficiency Test. The chance to ask any questions or express any concerns was given to all the learners.

INTERVENTION

The experimental group (N=68) participated in the intervention programme. Over the 16 weeks the participants participated in 24 combined PF and academic lessons of moderate to vigorous intensity for 30 minutes twice a week. The researcher designed and presented the lessons for both in and outside the classroom. The lessons were presented in the morning of the designated days of the week. Teacher participation was important to ensure that they were learning what kind of age appropriate PF they could include, while teaching mathematics and reading skills. This was done to facilitate the sustainability of the programme in these schools.

All tests and the intervention programme were done at the respective schools. The equipment was provided by the researcher and the Department of Sport Science, Stellenbosch University.

The intervention programme focused on PF components, sensory- and perceptual-motor skills that form the foundation for cognitive development, which is paramount for academic success (Kranowitz & Newman, 2010). The intervention programme focused on integrated activities that include a physical and cognitive approach. The activities focused on sensory and perceptual-motor skills such as: balance; directionality; midline crossing; laterality; overall coordination; spatial awareness; and body awareness. The activities also focused on numeracy and literacy and included number patterns, shape and space, as well as measurement and data handling for mathematics as per the curriculum (DoE, 2011; Cozens & Thomas, 2012). For English, the focus was on listening and reading with activities including sounding out of words and spelling of three- and four-letter words, combining letters to create words and learning the alphabet. Activities were in the form of fun games that integrated PF, sensory- and perceptual-motor skills and curricular content at moderate to vigorous intensity. It is the optimal intensity for learners aged 5 to17 years recommended by the WHO (2010).

The researcher used an integrated approach combining the bottom-up and top-down approaches for the intervention programme. The bottom-up approach focused on sensory integration and perceptual-motor learning by focusing on using sensory information that is interpreted and organised by the central nervous system to produce movement strategies (Pienaar, 2014). This approach was applied, and the focus was on improving mathematics, reading and spelling by emphasising the underlying motor skills such as: laterality; directionality; midline crossing; spatial awareness; body awareness; balance; and bilateral co-ordination (Van Deventer *et al*., 2014). The top-down approach was centred on the task, the cognitive orientation and problem-solving skills to organise and apply a suitable plan for effective implementation of a task (Pienaar, 2014). This approach was used with the focus on improving mathematics, reading and spelling by placing emphasis on numbers, shapes, letter formations and sounds with physical movement. This included PF tasks to specifically improve PF, strength and resistance activities, stretching and aerobic/cardiovascular fitness (Van Deventer, 2014).

ETHICAL CLEARANCE

The current study was presented to the Research Ethics Committee at Stellenbosch University. Ethical clearance (8867) was granted and permission from the Western Cape Education Department (WCED) and the principals of the respective schools were obtained. Participants and parents were informed about the current research and were asked if they would be willing to take part. Parental consent was granted, and each child gave informed assent to participate in the study verbally and in writing. Participants and parents were advised that they could withdraw from the study whenever they wished to do so without any fear of failure or judgement. All forms and assessment forms collected used a participant number for confidentiality purposes.

There was a qualified Kinderkineticist (SAPIK registrations number: 01/015/02/1516/005), who was trained in first aid on site for any medical assistance if needed. Each school had a sick bay that learners could go to if they fell ill or were injured. This research intervention was insured by the Stellenbosch University.

All data collected was stored on a password-protected laptop and kept confidential. Once the research is finalized, all data will be permanently deleted from the laptop and hard copies will be stored in a secured office at the Department of Sport Science, Stellenbosch University for a period of three years.

ASSUMPTIONS

In the current study, it was assumed that parents and teachers would encourage their children to participate. Furthermore, it was assumed that participant's best efforts would be given when performing the Fitnessgram test battery, the ESSI Reading and Spelling Test and the VASSI Mathematics Proficiency Test, and truly concentrate as best they could on what was required of them. It was also assumed that the participants' mathematical, reading, spelling and fitness performance would improve significantly after the 16-week intervention programme.

DELIMITATIONS

The current research study only made use of children that were from the selected primary schools who were 6, 7 and 8 years-old and in Grade 1 at the time of data collection.

STATISTICAL ANALYSIS

The statistical analysis was completed by Professor Kidd. Mixed model repeated measures ANOVA with group, time as fixed effects and the subjects as random effects was used for the statistical analysis. Possible effects of the intervention were investigated by checking if the group*time interaction was significant. Fisher LSD post hoc testing provided more detailed analyses of discrepancies in mean scores between groups and over time. A 5% significance level was used as a guideline for significant results.

SUMMARY

A quasi-experimental design was used in the current study, because the participants were not assigned randomly. Grade 1 learners (N=119) aged 6, 7 and 8-years old were invited to participate and were assigned to an attentional control group [n=51] and experimental group [n=68]. The Fitnessgram was used to assess body composition and physical fitness because of its' low costs. The VASSI Mathematics Proficient Test measured mathematical skills and reading and spelling was measured by the ESSI Spelling and Reading Test. The intervention programme was presented to the experimental group (N=68). Over the 16 weeks, participants participated in 24 combined academic lessons and moderate to vigorous-intensity PA for 30 minutes, twice a week. The intervention approach was an integrated approach combining the bottom-up and top-down approaches. Ethical clearance from Stellenbosch University and permission from principals and the WCED were granted.

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CHAPTER FOUR:

RESEARCH ARTICLE ONE

THE EFFECT OF A PHSYICALLY ACTIVE ACADEMIC INTERVENTION ON PHYSICAL FITNESS AND MATHEMATICAL PERFORMANCE OF GRADE 1 LEARNERS

The article will be presented for publication in the European Journal Sport Science and was presented according to the author guidelines of this journal (Appendix A) This chapter used to reference according to the specific journal and may differ from that used in other chapters of this thesis.

The effect of a physically active academic intervention on the physical fitness and mathematical performance of Grade 1 learners

Carynne Alison Fisher & Eileen Africa

Field of Study: Sport Science (Kinderkinetics)

Carynne Alison Fisher

Department of Sport Science

Stellenbosch University

Matieland

Republic of South Africa

7602

Tel: (+27) 74 929 0883

Email: fishercarynne@gmail.com

Eileen Africa

Department of Sport Science

Stellenbosch University

Matieland

Republic of South Africa

7602

Tel: (+27) 21 808 4591

Email: africa@sun.ac.za

The effect of a physically active academic intervention on the physical fitness and mathematical performance of Grade 1 learners

Carynne Alison Fisher & Eileen Africa

Department of Sport Science, Stellenbosch University, South Africa, 7600

Abstract

Combining physical fitness (PF) and academic content can be a beneficial way to improve PF and mathematic performance of young learners. The purpose of the current study was to establish whether a physically active academic intervention programme could have an effect on the PF and mathematics performance of Grade 1 learners over a period of 16 weeks. Grade 1 [N=119] learners from two schools in Cape Town, South Africa, volunteered to participate. They were assigned randomly to an attentional control [n=51] and an experimental group [n=68]. Pre- and post-test data were collected. The following measuring tools were used. The Fitnessgram was used to measure physical fitness. The VASSI Mathematics Proficiency Test measured mathematical performance. The results found that the experimental group performed significantly ($p<0.01$) better in mathematics and upper body strength. Therefore, it could be assumed that improvements in upper body strength and mathematics performance of Grade 1 learners was because of the physically active academic intervention programme. These findings contributed significantly to former research that incorporated physically active academic interventions and found that these interventions could combat low levels of PA and enhance mathematical performance of young learners. The current study adds meaningfully to South African Sport Science literature because it is one of few studies performed in this field that have produced significant results.

Key words: *physical activity, physically active academic intervention, mathematics, Grade 1 learners.*

4.1 Introduction

Globally Physical Education (PE) in schools have declined over the years (Donelly & Lambourne, 2011; Van Deventer *et al*., 2014). In many South African (SA) schools, including PE into the school day is not a priority for teachers (Van Deventer, 2009; Silva *et al*., 2017; Tian *et al*., 2017). This is in spite of the fact that the school environment poses the ideal space to increase physical fitness (PF) (Donnelly & Lambourne, 2011; Andersen *et al*, 2015; Norris *et al*., 2015; Martin & Murtagh, 2017). According to Spaull and Kotze (2014), children in SA are performing below expected mathematics levels for the first formal years of schooling. This is in agreement with the results of Pirjo *et al*. (2016) who found that in the early years of formal schooling learners are performing inadequately in mathematics in SA. Various researchers agree that supporting low-performing learners early on can prevent future difficulties with mathematics, and therefore, creative, non-expensive interventions are necessary (Jordan *et al*., 2010; Pirjo *et al*., 2016).

Lessons combining regular PA and academics can be a new inventive approach to improve PA levels and academic performance, specifically mathematics (De Greef, 2016). From the literature reviewed for the current study there is a consensus that the ideal for this new inventive approach to improve academic performance and PA, without reducing instructional time, is the school environment (Martin & Murtagh, 2017). However, it is not clear how this can impact on the PF of learners because previous research only measured PA and academic outcomes. According to Hansen *et al*. (2014), literature indicates that there are important assumptions regarding the relationship between PF/PA and academic performance. However, Donelly *et al*. (2016) indicates that these findings are inconsistent.

The effect of PF on academic achievement has had less attention (Donelly *et al*., 2016; Syvaoja *et al*., 2019). However, Chaddock *et al*. (2016) found that there was an increase of evidence regarding the positive associations between PF and improved academic performance. This illustrates that there is a growing need for further research in this field (Syvaoja *et al*., 2019) to find results that are more consistent. Buck *et al*. (2008) found that fitness was a predictor of cognitive performance in the Stroop test when age, IQ and BMI were assessed. Improving PF in children has indicated to increases blood flow leading to improved brain vascularization, which could cause improved academic achievement (Garcia-Hermoso *et al*., 2014). Bezold *et al*. (2014) conducted a 2-year longitudinal study and found that a higher composite of fitness tests (aerobic capacity, muscle strength and endurance), was related to improved academic scores in nine to 15-year-old learners in New York, US.

Of the few studies that have been conducted on physically active academic interventions, Donnelly *et al*. (2011) conducted an intervention programme titled, "Physical activity across the curriculum" [p.1] (PAAC) with Grade 2 and 3 learners. The intervention consisted of 90 minutes of moderate to vigorous PA (MVPA) per week to assess the impact of the PAAC on BMI and scholastic performance over three years. Donnelly and co-workers (2011) found that the programme had a beneficial impact on changes in BMI and scholastic performance in spelling, reading, mathematics and overall scores. However, there were no significant differences found in cardiovascular fitness.

Andersen *et al*. (2015) conducted a seven-month, cluster-randomised parallel group-controlled trial with fifth graders in Norway, titled Active Smarter Kids (ASK) [p.2]. The intervention consisted of physically active academic lessons three times per week, with a duration of 30 minutes; PA breaks during academic lessons for five minutes per day and PA homework for 10 minutes daily. The intervention included the schools' mandatory 90 minutes of PE per week. The findings indicate that ASK positively influenced the academic performance of learners and that the most effective environment to promote health initiatives that are achievable and flexible, is the school. This statement concurs with Donelly and Lambourne (2011), who believe that the school environment is advantageous for physically active academic interventions because they are cost effective, enjoyable for leaners and teachers and learners spend most of their time at school. Most importantly, this intervention type can reduce sedentary time and promote an increase in mathematics performance (Donelly & Lambourne, 2011). However, PF was not assessed to determine whether it contributed to these findings, and therefore, this is an area to be explored.

In SA few studies have implemented such an intervention within the school environment. Krog (2015) performed an intervention among Grade 1 learners, using speed-stacking cups to enhance academic performance. The intervention was implemented across three Grade 1 classes in Gauteng Province, SA, which was introduced for 20 minutes every day for eight weeks. The Grade 1 learners were divided into Group A and Group B. Group A participated in the intervention from week one to eight followed by eight weeks of normal classroom activity. Group B started with normal classroom activity for the first eight weeks and then participated in the intervention from week eight to 16. The results indicated an overall improvement for both groups in adding, subtraction, reading and reading Afrikaans. However, Group A that started in weeks one to eight showed better improvements indicating that the timing of the intervention was important (Krog, 2015).

Although the study by Krog (2015) was not very physically active inclined, the intervention included perceptual-motor skills such as laterality, directionality, crossing the midline, sequencing, patterning and perceptual- and visual-motor skills. It is well known that improving these skills can improve learning (Mandigan, 2009; Kruger, 2011; Pienaar *et al.*, 2011b; Coetzee *et al.*, 2015). The study of Krog (2015) targeted the same age group (Grade 1 learners). as the current study because there is a current lack of findings indicating whether these types of interventions are effective.

Early intervention is critical for young children because the immature brain is exceedingly adaptive and capable of captivating a great diversity of influences and experiences (Thompson, 2008). Therefore, early childhood presents the ideal chance for learners to develop their motor skills (Ratey & Hagerman, 2009). As early numeracy effectively predicts later mathematical performance (Jordan *et al*., 2010), incorporating physically active academic programmes from the first grade could be beneficial for mathematics.

4.2 Methodology

4.2.1 Research Design

A quasi-experimental design was implemented in the current study because the participants were not randomly selected. Harris *et al*. (2006) defines this type of design as studies including pre- and post-tests. This design is used to establish cause and effect between an intervention programme and the results (Harris *et al*., 2006). The current study used an intervention (independent variable) to establish whether the specific outcome occurred (dependent variable [physical fitness and mathematical performance]) because of the intervention.

4.2.2 Participants

Grade 1 learners (N=119), aged 6, 7 and 8 years-old were invited to volunteer to participate (Table 1). Participants were selected from two local schools in Cape Town, Western Cape Province, SA, for financial and logistical reasons. The participants could not be randomly allocated because of the disruptions it may have caused for the school day and teacher's programmes. Therefore, a sample of convenience was implemented. Two classes were selected from all the Grade 1 classes. Of those two classes, learners were assigned randomly into the attentional control group (n=27 [girls] n=24 [boys] and the experimental group (n=32 [girls] n=36 [boys]. Both schools were no-fees schools (Quintile 1), as classified by the Department of Basic Education (DoBE). In both schools English was the language of instruction.

TABLE 1: **PARTICIPANTS**

GROUPS	BOYS	GIRLS	TOTAL	MEAN AGE (YRS)
CONTROL	24	27	**63**	6.47
EXPERIMENTAL	36	32	**56**	6.48
TOTAL	**60**	**59**	**119**	

4.2.2.1 Inclusion criteria

Participants were included in the study if:

- they were in Grade 1 at the time of data collection;
- parental consent was provided; and
- learners gave verbal consent and completed the assent form.

Exclusion criteria.

Participants were excluded if:

- they had any medically diagnosed learning delays such as Developmental Coordination Disorder. This was confirmed with the parent/legal guardian. They were allowed to participate; however, their data was not used for this study;
- they did not attend 20 out of 24 sessions - 90.9%
- they refused to participate;
- they did not complete either the pre- or post-test; and
- they were sick and could not participate in the intervention.

4.2.5 Measurement Tools

4.2.5.1 The Fitnessgram

The Fitnessgram and Activitygram was initially designed by Charles Sterling in 1977 (Meredith *et al*., 2006), as a physical fitness assessment and then regarded as a "report card". It is based on research and it is dedicated to health-related physical fitness (PF) (Meredith *et al*., 2006). It is a standardised test battery devoted to delivering a good quality physical fitness measurement tool and activity encouragement. It can be used as a feedback tool to encourage people to incorporate physical activity (PA) into their daily lifestyle and invest in healthy PA across the lifespan (Plowman & Meredith, 2013). The Fitnessgram was used in the current study for the pre- and post-tests to assess the PA levels of the selected participants. The Fitnessgram use health standards, namely: Healthy Fitness Zone (HFZ), Needs Improvement (NI) and High-Risk Needs Improvement (HR-NI), to interpret PF. These criterion-referenced standards highlight fitness goals instead of comparing learners according to group norms. These standards have been extensively supported over time (Plowman & Meredith, 2013). Reliability and validity are crucial for interpreting the results and trusting the outcome. The Fitnessgram has classification consistency, intra- and inter-rater reliability (Plowman *et al*., 2013). Classification consistency relates to how a learner is classified into a category (e.g. pass/fail) on repeated administrations of a test. Inter-reliability refers to the consistency between two different testers administering the same test. Inter-reliability is achieved when two testers approve the analysis of test results. Intra-reliability refers to the one tester observing the performance of a learner and placing him or her in the same category every time (Jackson *et al*., 2010; Plowman & Meredith, 2013). Various studies indicate moderate to high r-coefficients for inter-reliability. Beets and Pitetti (2006) found 0.64 to 0.68 between 13- to 18-year-old learners, while Leger *et al*. (1988) found an r-coefficient of 0.89 between 6- to 16-year-old learners for the PACER test.

Participants went through a standardised warm-up of dynamic stretching and a run around the court before completing the PACER 20m (Figure 1), for the aerobic capacity category of the Fitnessgram. The PACER test was explained to learners and the PACER test audio was played to all the participants before the test. Learners were allowed to ask questions regarding the test.

Learners had to begin running on the word "start" of the audio. They had to run from their starting cone to the 20m cone and wait for the audio tone signalling them to run. Learners were allowed two failed laps before their lap count was completed (Meredith & Welk, 2010). Learners could stop the test when they wanted but were encouraged to do their best. According to the World Health Organization (WHO, 2006), BMI for children is a weight-for-height ratio and the standard deviations to the median are used to classify overweight and obesity. Therefore, the combined standing height and body mass was used to calculate the BMI of each participant as per the formula, weight in kilograms divided by height in metres squared (Cole *et al*., 2000). The Fitnessgram Healthy Fitness Zone standards were used to determine the BMI scores for the children in the study (CDoE, 2018). Table 4.2 indicated the components of the Fitnessgram that was assessed in the current study.

TABLE 2: **THE FITNESSGRAM**

		MUSCULAR STRENGTH, ENDURANCE AND FLEXIBILITY			
Aerobic Capacity:	**Body Composition:**	**Abdominal Strength and endurance:**	**Trunk Extensor and Flexibility:**	**Upper Body Strength and Endurance:**	**Flexibility:** (optional)
The PACER*	Skinfold measurements*	Curl-up*	Trunk-lift*	90° push-up*	Back-saver sit and reach
One-mile run	Body mass index			Modified pull-up	Shoulder stretch
The walk test				Pull-up	
				Flexed arm hang	

* recommended activities

VASSI Mathematical Proficiency Test

The VASSI Mathematics Proficiency Test (VMPT) is administered in English, Afrikaans and Sesotho in SA. Educators or psychologists can administer it. The test was developed originally for diagnostic purposes (Vassiliou, 2003). The test is applicable for Grades 1 to 3 (Foundation Phase) and Grades 4 to 7 (Intermediate Phases). The test determines whether a learner experiences difficulty with mathematics, and if so, in which area the problem resides, for example: mathematical calculations; measurements; addition; and number patterns (Vassiliou, 2003). The test can determine whether learners meet curriculum expectations and indicate which areas needs further assistance (Vassiliou, 2003).

During week 2, a qualified educator administered the VMPT to the participants in their respective classrooms. The VMPT was completed at the same time for all participants. The questions were read out to the participants and they had to write down their answers on the answer sheet. All forms were collected, and raw scores and stanines were recorded on the answer sheet.

4.2.6 Intervention

The learners in the experimental group (N=68) participated in the intervention. Over a period of 16 weeks, they were exposed to PA of moderate to vigorous intensity and academic lessons lasting 30 minutes, twice a week. The sessions were designed and presented by the researcher in and outside of the classroom. The intervention programme was designed using the integrated approach, which combined the bottom-up and top-down approaches. The bottom-up approach focused on sensory integration and perceptual-motor learning by using sensory information that is interpreted and organised by the central nervous system to produce movement strategies (Pienaar, 2014). The top-down approach focused on the task, the cognitive orientation and problem-solving skills to organise and apply the suitable plan for effective implementation of a task (Pienaar, 2014). Sugden and Wright, (1996) and Pienaar, (2014), suggest that this type of approach could lead to improvements in perceptual-motor skills and sensory integration because there is no single method that works with children who have various abilities

The lessons were presented in the morning of the designated days of the week. Teacher participation was important to ensure that they were exposed to age-appropriate PA that they could include when teaching mathematics thus, enabling the sustainability of the programme in the schools. Lessons were designed in such a way that it required no additional time, included content from the school curriculum at no additional cost and was convenient for both in and outdoor spaces.

The intervention programme focused on integrated activities that included a physical and cognitive approach, as well as sensory- and perceptual-motor skills that forms the foundation for cognition and intellect. This is paramount for academic progress (Kranowitz & Newman, 2010. The activities concentrated attention on sensory- and perceptual-motor skills, such as: balance; directionality; midline crossing; laterality; overall coordination; spatial awareness; and body awareness. It further included number patterns, shape and space, as well as measurement and data handling for mathematics as per the curriculum (DoE, 2011b; Cozens & Thomas, 2012). For English, the focus was on listening and reading and the activities included sounding out words and spelling of three- and four-letter words, combining letters to create words and learning the alphabet. The lessons were presented as fun games at moderate to vigorous intensity as recommended by WHO (2010). Moderate to vigorous intensity activity is assumed to be the optimal intensity for learners aged five to 17 years.

The intervention programme used an integrated approach combining the bottom-up and top-down approaches. Attention of these lessons were directed on improving mathematics, reading and spelling by placing emphasis on numbers, shapes, letter formations and sounds and combining it with physical movement. The latter included PA tasks specific to improving PF; strength and resistance activities, stretching and aerobic/cardiovascular fitness (Van Deventer, 2014).

4.2.7 Ethical Clearance

The research protocol of the current research was presented to the Research Ethics Committee of Stellenbosch University and ethical clearance was received (8867). Permission from the WCED and the principals of the respective schools were also granted. Parents/Legal guardians' provided consent for their children to take part in the study and all learners gave verbal consent, as well as written assent. Participants and parents were told that they could withdraw from the study at any time if they chose to do so, devoid of fear of failure or judgement.

4.2.8 Statistical analysis

Professor Kidd used the mixed model repeated measures ANOVA with group, time as fixed effects and the subjects as random effects for statistical analysis. Possible effects of the intervention were investigated by checking if the group*time interaction was significant. Fisher LSD post-hoc testing provided for more detailed analyses of discrepancies in mean scores between groups and over time. A 5% significance level was used as a guideline for significant results.

4.3 Results

4.3.1 Fitnessgram

The Fitnessgram results are introduced in Table 1. No statistically significant difference in BMI were found between the control (15.57+2.57) and the experimental group (15.92+2.36). This indicated that the learners were in the Health Fitness Zone. No statistical difference was found in the Aerobic Capacity test between the control (4.98+1.26) and the experimental group (7.51+2.25), although the experimental group demonstrated more improvements in their aerobic capacity test. The experimental group demonstrated statistically significant ($p<0.01$) improvements in the curl-up (6.16+2.84), in comparison to the control group (1.88+2.87) during the post-test. This indicates that the experimental group moved into the HFZ and the control group stayed in the Needs Improvement Zone. The 90º push-up results indicated that the experimental group improved (6.22+2.25) significantly ($p<0.01$) more than to the control group (1.17+2.74) during the post-test. No significant difference was found between the experimental (28.59+2.73) and control (27.48+3.57) group for the trunk-lift during the post-test. The results for the sit-and-reach flexibility test found no significant difference between the experimental (25.51+3.49) and control group (24.71+4.69).

TABLE 1: Fitnessgram performance between the control and experimental groups: Pre- and Post-test

FitnessGram	Pre (n)	Post (n)	Control Group (M+SD)	Pre-Test	Post-Test	p-Value
BMI	54	51	15.43+2.45	15.30+2.47	15.57+2.45	0.47
Aerobic Capacity	54	51	4.86+2.00	4.75+2.53	4.98+1.26	0.78
Curl-Up	54	51	1.84+2.55	1.81+2.24	1.88+2.87	0.85
Push-Up	54	51	1.89+3.35	1.29+2.54	1.17+2.74	0.33
Trunk-Lift	54	51	26.13+4.48	24.85+4.89	27.48+3.57	0.39
Sit-and-Reach	54	52	23.86+4.72	24.71+4.69	24.71+4.69	0.08
FitnessGram	**Pre (n)**	**Post (n)**	**Experimental Group (M+SD)**	**Pre-Test**	**Post-Test**	**p-Value**
BMI	69	68	15.92+2.36	15.68+2.26	16.16+2.44	0.47
Aerobic Capacity	69	68	7.36+2.93	7.21+3.49	7.51+2.25	0.78
Curl-Up	69	68	3.27+3.60	1.43+1.23	6.16+2.84	0.01*
Push-Up	69	68	3.51+3.4	0.85+1.89	6.22+2.25	0.01*

Trunk-Lift	69	68	27.64+3.35	26.71+3.65	28.59+2.73	0.39
Sit-and-Reach	69	68	23.91+4.20	22.33+4.26	25.51+3.49	0.08

*p<0.01

VASSI Mathematics Proficiency Test (VMPT)

Post intervention the ANOVA indicated significant improvements (p<0.01) in the VMPT of the experimental group (37.73+27.37) in comparison to the control group (14.07+13.93) (Figure 2). These results indicated that the experimental group performed in the average rank, whereas the control group was in the poor rank of the VMPT. The letters on the Figure 2 indicate the significant differences in the means that were derived from the Fisher LSD tables. The intervention group indicated overlapping letters “c” vs “a” indicating the p-value was <0.05 suggesting a significant distinction. The control group, on the other hand, indicated “b” vs “bc” suggesting that the p-value was >0.05.

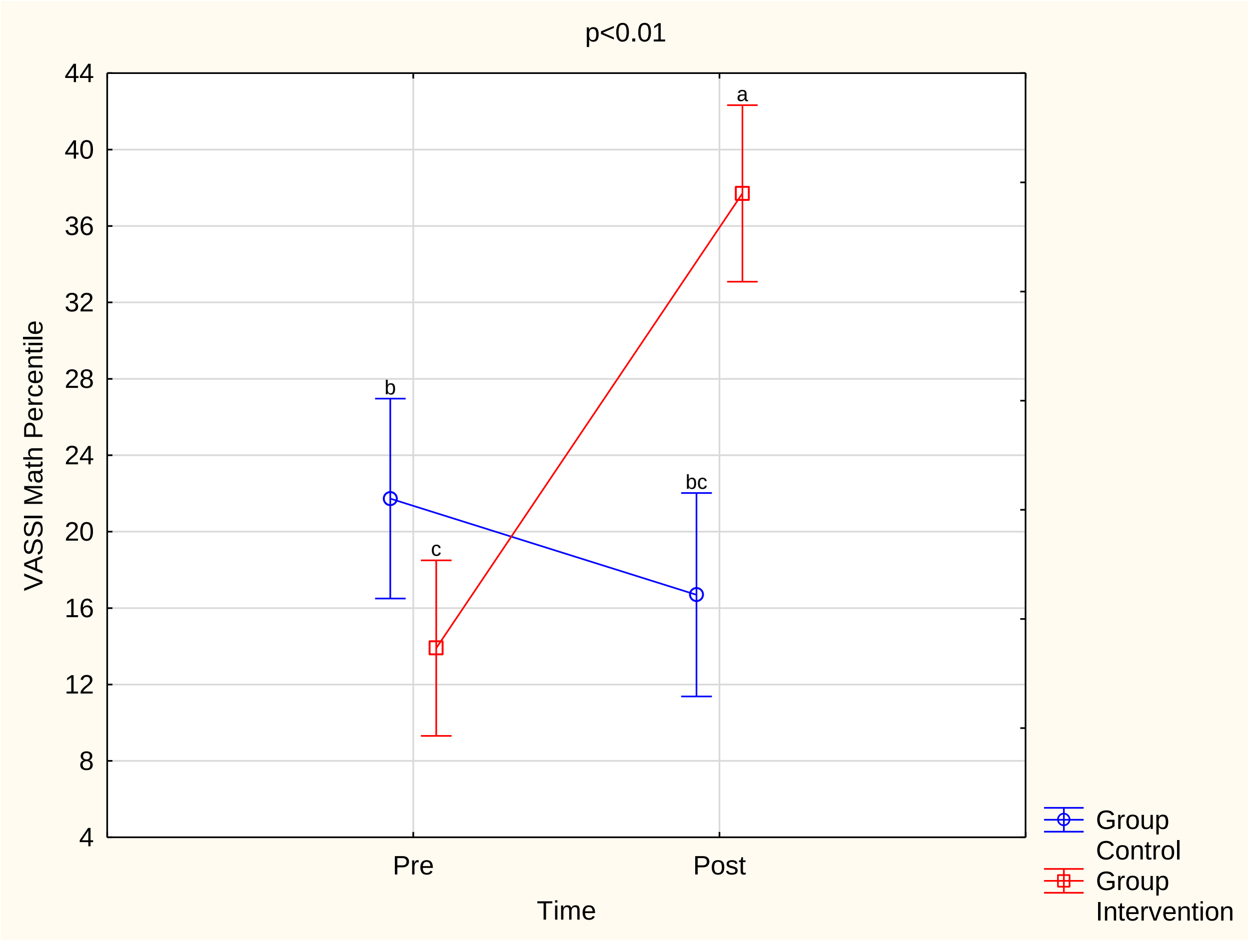

Figure 2: VASSI Mathematics Proficiency Test performance between the control and experimental groups

Regarding the VMPT performance within groups there was a statistically significant improvement in the experimental group ($p<0.01$) between the pre- and post-test. There seemed to be a decrease in the performance of the control group between the pre- and post- test, however, not statistically significant.

4.4 Discussion of results

Research by Mullender-Wijnsma *et al*. (2015) indicate that physically active academic interventions are a promising inventive way of presenting academic lessons and found that it could increase academic performance and PA levels. Few studies researched the potential benefits of physically active academic interventions on PF and scholastic performance in young learners (Donelly *et al*., 2009; Reed *et al*., 2010). The purpose of the current research was to assess if a physical active academic intervention could enhance PF and academic performance of Grade 1 learners.

In the current study, it appears that the intervention programme showed a statistically significant improvement in two of the six subtests of the Fitnessgram namely; upper body strength and endurance and abdominal strength and endurance. The results in Table 2 also show that the experimental group improved more than the control group in five the six subtests (aerobic capacity, abdominal strength and endurance, upper body strength and endurance, trunk extensor and flexibility, and flexibility), which indicate that there were practical improvements. Therefore, it can, be assumed that the intervention programme succeeded in improving upper body strength endurance and abdominal strength and endurance based on these findings.

These results indicated that the control group was in the Needs Improvement Zone and the experimental group was in the Health Fitness Zone. This indicates that the experimental group performed significantly better than the control group. These significant changes are associated with the exposure to the physically active academic intervention programme and suggests that if it is implemented correctly, it can increase strength and improve overall PF. While there were no significant discrepancies found in BMI, trunk-lift, sit-and-reach flexibility and shoulder flexibility, the results indicated that better improvements were found in the experimental group than in the control group in these subtests, which is a practical finding. This is similar to the results of Garcia-Hermoso *et al*. (2017) who found that BMI was not a strong predictor of academic achievement. Pienaar *et al*. (2015) also found no significant findings for flexibility in the Fitnessgram subtests.

Statistically significant improvements were found in the VMPT of the experimental group in comparison to the control group. Mullender-Wijnsma *et al*. (2015) found increases in general mathematics and mathematics speed tests after a physically active academic intervention. The current study, therefore, agrees to findings, which contributes greatly to this field as studies like that of Reed *et al*. (2010), who did not find a significant improvement in mathematics after exposure to an intervention.

Noteworthy improvements in the VMPT and upper body strength is an indication that the improvements were a result of the intervention. The quasi-experimental design of this research, therefore, indicated that improvements in the experimental group, in comparison to the control group, were because of the intervention programme (Donelly *et al*., 2015; Mullender-Wijnsma *et al*., 2015). The experimental group performed better in the mathematics test and in strength according to the results of the current study. No statistically significant discrepancies in BMI were found between the groups. Research by Mullender-Wijnsma *et al*. (2015), found similar results whereby the BMI between the intervention and control group in the first year of the PAAC were not significant different. However, if the intervention was implemented for an extended period, it could have had longer lasting and significant effects (Mullender-Wijnsma *et al*., 2015).

The assessment tools used in this current study mimics that of those used in other studies. However, some of these studies did not find significant results. This includes the study by Van Deventer *et al*. (2014) who made use the VMPT but found no significant results between the integrated program group and the intensive program group. Similar research combining academic content and PA showed similar significant results because of the intervention programme (Donelly & Lambourne, 2011; Mullender-Wijnsma *et al*., 2015; Norris *et al*., 2015).

Various studies used the Fitnessgram to measure the PF levels of children. Bai *et al*. (2015) assed the prevalence of youth fitness in the US using the Fitnessgram. Pienaar *et al*. (2011a) determined the association between physical fitness and academic achievement in SA with the use of the Fitnessgram among primary school children. The results displayed a significant association between academic performance and overall strength scores. This coincides with the findings of the current study that strength and academic achievements were significant for the experimental group.

The PACER aerobic capacity results were not significant in this study, however, the experimental group performed better in both the pre- and post-test than the control group. For flexibility between the experimental and control group, no significant differences were found. It is notable that the girls of the experimental group had a lower trunk-lift score at the pre-test, showed improvements after exposure to the intervention programme. Within both the control and experimental group improvements from the pre- to the post-test for the sit-and-reach test were found. These findings agree with Pienaar *et al*. (2011a), who displayed no significant results in BMI, aerobic capacity and overall flexibility of 9-to-11-year-old learners. This could lead to future research doing a longer intervention or to follow up on the groups to further determine any long-term effects of the intervention.

4.5 Conclusion

The main findings of the current study were that improvement in academic mathematics and upper body strength following a physically active academic intervention in the experimental group. Mullender-Wijnsma *et al*. (2015) and Donelly and Lambourne (2011), found similar results following a physically active academic intervention. This study contributes to the notion that physically active academic interventions can be beneficial in the school environment to improve PF of young learners, which does seem to have been determined in previous studies. The current study's results suggest that physically active academic interventions can have significant effects on mathematics. These findings also contribute significantly to the field of study that explores whether interventions integrating PF into academic lessons are beneficial for young children's PF and mathematical achievements. In conclusion, it can be suggested that the results found in the current study agree with various studies in showing that physically active academic interventions can be effective in improving mathematical performance and that PF can be a contributing factor.

4.6 Limitations

This study only made use of children that were from the primary schools in question. The study only made use of 6, 7 and 8 years-old children in Grade 1. Teacher involvement was less than anticipated because of external factors, such as having to look after learners from other classes because of absent teachers. Wet weather conditions did not allow some sessions to occur outside as planned. Protests in the local area did not allow some sessions to occur because the researcher was not allowed into the area by the local police. However, only 8.33% of intervention times was lost, and therefore, more than 90% of the intervention took place. This could not be predicted and could not be controlled. Teachers of the experimental group were newly qualified, and therefore, were not experienced teachers. Furthermore, the reading test only measured word recognition and not understanding because the learners were only required to read a list of words and not a comprehensive text.

4.7 Recommendations

There is room for future research to extend the research scope and determined more consistent findings on how integrating PF and mathematical content can beneficially impact PF and mathematics performance. Future research could implement a longer intervention to determine how this can affect overall PF and mathematical performance. When working with schools, it might be noteworthy to begin the intervention at the beginning of the academic year to determine whether the timing of the intervention is influential on the findings. A larger sample size will be beneficial for future research to better understand of this field and for generalisation. It is recommended that future research follow up on the groups that were involved to determine if there were any long-term effects of the intervention programme. More teacher involvement in the implementation of these interventions should be explored to determine its effects and how teacher's influence learners regarding the intervention. Future research should consider assessing motor proficiency in addition to physical fitness to measure the effects on motor proficiency.

One can attain that integrating PF and academic content can increase the PF of learners greatly and have a constructive influence on academic success. However, these benefits can differ in terms of the length of the intervention, the design, the assessment tools used, and the nature of the intervention implemented.

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CHAPTER FIVE:

RESEARCH ARTICLE TWO

A PHYSICALLY ACTIVE ACADEMIC INTERVENTION TO IMPROVE PHYSICAL FITNESS, READING AND SPELLING PERFORMANCE OF SELECTED GRADE 1 LEARNERS

The article will be presented for publication in the Journal of Paediatrics. The article was presented according to the author guidelines of this journal (Appendix A This chapter used to reference according to the specific journal and may differ from that used in other chapters of this thesis.

A physically active academic intervention aimed at physical fitness, reading and spelling performance of selected Grade 1 learners

Carynne Alison Fisher & Eileen Africa

Field of Study: Sport Science (Kinderkinetics)

Carynne Alison Fisher

Department of Sport Science

Stellenbosch University

Matieland

Republic of South Africa

7602

Tel: (+27) 74 929 0883

Email: fishercarynne@gmail.com

Eileen Africa

Department of Sport Science

Stellenbosch University

Matieland

Republic of South Africa

7602

Tel: (+27) 21 808 4591

Email: africa@sun.ac.za

A physically active academic intervention aimed at physical fitness, reading and spelling performance of selected Grade 1 learners

Carynne Alison Fisher & Eileen Africa
Stellenbosch Department of Sport Science, Stellenbosch University, South Africa, 7600

Abstract

The incorporation of physical activity (PA) into academic lessons has previously been researched, however, the results of these studies have been inconsistent and PA rather than physical fitness (PF) has been measured. The aim of the current study was to establish the benefits of a physically active intervention programme on the reading and spelling performance and PF of Grade 1 learners over a 16-week period and to determine if there were any differences between genders. The study sample [N=119] from two primary schools in Cape Town, Western Cape Province, South Africa, was conveniently selected and the classes were randomly selected into an attention control group [n=51] and an experimental group [n=68]. The Fitnessgram was used to assess PF and body composition, respectively. The ESSI Reading and Spelling Test was used to assess literacy. Pre- and post-intervention data were collected. Over a period of 16 weeks, the intervention programme consisted of 30-minute lessons twice a week. The programme focused on PF, aerobic capacity and the academic content of the curriculum. The results of the current study found significantly ($p<0.01$) better reading and upper body strength performances in the experimental group compared to the control group. Inherently, differences between the boys and girls were not significant. The physically active academic intervention was successful in improving reading and strength performance in the selected Grade 1 boys and girls. Hence, the current study suggests that physically active academic lessons could be a creative way to increase the PF and reading achievements of children, regardless of gender.

Key words: *physical activity, physically active academic intervention, mathematics, academic performance, Grade 1.*

5.1 Introduction

The association between PA and academic performance has been well researched and many studies indicate that regular PA could have a constructive impact on academic performance (Tomporowski *et al*., 2011; Howie & Pate, 2012). However, little research was conducted on the integration of PF in academic content could affect academic performance, especially reading and spelling. This is a great academic focus for Grade 1 learners in South Africa (SA) (DoE, 2011; Cozens & Thomas, 2012). In SA, the Department of Education (DoE), however, only allocates two hours per week for PE in Grade 1 (DoE, 2011; Tian *et al*., 2017). However, in many schools, there is not enough time for teachers to include PE into the academic day (Van Deventer, 2009; Silva *et al*., 2017; Tian *et al*., 2017). Therefore, it seems as if children do not participate in the PE as required by the curriculum.

According to the literature a difference exists between PA levels and academic performance among girls and boys from elementary, junior/middle, high school and college (Voyer & Voyer, 2014; Cooper *et al*., 2015). Earlier literature provided various explanations as to why girls are less physically active than boys (Telford *et al*., 2016). Grade 2 girls performed better in spelling than boys after an integrated programme that focused on sensory- and perceptual-motor skills according to a study conducted by Van Deventer *et al*. (2014) in SA. According to Telford *et al*. (2016) it is a consistent finding in literature that girls are less active than boys, which can furthermore impact academic performance. Furthermore, recent research has indicated that in schools and family boys are encouraged more to participate in PA in comparison to girls, (Costill & Best, 2016). If this is the case and teachers are not finding time to teach PE in schools, this could lead to girls being less active later in life. Bezold *et al*. (2014)

conducted a 2-year longitudinal study with nine to 15-year-old learners in New York, US and found that a higher composite of fitness tests (aerobic capacity, muscle strength and endurance) was linked to improved academic scores.

The problem, however, is that schools are not incorporating sufficient PE for young children because their focus is on academic achievements (Howie & Pate, 2012; Van Deventer *et al*., 2014). Madigan and Hess (2009) emphasise that motor development forms the basis for academic concepts, such as reading. This is consistent with the findings from studies by Krog and Kruger (2011) and Coetzee *et al*. (2015), who purport that perceptual-motor skills are requirements for learning readiness and cognitive functions, such as memory and awareness (Gallahue & Ozmun, 2006). Perceptual-motor skills can affect letter discrimination and can, therefore, impact reading and spelling abilities. Reading performance has proven the seriousness of the literacy problem for South African learners and that there is a need for solutions (Naidoo *et al*., 2017). Because a focus on literacy and numeracy is an ongoing issue in the first formal years of schooling in SA, it creates space for physically active academic interventions.

PF is beneficial for children because it lowers the risk of cardiovascular disease, obesity, bone and musculoskeletal function (Lippincott *et al*., 2006). PF also has psychological effects, such as decreasing stress, anxiety, depression, improving self-confidence and quality of life, which could lead to improved academic performance. Various studies found a positive association between PF and academic performance (Buck *et al*., 2008; Hansen *et al*., 2014; Garcia-Hermoso *et al*., 2017), however, there were no interventions that incorporated PF in academic lessons.

A strategy to combine PF and academic lessons can be a new innovative teaching strategy to increase PF, reading and spelling performance (De Greef, 2016). From the literature there is a need for further research to determine the effects of PF and academic content on academic performance. Further research is also required to bridge the gap between PF and PA difference found between boys and girls (Costill, 2016; Telford *et al*., 2016).

5.2 Methodology

5.2.1 Research Design

The current study used a quasi-experimental design because randomly selection of the participants were not possible. Quasi-experimental designs are described as pre- and post-test studies (Harris *et al*., 2006). The purpose of the design is to determine cause and effect between an experimental intervention and the result thereof (Harris *et al*. (2006). The independent variable in this was the intervention used to determine whether the specific outcomes; PF, reading and spelling performance, which is the dependent variable, occurred because of the intervention.

5.2.2 Participants

Grade 1 learners (N=119) aged 6, 7 and 8 years-old were invited to participate. Participants were selected from two local schools in Cape Town, Western Cape Province, SA, for logistical and financial reasons. The participants were not randomly allocated because of the disruptions it may have caused because of the daily running of the schools and teacher's programmes. Hence, a sample of convenience was used. Classes were randomly assigned into an experimental and attentional control group. Table 1 indicates the distribution of girls and boys in the experimental and attentional control group. Both schools where no-fees schools (Quintile 1) as classified by the Department of Education (DoE). Schools in SA are ranked into poverty ranking (Quintile 1-5), with Quintile 1 being the poorest schools. English was the language of instruction.

TABLE 1: **PARTICIPANTS**

GROUPS	**BOYS**	**GIRLS**	**TOTAL**	**MEAN AGE (YRS)**
Experimental	36	32	**68**	6.47
Control	24	27	**51**	6.48
TOTAL	**60**	**59**	**119**	

5.2.2.1. Inclusion criteria

Participants were included in the study if:

- they were in Grade 1 at the time of data collection;
- they attended the selected schools;
- parental and/or legal guardian consent was provided; and
- they gave verbal consent and completed the assent forms.

5.2.2.2 Exclusion criteria

Participants were excluded if they:

- had any medically diagnosed learning delays such as Developmental Coordination Disorder. This was confirmed with the parent/legal guardian. They were not excluded from participating; however, their data was not used for this study;
- did not attend 20 out of 24 or 90.9% of the sessions;
- refused to participate
- did not complete either the pre- or post-test; and
- they were sick and could not participate in the intervention.

5.3 Measurement Tools

5.3.1 The Fitnessgram

The Fitnessgram and Activitygram was initially designed by Charles Sterling in 1977 (Meredith *et al*., 2006) as a physical fitness assessment and then regarded as a "report card". They are based on research and is dedicated to health-related physical fitness (Meredith *et al*., 2006). It is a standardised test battery devoted to delivering a good quality physical fitness measurement tool and to encourage activity A. It can be used as a feedback tool to encourage incorporating PA into daily life and healthy PA across the lifespan (Plowman & Meredith, 2013). The Fitnessgram was used in the current study for the pre- and post-tests to assess the PA levels of the selected children. The Fitnessgram uses health standards namely: Healthy Fitness Zone (HFZ); Needs Improvement (NI); and High-Risk Needs Improvement (HR-NI) to interpret PF. These criterion-referenced standards are there to highlighting fitness goals instead of comparing learners according to group norms. These standards have been extensively supported over time (Plowman & Meredith, 2013). Reliability and validity are crucial for interpreting the results and trusting the outcomes. The Fitnessgram has classification consistency, intra- and inter-rater reliability (Plowman *et al*., 2013). Classification consistency relates to how the learner is classified into a category (e.g, pass/fail), on repeated administrations of a test. Inter-reliability refers to the consistency between two different testers administering the same test. Inter-reliability refers to the consistency between two different testers administering the same test. Inter-reliability is achieved when two testers approve the analysis of test results. Intra-reliability refers to the one tester observing the performance of a learner and placing him or her in the same category every time (Jackson *et al*., 2010; Plowman & Meredith, 2013). Various studies indicate moderate to high r-coefficients for the PACER test. Beets and Pitetti (2006) found 0.64 - 0.68 between 13- to 18-year-old learners, while Leger *et al*. (1988) found an r-coefficient of 0.89 between 6- to 16-year-old learners for the PACER test.

Participants went through a warm-up consisting of dynamic stretching and running one lap before completing the PACER 20m for the aerobic capacity category of the Fitnessgram (Figure 1) participants before the test. Learners could ask questions regarding the test if they wished. Learners had to start running on the word start of the audio. They had to run from their starting cone to the 20m cone and wait for the audio signalling them to run. Learners were allowed two failed laps before their lap count was completed (Meredith & Welk, 2010). Learners could stop the test whenever they wanted but were encouraged to do their best.

From the height and weight measured, BMI was determined. BMI for children is a weight-for-height ratio and the standard deviations to the median are used to classify overweight and obesity (WHO, 2006). Therefore, the combined standing height and body mass was used to calculate the BMI of each participant as per the formula, weight in kilograms divided by height in metres squared (Cole *et al*., 2000). The Fitnessgram, Healthy Fitness Zone standards were used to determine the BMI scores for the children in the study (CDoE, 2018). Table 2 indicate the subtests of the Fitnessgram that was assessed in the current study.

Table 2: The Fitnessgram subtests

		MUSCULAR STRENGTH, ENDURANCE AND FLEXIBILITY			
Aerobic Capacity:	**Body Composition:**	**Abdominal Strength and endurance:**	**Trunk Extensor & Flexibility:**	**Upper Body Strength and Endurance:**	**Flexibility:** (optional)
The PACER*	Skinfold measurements*	Curl-up*	Trunk-lift*	90° push-up*	Back-saver sit and reach
One-mile run	Body mass index			Modified pull-up	Shoulder stretch
The walk test				Pull-up	

				Flexed arm hang	

*recommended activities

5.3.3 ESSI Reading and Spelling Skills Test

The ESSI Reading and Spelling Skills Test is an assessment tool designed for diagnostic purposes in SA. This test was designed for Grades 1 to 3 (Foundation Phase) and Grades 4 to 7 (Intermediate Phase) and is available in English and Afrikaans. The rationale for this test is based on the belief that reading and writing ability has an influence on academic achievement in language subjects. Therefore, assuming that if learners' experience difficulty in their reading and writing abilities, they too will experience other learning difficulties; thus, affecting their overall academic performance (Esterhuyse, 1997).

5.3.4 Intervention

The experimental group (N=68) participated in the intervention programme, which involved PA of moderate to vigorous intensity combined with academic lessons for 30 minutes twice a week. Sessions were designed and presented by the researcher in and outside the classroom. Teachers were included during the presentation of the lessons to ensure the sustainability of the programme in these schools. Lessons were designed in a way that required no additional time, included content from the school curriculum and was appropriate for both indoor and outdoor spaces. The integrated approach was used to design the intervention programme, which combined the bottom-up and top-down approaches. The bottom-up approach focused on sensory integration and perceptual-motor learning by using sensory information that is interpreted and organised by the central nervous system to produce movement strategies (Pienaar, 2014). The top-down approach was centred on the task, the cognitive orientation and problem-solving skills to organise and apply the suitable plan for effective implementation of a task (Pienaar, 2014). Sugden and Wright, (1996) and Pienaar, (2014) suggest that this type of approach could lead to improvements in perceptual-motor skills and sensory integration because there is no single method that works with learners who have various abilities.

The intervention programme focused on perceptual-motor skills that forms the foundation for cognition and intellect, which is paramount for academic success (Kranowitz & Newman, 2010). The intervention followed an integrated approach combining the top-down and the bottom-up approaches. The focus was on improving reading and spelling by placing emphasis on letter formations and sounds incorporated in PA.

5.3.5 Ethical Clearance

The research protocol of the current research was presented to the Research Ethics Committee of Stellenbosch University and ethical clearance was received (8867). Permission from the WCED and the principals of the respective schools was also granted. Parents/Legal guardians' consent was given by parents for learners to take part in the study and all learners gave verbal consent, as well as written assent. Participants and parents were told that they could withdraw from participating in the study at any time if they chose to do so devoid of fear of failure or judgement.

5.3.6 Statistical analysis

Professor Kidd used the mixed model repeated measures ANOVA with group, time as fixed effects and the subjects as random effects for statistical analysis. Possible effects of the intervention were investigated by checking if the group*time interaction was significant. Fisher LSD post-hoc testing provided for more detailed analyses of discrepancies in mean scores between groups and over time. A 5% significance level was used as a guideline for significant results.

5.4 Results

The results are displayed as means and standard deviations of the Fitnessgram in Table 2. BMI showed no statistically significant differences between the control (15.57+2.57) and the experimental group (15.92+2.36) post intervention. The results indicated that the learners were in the Health Fitness Zone (HFZ). The Aerobic Capacity test results found no significant difference between the control (4.98+1.26) and the experimental group (7.51+2.25) post intervention, although the experimental group showed better improvements post intervention. Significant improvements ($p<0.01$) were found in the experimental group in the curl-up test (6.16+2.84) in comparison to the control group (1.88+2.87) post the intervention. The experimental group results showed that they moved into the HFZ and the control group remained in the Needs Improvement Zone. The results of the 90^{o} push-up indicated that the experimental group improved (6.22+2.25) significantly after the intervention ($p<0.01$) compared to the control group (1.17+2.74). There was no significant difference between the experimental (28.59+2.73) and control (27.48+3.57) group for the trunk-lift post intervention. No significant differences were found for the results post intervention for the sit-and-reach test between the experimental (25.51+3.49) and control group (24.71+4.69).

Table 3: Fitnessgram performance between the control and experimental groups

Fitnessgram	Pre (n)	Post (n)	Control Group (M+SD)	Pre-Test	Post-Test	p-Value
BMI	54	51	15.43+2.45	15.30+2.47	15.57+2.45	0.47
Aerobic Capacity	54	51	4.86+2.00	4.75+2.53	4.98+1.26	0.78
Curl-Up	54	51	1.84+2.55	1.81+2.24	1.88+2.87	0.85
Push-Up	54	51	1.89+3.35	1.29+2.54	1.17+2.74	0.33

Trunk-Lift	54	51	26.13+4.48	24.85+4.89	27.48+3.57	0.39
Sit-and-Reach	54	51	23.86+4.72	24.71+4.69	24.71+4.69	0.08
Fitnessgram	Pre (n)	Post (n)	Experimental Group (M+SD)	Pre-test	Post-test p-Value	
BMI	69	68	15.92+2.36	15.68	2.26	0.47
Aerobic Capacity	69	68	7.36+2.93	7.21+3.49	7.51+2.25	0.78
Curl-Up	69	68	3.27+3.60	1.43+1.23	6.16+2.84	0.01*
Push-Up	69	68	3.51+3.4	0.85+1.89	6.22+2.25	0.01*
Trunk-Lift	69	68	27.64+3.35	26.71+3.65	28.59+2.73	0.39
Sit-and-Reach	69	68	23.91+4.20	22.33+4.26	25.51+3.49	0.08

* = p<0.01

No statistically significant difference was found in the ANOVA regarding spelling performance (Figure 2), between the control and experimental group (p=0.03) after the intervention. Although the experimental group showed no significant differences, they showed better improvements (40.70+25.78) than the control group (14.34+15.74) post intervention. The experimental group moved to the 40-percentile rank indicating that they improved from poor to average in the spelling test, while the control group remained in the poor rank. The experimental group indicated overlapping letters “c” vs “c” in the pre-test and “a” vs “b” in the post-test, which indicates no statistically significant difference shown as a p-value of >0.05.

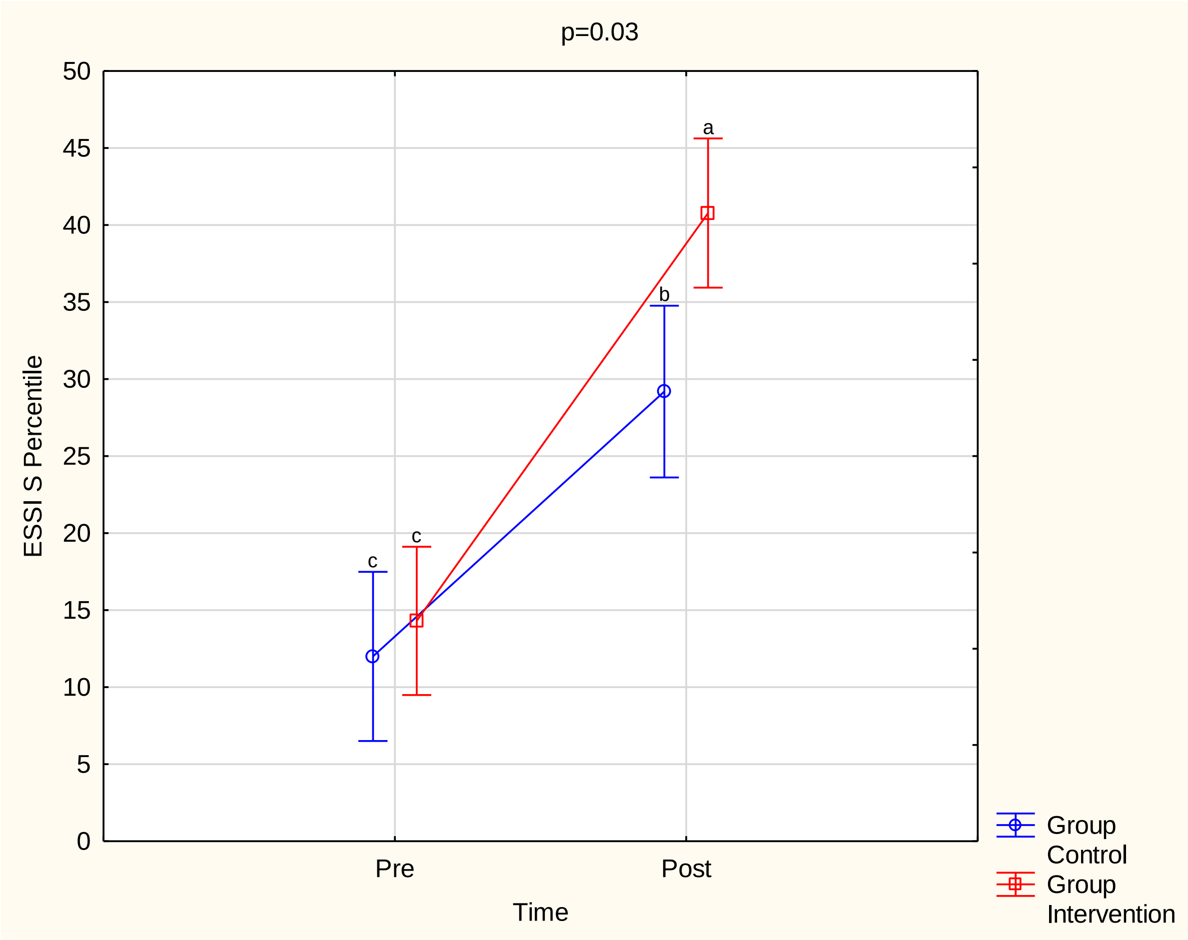

Figure 2: ESSI Spelling Test performance between groups: Control and Experimental

Figure 3 presents the results as means and standard deviations. The ANOVA indicated that the results of the experimental groups performance in the ESSI reading test (42.69+34.52) were significantly better ($p<0.01$) than that of the control group (12.01+14.25) post intervention. The control groups results were closer to the poor rank (11th percentile), whereas the experimental group performed at the average rank (40th percentile), which indicate a better performance post intervention. The experimental group indicated overlapping letters in the pre-test “b” vs “b” and “a” vs “b” in the post-test, which indicate a statistically significant difference ($p < 0.05$).

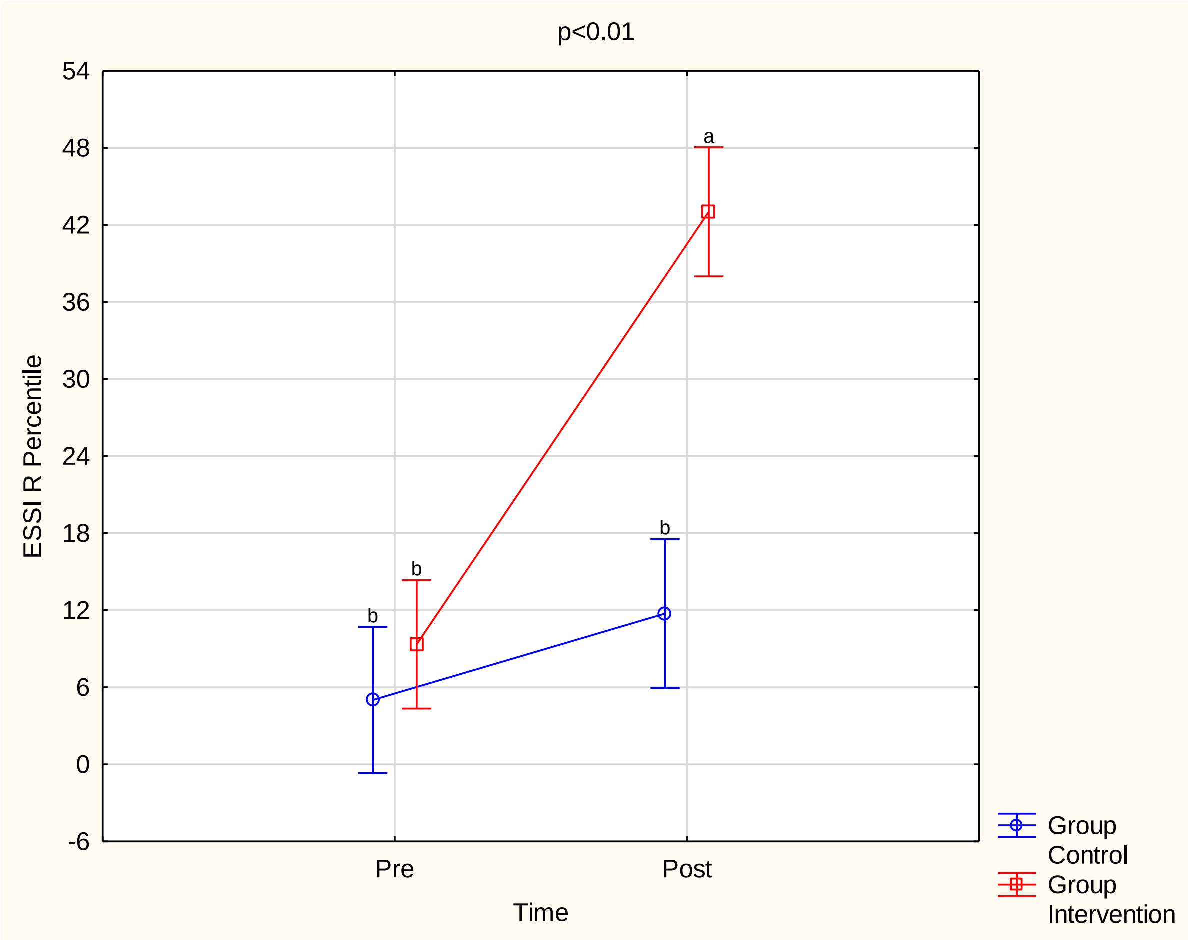

Figure 3: ESSI Reading test performance between groups: Control and Experimental

The current study observed the physical fitness and academic outcomes of the boys and the girls to determine whether there were significant differences (Table 4). No statistically significant differences were found in BMI, aerobic capacity, curl-ups, trunk-lift and sit-and-reach subtests between the boys and the girls. There was however, a statistically significant difference between the boys and girls for the push-up subtest ($p<0.01$). No statistically significant differences were found between the boys and the girls ($p>0.10$) in the ESSI reading test performance post intervention. However, greater improvements were found with the girls and boys in the experimental group in the reading test performance compared to the boys and girls from the control group post intervention. The ESSI spelling test results indicated no statistically significant differences between the boys and girls of the experimental and the control group (p>0.19) post intervention. Spelling improved post intervention for both groups, although the boys and girls in the experimental group performed better. Based on the results, gender was not significant in this study.

Table 4: The Fitnessgram, VASSI Math test and ESSI Reading and Spelling: Gender differences between the Control and Experimental groups

Fitnessgram	(M+SD)	p-Value	Pre and Post-test (M+SD)	p-Value
BMI Girls Boys	15.71+2.23 15.71+2.57	0.76	15.45+2.57 15.98+2.57 15.59+2.12 15.59+2.12	0.30
Aerobic Capacity Girls Boys	6.05+2.58 6.51+3.09	0.41	5.58+2.45 6.55+2.65 6.73+3.98 6.3 +1.82	0.35
Curl-Up Girls Boys	2.31+2.94 3.00+3.54	0.07	1.04+1.76 3.66+3.34 1.03+1.99 4.98+3.65	0.14
Push-Up Girls Boys	1.86+2.78 3.20+3.60	0.01*	0.49+1.36 3.32+3.16 1.63+2.72 4.78+3.71	0.96
Trunk-Lift Girls Boys	26.62+4.39 27.35+3.41	0.26	25.17+4.82 28.18+3.24 26.65+3.61 28.06+3.08	0.03
Sit-and-Reach Girls Boys	23.73+4.25 24.04+4.60	0.57	22.74+4.37 24.77+3.89 22.53+4.53 25.56+4.20	0.24
Academic tests	(M+SD)	p-Value	Pre and Post-test (M+SD)	p-Value
ESSI Reading Girls Boys	20.17+27.29 16.44+24.82	0.10	7.17+8.988 34.05+32.99 7.76+14.50 25.11+29.66	0.02
ESSI Spelling Girls Boys	25.92+23.63 22.90+23.47	0.19	12.79+11.82 39.92+25.07 13.83+16.12 31.98+26.15	0.02

*p<0.01

5.5 Discussion

Previous research has been done on physically active academic interventions to establish the benefits on PA levels and academic success, however, many results were inconsistent (Martin & Murtagh, 2017). These interventions also only measured PA and not PF to determine its' effects on academic performance, such as reading and spelling. The purpose of the current study was to measure whether a physically active academic programme could enhance PF, reading and spelling performance of Grade 1 learners and whether gender differences were present.

A statically significant difference was found in abdominal and upper body strength and endurance (the curl-up and push-up tests) between the experimental and control group post intervention. This indicated that the control group was in the needs improvement zone (NI) and the experimental group was in health fitness zone (HFZ). The possible reason for this significant improvement could be that PF caused increases in blood flow leading to improved brain vascularization that could affect cognitive performance (Hillman *et al*., 2008). It is, therefore, assumed that these improvements were because of the exposure to the intervention programme.

Chaddock *et al*. (2012) indicate that there is a scarcity of evidence on the relationship between muscular strength and academic achievement. Gacia-Hermoso *et al*. (2017) found that adolescents with higher levels of cardiorespiratory fitness and muscular strength had significantly higher academic performance scores than those with lower fitness levels. This notion supports the findings of the current study.

Donelly *et al*. (2016) found that studies using the Fitnessgram and academic achievement tests indicated that higher scores on academic tests were found among learners in the HFZ zone

(Wittenburgh *et al*., 2010). The study performed by London *et al*. (2011) found that increased fitness, and maintaining fitness levels, showed increased academic achievement scores for learners in the HFZ. Although BMI, trunk-lift, sit-and-reach flexibility and shoulder flexibility were not statistically significant, the results of the current study indicated that the experimental group had better improvements in these subtests of the Fitnessgram post intervention. It can be assumed that these results could be because of the intervention programme's design and the academic content of the lessons.

The current study indicated statistically significant improvements for the experimental group in the ESSI reading test post intervention. This is consistent with the findings of Mullender-Wijnsma *et al*. (2015), who also found significant improvements in a one-minute reading test after a physically active, academic intervention. It is assumed that these results were found because the intervention included activities and games that used concrete letters for learners to read and build words. Performing perceptual-motor skills in the above-mentioned intervention could be another reason for these improvements. This is supported by the research of Habibollah *et al*. (2018), who found improvements in reading, writing and mathematics after a perceptual-motor intervention in children with learning disabilities. The research conducted by Sardinha *et al*. (2014), found that higher levels of cardiorespiratory fitness was a high-predictor of academic achievement, specifically in language areas.

Between the experimental and control group there were no statistically significant differences found in the ESSI spelling test because both groups improved post intervention. This can be because of natural development and maturation (Pienaar *et al*., 2011). Hansen *et al*. (2014) found that increased PF had a greater impact on spelling and mathematics when learners scored between 22 to 28 laps on the PACER test. This indicates that better aerobic capacity more improvements were found in academic achievement (Hansen *et al*., 2014). This could be another possible reason for the current study not finding significant results in spelling because the aerobic capacity results were not significant. This correspond with the findings of Lambourne *et al*. (2013), who found no significant associations between PA and spelling. Although not statically significant, better performances in the ESSI spelling test were found in the experimental group when compared to the control group post intervention. This is supported by Van Deventer *et al*. (2014), who made use of the ESSI reading and spelling test and found no significant results between the experimental and control groups.

The results of the current study suggest that the intervention was the reason for the improvements found in the experimental group, which were similar to the findings of Donelly *et al*. (2015) and Mullender-Wijnsma *et al*. (2015). The current study used assessment tools that mimic those used in other studies. However, some of these studies did not find significant results. This includes the study by Van Deventer *et al*. (2014), who made use of the ESSI reading and spelling test. However, Van Deventer and co-workers (2014) found results between the experimental and control groups that were not significant.

Various studies used the Fitnessgram to assess the physical fitness of children. Bai *et al*. (2015) assessed the prevalence of youth fitness in the US with the use of the Fitnessgram. Pienaar *et al*. (2011) established the relationship between physical fitness and academic achievement by using of the Fitnessgram in primary school (9- to 12-years-old) children in SA. Bai *et al*. (2015) looked at a correlation between academic performance and total strength and found it to be significant. This coincides with results of the current study that found the differences in strength and academic achievement of the experimental group to be significant. General findings indicate that regular PA can positively influence academic performance and are beneficial for children (Donelly & Lambourne, 2011; Pienaar *et al*., 2011; Mullender-Wijnsma *et al.*, 2015). Although previous research finding in this field of study are inconsistent, the current study supports similar significant findings of previous studies conducted.

Gender differences in reading, spelling and PF were looked at in the current study. Gender was not found to be a contributing factor in this study, similar to the study by Van Deventer *et al*. (2014), who found no differences between Grade 2 girls and boys. A possible reason could be biological, that the learners in the current study have not yet reached sexual maturity, which has shown to indicate differences in PA and PF levels between girls and boys. This is supported by to Wickel *et al*. (2009) and Telford *et al*. (2016). There was a statistically significant difference was found between the boys and girls in the push-up test ($p<0.01$), as the boys performed better than the girls. This is different to the findings from Abdelkarim *et al*. (2017) who that strength and the six-minute run were the strongest correlations with language understanding and mathematical thinking performance of learners ages six to eight years-old in Germany. Research has indicated that girl's participation in PA and PF is unlikely because of a lack of social support and encouragement (Edwardson *et al*., 2012; Costill, 2016). This current study provided girls and boys an equal opportunity and support to engage in PF, which is associated with better academic performance.

The results for the ESSI reading test indicated that girls and boys in the experimental group had performed better compared those who were not exposed to the programme. Interestingly, the girls compared to the boys in the control group performed better on the ESSI spelling test. Although differences between the boys and girls in the experimental group were not significant,' the reading and spelling skills for both genders improved noteworthy. It could be assumed that these improvements were because of the intervention. This is similar to Van Deventer's *et al*. (2014) finding that no significant results were found in the academic tests between the girls and boys. Hansen *et al*. (2014) found that increased aerobic fitness could have a greater impact on mathematics and spelling performance below a specific threshold for children aged between eight- and 10- years. Ahamed *et al*. (2007) and Resaland *et al*. (2016)

also found no similarities between the educational performance (mathematics, reading and langauge) between boys and girls in Grade four and five.

5.6 Conclusion

The current research has shown that incorporating PF into academic lessons can significantly improve muscular strength and reading. This is consistent with results from Davis and Cooper (2011) who found that fitness was positively associated with reading scores. The current study contributes to the notion that physically active, academic interventions can be beneficial to children's PF and reading performance. Results of the current intervention programme suggests that positive outcomes of physically active academic interventions on increasing PF without taking away academic instruction time. This is particularly important in the South African context as teachers already find very little time to conduct PE requirements and, although the emphasis is on academic learning, children are still performing poorly academically. The current study found this intervention indicated that it could be beneficial to strength and reading achievement for young children, despite gender. This is important because it means that this type of intervention can be beneficial to boys and girls in Grade 1, therefore, attempting to bridge the gap between gender differences in PF participation.

5.7 Limitations

This study only made use of children aged 6, 7 and 8 years-old children in Grade 1 at the time of data collection. Involvement from teachers was less than expected because of external factors, such as having to look after learners from other classes because of absent teachers. Wet weather conditions did not allow some sessions to occur outside as planned. School facilities were lacking because classrooms were very small and crowded and outdoor facilities very poorly maintained. Protests in the local area did not allow some sessions to occur because local police did not permit the researcher into the area, however, more than 90% of the intervention was completed. The protests could not be predicted and could not be controlled. Teachers of the experimental group were newly qualified, and therefore, were not experienced in teaching. The reading test only measured word recognition and not comprehension of a text.

5.8 Recommendations

To advance the literature on physically active, academic interventions on physical fitness and reading, spelling and mathematical performance in school children, further studies are needed that use larger sample sizes and longer interventions to determine the long-term outcomes. Future research should consider using a reading test that measures word recognition and comprehension for a better reflection of reading skills. More informative body composition and fatness assessments is recommended to determine the influence that body composition have on physical fitness and academic performance. Future research should consider assessing motor proficiency in addition to physical fitness to measure the effects on motor proficiency.

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CHAPTER SIX

SUMMARY AND CONCLUSION

SUMMARY

Relatively few published studies exist on physically active, academic interventions' benefits on academic achievement and physical fitness (PF), especially in a South African context. With that said, there have been inconsistent results including differences between boys and girls (Donelly *et al*., 2016), and few have measured PF. Therefore, this study aimed to add knowledge to this field globally and especially in South Africa (SA) to decrease the gap in the literature and provide consistent results.

This thesis was presented in six main chapters, namely; Chapter One (introduction and problem statement); Chapter Two (theoretical background); Chapter Three (methodology); and Chapters Four and Five (two articles). The two articles were presented according to the guidelines of the specific journals.

Chapter One presented the introduction and problem statement. Chapter Two focused on the background of the benefits of early childhood physical activity (PA) and Physical Fitness (PF), the link between academic achievement and regular PA and PF, gender differences in PA and PF, and recent findings on the benefits of interventions combining PA and PF into school subjects. The current study also addressed the gap in this field of study and the relevance in the South African context for interventions to combat low PF and academic achievements.

Chapter Three provides insight into the methodology of this study. It includes the type of design, the participants, procedures, assessment tools and statistical analysis.

Chapter Four is research article titled: *The effect of a physically active academic intervention on physical fitness and mathematical performance of Grade 1.*

Chapter Five is a research article titled: *A physically active academic intervention to improve physical fitness, reading and spelling performance of selected Grade 1 learners.*

In summary, in the current study an improvement in academic performance, namely; in mathematics, reading and in muscular strength following a physically active, academic intervention was found in the experimental group after the intervention. This study found that the greatest improvements in mathematics; reading and strength were found in the experimental group. These findings are similar to results from Mullender-Wijnsma *et al*. (2015) and Donelly and Lambourne (2011), following a physical active academic intervention. However, the current study differed because it assessed physical fitness, mathematical, reading and spelling skills. The current study found that gender was not significant and that both boys and girls improved in physical fitness, mathematics and reading performance after being exposed to the physically active, academic intervention. The current study contributes to the notion that physically active, academic interventions could be beneficial to children’s mathematics and reading performance and importantly it has shown that it can improve muscular strength.

CONCLUSIONS

The conclusions derived from the current study are presented according to the specified aims in Chapter One.

Research article 1: The effect of a physically active academic intervention on physical fitness and mathematical performance of Grade 1 learners

The study highlighted the lack of PA in the South African school environment and that combining PF into academic lessons could be beneficial for improving muscular strength and mathematical performance, which is similar to the findings from De Greef (2016). The current study found that a 16-week intervention programme, combining PF into academic lessons, significantly improved strength and mathematics performance of the experimental group. These results were in agreement with various studies who found improvements in mathematics and strength following a physically active, academic intervention (Donelly & Lambourne, 2011; Mullender-Wijnsma *et al.*, 2016; Gardia-Hermoso *et al.*, 2017). The current study suggests that a physically active, academic intervention can have significant effects on mathematics and contribute significantly to this field of study. This is critical to the South African context to provide more evidence on the importance of incorporating PF and PE back into the school setting.

Research article 2: The effect of a physically active academic intervention to improve at the physical fitness, reading and spelling performance of selected Grade 1 learners

The current study highlighted the lack of PA and PF in South African schools and that an early intervention is a great means to improve PF, reading, spelling and mathematic performance in young children. The differences in PF and academic performance between girls and boys was also explored as literature has found consistent results that PA and PF are different between girls and boys, and therefore, impact on academic performance. Research has shown that significant improvements in strength can be an outcome when incorporating PF into academic lessons (Pienaar *et al*., 2011; Donelly *et al*., 2016; Mullender-Wijnsma *et al*., 2016; Garcia-Hermoso *et al*., 2017; Santana *et al*., 2017). However, there is little evidence on how PF combined with academic lessons can affect PF and reading, spelling and mathematic performance and the results of previous studies vary. This corresponds with Davis and Cooper (2011) who found that fitness, mathematical and reading scores were positively associated. The results of the current study found a statistically significant influence on the muscular strength and reading performance in selected Grade 1 learners after exposure to the 16-week physically active, academic intervention programme. The result of the intervention suggest that physically active, academic interventions could have a beneficial influence on increasing muscular strength and reading performance without taking away academic instruction time. Importantly, these findings were not significant to gender, suggesting that this type of intervention would be beneficial to boys and girls in Grade 1. As gender was not a contributing factor to the result, this further support the continual argument that children should participate in PF for the associated health and academic benefits. This study is, therefore, important for the South African context because low academic achievements and strength can be improved with a new innovative programme that is enjoyable for the children and teachers, despite of gender.

LIMITATIONS

Various limitations from the current study can be highlighted:

- the study only made use of children that were from the primary schools in question and who were 6, 7 and 8-year-old and in Grade 1;
- the teachers’ involvement was less than anticipated because of external factors, such as having to look after learners from other classes because of absent teachers;
- wet weather conditions did not allow some sessions to occur outside as planned;

- protests in the specific areas did not allow some sessions to take place because the researcher was not permitted into the areas by local police forces. This could not be predicted and could not be controlled; and
- the teachers of the experimental group were newly qualified, and therefore, not experienced in the field of study.

RECOMMENDATIONS

Future research is recommended to determine results that are more conclusive. A larger sample size and follow up assessments are recommended to establish any long-term effects of the intervention on PF and academic performance. A better reading assessment should be used to determine more than just word recognition and include comprehension of a text. Researchers could implement the intervention programme more frequently to determine whether it has an influential effect on the outcomes. Randomising groups would be beneficial to find results that are more consistent. In is recommended that lessons should be approved by the teachers to ensure the correct content is being included in lessons. Future researchers could look at teacher involvement and how this could possibly be an influential factor. It is important that future research include their intervention programmes to ensure replication to find more consistent results.

6.5 REFERENCES

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APPENDIX C: Ethical clearance

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19 March 2019

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FOR CONTINUATION OF PROJECTS AFTER REC APPROVAL PERIOD

Please note that a progress report should be submitted to the Research Ethics Committee: Humanities before the approval period has expired if a continuation of ethics approval is required. The Committee will then consider the continuation of the project for a further year (if necessary)

Included Documents:

Document Type	File Name	Date	Version
Data collection tool	Fitnessgram Summary	16/11/2018	1
Parental consent form	Carynne Coens Parental Consent Form	14/12/2018	2
Assent form	Carynne Coens Assent Form	14/12/2018	2
Data collection tool	VASSI Mathematical Proficiency Test and ESSI Reading and Spelling Skills Test Summary	14/12/2018	2
Default	Carynne Coens - Response to DESC Reviewer 2018	14/12/2018	1
Informed Consent Form	Carynne Coens Parental Consent Form	14/12/2018	2
Informed Consent Form	Carynne Coens Parental Consent Form.	12/03/2019	3
Proof of permission	Research approval letter	12/03/2019	1
Proof of permission	Merrydal Permission Letter 1	12/03/2019	1

Page 1 of 3

Default	Letter of Response REC - Carynne Coams	12/03/2019	1
Research Protocol/Proposal	Carynne Coams MSc REC Modifications edit	12/03/2019	3
Parental consent form	Carynne Coams Parental Consent Form.	12/03/2019	3
Insurance cover	20190114_US_Confirmation of Liability and PI insurance_The effect of a...	12/03/2019	1

If you have any questions or need further help, please contact the REC office at cgraham@sun.ac.za.

Sincerely,

Clarissa Graham

REC Coordinator: Research Ethics Committee: Human Research (Humanities)

National Health Research Ethics Committee (NHREC) registration number: REC-050411-032.
The Research Ethics Committee: Humanities complies with the SA National Health Act No.61 2003 as it pertains to health research. In addition, this committee abides by the ethical norms and principles for research established by the Declaration of Helsinki (2013) and the Department of Health Guidelines for Ethical Research: Principles Structures and Processes (2nd Ed.) 2015. Annually a number of projects may be selected randomly for an external audit.

Investigator Responsibilities

Protection of Human Research Participants

Some of the general responsibilities investigators have when conducting research involving human participants are listed below:

1.Conducting the Research. You are responsible for making sure that the research is conducted according to the REC approved research protocol. You are also responsible for the actions of all your co-investigators and research staff involved with this research. You must also ensure that the research is conducted within the standards of your field of research.

2.Participant Enrollment. You may not recruit or enroll participants prior to the REC approval date or after the expiration date of REC approval. All recruitment materials for any form of media must be approved by the REC prior to their use.

3.Informed Consent. You are responsible for obtaining and documenting effective informed consent using only the REC-approved consent documents/process, and for ensuring that no human participants are involved in research prior to obtaining their informed consent. Please give all participants copies of the signed informed consent documents. Keep the originals in your secured research files for at least five (5) years.

4.Continuing Review. The REC must review and approve all REC-approved research proposals at intervals appropriate to the degree of risk but not less than once per year. There is **no grace period.** Prior to the date on which the REC approval of the research expires, **it is your responsibility to submit the progress report in a timely fashion to ensure a lapse in REC approval does not occur.** If REC approval of your research lapses, you must stop new participant enrollment, and contact the REC office immediately.

5.Amendments and Changes. If you wish to amend or change any aspect of your research (such as research design, interventions or procedures, participant population, informed consent document, instruments, surveys or recruiting material), you must submit the amendment to the REC for review using the current Amendment Form. You **may not initiate** any amendments or changes to your research without first obtaining written REC review and approval. The **only exception** is when it is necessary to eliminate apparent immediate hazards to participants and the REC should be immediately informed of this necessity.

6.Adverse or Unanticipated Events. Any serious adverse events, participant complaints, and all unanticipated problems that involve risks to participants or others, as well as any research related injuries, occurring at this institution or at other performance sites must be reported to Malene Fouche within **five (5) days** of discovery of the incident. You must also report any instances of serious or continuing problems, or non-compliance with the RECs requirements for protecting human research participants. The only exception to this policy is that the death of a research participant must be reported in accordance with the Stellenbosch University Research Ethics Committee Standard Operating Procedures. All reportable events should be submitted to the REC using the Serious Adverse Event Report Form.

7.Research Record Keeping. You must keep the following research related records, at a minimum, in a secure location for a minimum of five years: the REC approved research proposal and all amendments; all informed consent documents; recruiting materials; continuing review reports; adverse or unanticipated events; and all correspondence from the REC

8.Provision of Counselling or emergency support. When a dedicated counsellor or psychologist provides support to a participant without prior REC review and approval, to the extent permitted by law, such activities will not be recognised as research nor the data used in support of research. Such cases should be indicated in the progress report or final report.

9.Final reports. When you have completed (no further participant enrollment, interactions or interventions) or stopped work on your research, you must submit a Final Report to the REC.

10.On-Site Evaluations, Inspections, or Audits. If you are notified that your research will be reviewed or audited by the sponsor or any other external agency or any internal group, you must inform the REC immediately of the impending audit/evaluation.

APPENDIX D:

APPENDIX D: WCED PERMISSION

Directorate: Research

Western Cape Government

Education

Audrey.wyngaard@westerncape.gov.za

tel: +27 021 467 9272

Fax: 0865902282

Private Bag x9114, Cape Town, 8000

wced.wcape.gov.za

APPLICATION TO CONDUCT RESEARCH IN PUBLIC SCHOOLS WITHIN THE WESTERN CAPE

Note

- This application has been designed with students in mind.
- If a question does not apply to you indicate with a N/A
- The information is stored in our database to keep track of all studies that have been conducted on the WCED. It is therefore important to provide as much information as is possible

1 APPLICANT INFORMATION

1.1 Personal Details		
1.1.1	Title (Prof / Dr / Mr/ Mrs/Ms)	**Carynne Alison Cozens**
1.1.2	Surname	**Cozens**
1.1.3	Name (s)	**Carynne Alison**
1.1.4	Student Number (If applicable)	**16524624**

1.2 Contact Details

1.2.1	Postal Address	**Department of Sport Science**
1.2.2	Telephone number	**021 8084591**
1.2.3	Cell number	**074 929 0883**
1.2.4	Fax number	**N/A**
1.2.5	E-mail Address	**dodosoutha@icloud.com**
1.2.6	Year of registration	**2018**
1.2.7	Year of completion	**2019**

2 DETAILS OF THE STUDY

2.1 Details of the degree or project		
2.1.1	Name of the institution	**Stellenbosch University**
2.1.2	Degree / Qualification registered for	**MSc Sport Science: Kinderkinetics**
2.1.3	Faculty and Discipline / Area of study	**Education**
2.1.4	Name of Supervisor / Promoter / Project leader	**Dr Eileen Africa**
2.1.5	Telephone number of Supervisor / Promoter	**021 808 4591**

2.1.6	E-mail address of Supervisor / Promoter	africa@sun.ac.za

2.1.7	**Title of the study**

The effect of a physically active academic intervention on physical fitness and academic performance in Grade 1.

2.1.8	**What is the research question, aim and objectives of the study**

RESEARCH QUESTION

Will the physically active academic intervention have an effect on physical fitness, mathematics and, reading and spelling specifically of Grade 1 learners?

AIMS AND OBJECTIVES

Primary Aim

To investigate the effect of a physically active academic intervention on mathematics, reading, spelling and physical fitness of Grade 1 learners.

Objectives

1. To determine the effect on children's reading and spelling skills by using the ESSI Reading and Spelling test.
2. To determine the effect on children's mathematics proficiency by using the VASSI Mathematics Proficiency test.
3. To determine the effect on the children's physical fitness by using the Fitnessgram.
4. To determine the difference between boys and girls by comparing results of the pre- and post-test of the above mentioned tests.

2.1.9	**Name (s) of education institutions (schools)**
Timour Hall Primary School Bergvliet Primary School	

2.1.10	**Research period in education institutions (Schools)**	
2.1.11	Start date	**January 2019**
2.1.12	End date	**June 2019**

APPENDIX E

APPENDIX E: PERMISION FROM THE SELECTED SCHOOLS

West End Primary School

principal@westendps.co.za

Tel: +27 21 371 2400 Fax: 086 544 2074

Enquiries / Navrae / Imibuzo: A Stander

Reference / Verwysing / Isalathiso:

To whom it may concern

Please be informed that Ms Carynne Cozens has permission to conduct her research at our school, West End Primary. The research titled "**The Effect of a Physically Active Academic Intervention on Physical Fitness and Academic Performance**" will be done in the grade 1 class.

Ms AM Stander

Deputy Principal

30 January 2019

MERRYDALE PRIMARY SCHOOL

LABOUR AND REWARD

Merrydale Avenue
Mitchells Plain
7785
Ph: 021 371 3010
Fax: 086 516 4333
e-mail: merrydale.prim@wcgschools.co.za
website: http://merrydaleps.webs.com
Facebook: Merrydale Primary School

11 January 2019

Carynne Cozens

I hereby grant you permission to test of the learners at Merrydale Primary School.

Kind Regards

TREVOR DILGEE
PRINCIPAL

MERRYDALE PRIMARY SCHOOL
Merrydale Avenue
Mitchells Plain, 7785
Tel: 021 371 3010 • Fax: 086 516 4333
Email: merrydaleps@mweb.co.za
Facebook: Merrydale Primary School

VISION
"MERRYDALE PRIMARY SCHOOL WILL STRIVE FOR EXCELLENCE IN THE PURSUIT OF THE HOLISTIC DEVELOPMENT OF THE LEARNERS IN AN INCLUSIVE, SAFE LEARNING ENVIRONMENT"

APPENDIX F

APPENDIX F: INSURANCE

MARSH

Marsh Proprietary Limited

50 Dorp Street
Stellenbosch,7600

P.O Box 414
Stellenbosch
7599

+27 21 834 1346

www.marsh-africa.com

14 January 2019

TO WHOM IT MAY CONCERN

STELLENBOSCH UNIVERSITY: CONFIRMATION OF INSURANCE.

STUDY: THE EFFECT OF A PHYSICALLY ACTIVE ACADEMIC INTERVENTION ON PHYSICAL FITNESS AND ACADEMIC PERFORMANCE IN GRADE 1

This serves to confirm that the following cover has been arranged for Stellenbosch University and others:

1. Primary General Liability (Broad form) insurance policy number 1000/28439, underwritten by Stalker Hutchison Admiral for a limit of R5 000 000.

2. Employers Liability insurance policy number 1000/28439, underwritten by Stalker Hutchison Admiral for a limit of R5 000 000.

3. Umbrella Liability insurance policy no 1000/22890 underwritten by Stalker Hutchison Admiral for a limit of R150 000 000.

3. **Total Liability limit** – R155 000 000

4. Professional Indemnity insurance policy number 4000/24901 underwritten by Stalker Hutchison and Admiral for a limit of ZAR 150 000 000 and includes Medical Malpractice insurance.

5. The cover mentioned above is extended to include North American extension.

6. Period of insurance: 1 January 2018 to 31 December 2018.

Subject to the terms, conditions and exclusions of the policy wordings.

We trust that you will find the above to be in order. Please do not hesitate to contact the writer should you have any queries.

Kind regards

Fagma Jordaan

Senior Client Executive

An authorised financial services providerFSB/FSP Licence no.: 8414
Registration no.: 1999/000348/07
Directors: IB Skosana (Non-Executive Chairman), JJ Erwee (CEO), BR Blake (Vice Chairman)*, F Abrahams, R Ebrahim, S Montsi, M Pienaar, MG Sokkie (*British)

APPENDIX G

APPENDIX G: PARENTAL CONSENT

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

STELLENBOSCH UNIVERSITY
PARENT/LEGAL GUARDIAN CONSENT FOR CHILD TO PARTICIPATE IN RESEARCH

The Effect of a Physically Active Academic Intervention on Physical Fitness and Academic Performance in Grade 1.

I would like to invite your child to take part in a study conducted by Carynne Alison Cozens, from the Sport Science Department at Stellenbosch University. Your child will be invited as a possible participant because he/she are in Grade 1 in the respective school we are conducting the research.

1. PURPOSE OF THE STUDY

We would like to determine if we can teach your children mathematics, reading and spelling while incorporating physical activity into the lessons. We want to determine if this will have an effect on the mathematics, reading, spelling ability and physical fitness.

2. WHAT WILL BE ASKED OF MY CHILD?

If you consent to your child taking part in this study, the researcher will then approach the child for their assent to take part in the study. If the child agrees to take part in the study, he/she will be asked to participate in pre-tests that will assess their mathematical proficiency, reading and spelling ability and their physical fitness. We will then conduct an intervention where we will integrate physical activity while teaching mathematics, reading and spelling. These lessons will occur 2 times per week, for 30 minutes each, for the duration of the first and second term of 2019. The lessons will take place at the school and children will not be required to bring any additional materials.

3. POSSIBLE RISKS AND DISCOMFORTS

There may be a possibility that your child could trip or fall while participating in these activities. There will always be a researcher that is first aid qualified in case your child needs assistance. If children feel any discomfort or anxiety while participating in the assessments, they are free to express this and they may stop at any time.

4. POSSIBLE BENEFITS TO THE CHILD OR TO THE SOCIETY

By participating in this study, your child will benefit in becoming more physically active. Your child will experience a new way of learning mathematics, reading and spelling. These activities are beneficial for their mental and physical health as they will have the opportunity to improve their academic and physical skills. If your child participates in this study, this can benefit them in the long term as we are hopeful that this will increase his/her academic ability and physical development. We hope to encourage an active lifestyle and new, fun, way of learning academic content.

5. PAYMENT FOR PARTICIPATION

No costs will be involved for children to partake. There will be no payment or compensation for participating in this study. We kindly request voluntary participation.

6. PROTECTION OF YOUR AND YOUR CHILD'S INFORMATION, CONFIDENTIALITY AND IDENTITY

Any information you or your child will share with me during this study that could possibly identify you or your child will be protected. This will be done by keeping all information on your child safely secured on a password protected computer that only the researchers will have access to. This information will only be used for this study and for research purposes of this study.

Children will be photographed and video recorded during some lessons only. This is only for the purpose of the study. Photographs will be made available for parents to view. Only the researchers will have access to view this content. Once the research is complete, all data collected will be deleted from the password protected computer.

7. PARTICIPATION AND WITHDRAWAL

You and your child can choose whether to be part of this study or not. If you consent to your child taking part in the study, please note that your child may choose to withdraw or decline participation at any time without any consequence. Your child may also refuse to answer any questions they don't want to answer and still remain in the study. The researcher may withdraw your child from this study if they do not complete 40 out of 44 sessions, due to any circumstances. If children sustain any injuries, such as broken limbs, that prohibit participation, children will be excluded from the study for their own safety.

8. RESEARCHERS' CONTACT INFORMATION

If you have any questions or concerns about this study, please feel free to contact Carynne Cozens at 074 929 0883, and/or the supervisor Dr. E. Africa at 021 808 4591.

9. RIGHTS OF RESEARCH PARTICIPANTS

Your child may withdraw their consent at any time and discontinue participation without penalty. Neither you nor your child is waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your or your child's rights as a research participant, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.

DECLARATION OF CONSENT BY THE PARENT/ LEGAL GUARDIAN OF THE CHILD- PARTICIPANT

As the parent/legal guardian of the child I confirm that:

- I have read the above information and it is written in a language that I am comfortable with.
- All issues related to privacy, and the confidentiality and use of the information have been explained in the document.

By signing below, I _______________________________ *(name of parent)* agree that the researcher may approach my child to take part in this research study, as conducted by Carynne A. Cozens.

____ ________________________

Signature of Parent/Legal Guardian **Date**

DECLARATION BY THE PRINCIPAL INVESTIGATOR

As the **principal investigator,** I hereby declare that the information contained in this document has been thoroughly stated in this document to the parent/legal guardian. I also declare that the parent/legal guardian was encouraged and given ample time to ask any questions.

______________________________________ ____________________

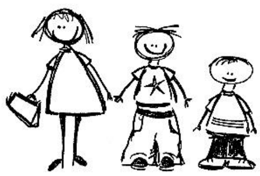
Signature of Principal Investigator **Date**

A

APPENDIX H: ASSENT FORM

	STELLENBOSCH UNIVERSITY

ASSENT FORM FOR MINORS



TITLE OF THE RESEARCH PROJECT: The effect of a physically active academic intervention on physical fitness and academic performance in Grade 1.

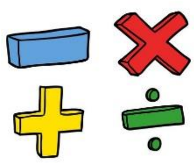
RESEARCHERS' NAME(S): Carynne Alison Cozens

RESEARCHER'S CONTACT NUMBER: 074 929 0883

What is RESEARCH?

Research is something we do to find new knowledge about the way things (and people) work. We use research projects or studies to help us find out more about children and the things that affect their lives and health.

What is this research project all about?



We want to see if we can help teach you maths and, how to read and spell while doing fun exercises.

Why have I been invited to take part in this research project?
We would like you to be a part of our project because you are in Grade 1 this year and we want to help you learn and get active.

Who is doing the research?

My name is Carynne and I work with the Stellenbosch University. We want to work with you to teach you maths, reading and spelling in a fun way.

What will happen to me in this study?

We would like to participate in our fun programme. This will include doing fun activities to see how fit you are and to see if you can read and spell. We have a fun programme planned for you where you will get to do fun exercises while learning to math, reading and spelling.

Can anything bad happen to me?

You may sweat and feel uncomfortable while doing the activities.

Can anything good happen to me?

You will get a chance to do fun exercises that will help you grow and get stronger all while having fun. You will learn maths, reading and spelling in a new fun way. This may help you in future to hopefully improve your reading and spelling skills, and your maths skills.

Who can I talk to about the study?

If you have any questions about this project, you can ask your teacher or the researchers at any time.

What if I do not want to do this?

If you do not want to do any of the activities, at any time, you do not have to. You can stop participating at any time if you want to and you will not get into any trouble.

Do you understand this research study and are you willing to take part in it?

YES ☐ NO ☐

Has the researcher answered all your questions?

YES NO

Do you understand that you can STOP being in the study at any time?

YES NO

__________________________ _____________________

Signature of Child Date

APPENDIX I

APPENDIX H: INTERVENTION PROGRAMME

The focus areas of the intervention programme are explained in detail in this booklet, followed by all the lessons incorporated in the intervention programme.

Laterality:

Laterality refers the internal awareness that they body has two sides and these sides are different. Laterality serves as the foundation for directionality and shortfalls are displayed in reading. Laterality and directionality have a direct impact on reading. In order to read correctly, the learner must be able to recognise and understand that words are made up of letter combination, to be able to read from left to right, how to hold the book the right side up and where on the page to write.

A Kinderkineticist can assist in improving laterality by incorporating body awareness, spatial awareness and laterality movements into games and fun activities. Laterality can improve and is will lay the foundation for directionality. If this improves, this will develop further writing and reading skills and midline crossing.

Proprioception:

Proprioception refers to the awareness of one’s body parts in relation to each other and the surrounding environment. It refers to the actual awareness of sensations gained from receptors in the muscles, skin, tendons, joints and connective tissue. Each proprioceptive receptors provide information to the brain about the body and the surrounding environment. The proprioceptive system sends information to the brain about the location of joints, body parts, movements of these joints and body parts, pressure on the skin and connective tissue, temperature and pain felt in the joints and muscles. Factors influencing the proprioceptive system include the vestibular function, motor control and sensory inflammation. Sensory information is a crucial component of special awareness as children gathers information about his/ her environment from sensations gathered from senses such as touch, smell and hearing etc. Developing the proprioceptive system is vital for their growth and development as it is required for walking, posture control and moving around in different environments. Body and spatial awareness are important for children to move around efficiently and make use of the environment effectively. Therefore, it is important part of development and growth for children in their everyday life and should be encouraged.

A Kinderkineticist can improve proprioception firstly by using certain measurement tools to access the child's proprioceptive abilities. Tests can include Romberg test, Angel's-in-the-snow etc. Incorporating techniques such as: contraction, compression tonic contractions of the muscles around the joints, increasing strength produced by muscles and increasing the duration of a movement. This can all be done with the use of fun games and activities and with repetition there will be improvements in proprioception which will simultaneously improve other areas of development.

Letter-sound recognition

Letters are the building blocks of the alphabet and writing of the alphabet. The alphabet consists of two-dimensional visual patterns associated with a single name, and in most alphabetic writing systems each letter. This is important building blocks for reading and writing.

A Kinderkineticist can assist in improving letter-recognition by incorporating letters into fun games and movement activities. Developing letter recognition will further develop reading, spelling, phonics and writing.

Number Recognition

Number recognition refers to the ability to recognise two-dimensional numbers. The development of number sense includes the meaning of different kinds of numbers, the relationship between different kinds of numbers, the relative size of different numbers, the representation of numbers in various ways and the effect of operating with numbers. Number recognition is one of many building blocks of mathematics.

A Kinderkineticist can assist in developing number recognition and number concept by integrating numbers into games and movement activities. Developing this mathematical concept with further develop mathematical operations and problem-solving and could lead to improved mathematical achievement.

Reaction Time

Reaction time is referred to as the period of preparation required to occur the movement by taking the stimulus. Reaction time is a positive effect of the organ systems while the nervous system working in a coordinated manner among muscle groups. Reaction time can be shortened with training. Reaction time is important as it the main component of many skills such as sport skills.

A Kinderkineticist can help improve reaction time with specific reaction time activities incorporated into training programs, sport programs and fun games. Developing reaction time can benefit sport skills and can further develop decision making.

Counting

Counting with regards to the CAPS document in South Africa consists of counting concrete object, counting forwards and backwards, Counting is an important initial mathematics skill that children are required to learning in the formal years of schooling. Counting is an important skill that is used across the life span. A Kinderkineticist can help children learn to count by incorporating the use of concrete objects as well as dance and movement to music. Improving counting will help children in mathematics performance.

Body Awareness

Movement facilitates the development of body awareness. Body awareness refers to the self-concept (body image), and in the internal awareness of the body (body schema). Adequate movement opportunities and experiences will aid in the development of body awareness. This will develop a positive body image and self-concept that is an emotional advantage. The lack of movement could result in negative body image and not understanding how their own body can move and what it can do. This an important skill for young children to develop in order to function optimally in a classroom environment as this helps them know feel good to learn and understand what their bodies need to do in a classroom environment.

By improving body awareness, children with poor body awareness tend to have difficulties learning new skills, orientation, body orientations and poor judgement in distance. Clumsiness and stumbling can occur when moving at an increased pace.

Coordination

Hand eye-coordination and foot coordination are both aspects of coordination. Hand- eye coordination refers to the ability to direct the movement of the hands with the use of the eyes. This is important for children to develop as this is an essential skill used for learning to write and writing within the lines on a page. Foot-eye coordination refers to the ability to coordinate of the movement of the feet and eyes to execute various movements such as kicking a ball. This skill is particularly important when learning sport specific kills.

A Kinderkineticist can assist in developing coordination by regularly using visual stimulation and practising manual dexterity, and-eye coordination and foot-eye coordination movements such as fun games, sports.

Spatial-Awareness

Movement can assist young children in developing spatial awareness. Through movement, children learn to gain knowledge on where the body is in space and where they body is in relation to objects near them. This is particularly important when dealing with letter identification and symbol orientation on a page, such as understanding the difference between the letters b, d and p (Krog, 2015). Writing between lines is reliant on satisfactory spatial awareness. Movement needs to occur for learners to develop these spatial concepts as they need to perceive object in relation to their bodies before they can relate object to each other (Burn, 2007; Nel & Hugo, 2013). Movement should then be non-negotiable in a learning environment for young children to develop these underlying motor skills that are essential for learning.

A Kinderkineticist can assist by incorporating spatial awareness activities in various games and activities to further develop spatial awareness. This will further assist in handwriting skill and letter recognition and formation.

Measurement

Measurement includes learning about length, mass and capacity/ volume and the ability to compare, order and estimate numbers according to the Curriculum Assessment Policy Statement. This is an important mathematical skill for all learners in Grade 1. This Grade is the foundation year and the building block for the former years and therefore developing this skill will assist in further mathematical performance.

Dynamic balance

Balance is required for posture and locomotion. Locomotion requires more balance as it is more a more complex task for requiring the body to move in a propelling manner and move laterally and the increase and decrease of force and speed. Balance during movement is referred to as dynamic balance. Young children struggle with this due to the weight of their body. A

Kinderkineticist can help develop dynamic balance and muscle strength in order fo young children to control their posture and ability to move around their environment in a balanced and controlled manner.

Bilateral coordination

Bilateral coordination refers to the ability to use both sides of the body to produce coordinated and controlled movements. This can be with the use of both sides of the body to do the same movement or using alternating movements such as walking. Developing bilateral coordination, the arms and legs to work well together. Poor bilateral coordination could lead to daily struggles such as climbing stairs and dancing. Kinderkineticist should incorporate activities that focus on bilateral coordination to further development movement and movement patterns

Midline Crossing

Midline crossing is important for optimal child development. Midline crossing refers to the ability of the one side of the body to cross over to the other side of the body by moving across the centre line of the body. An example would be the right hand crossing the midline to pick up an object from the left side of the body. Midline crossing develops after laterality and hand preferences Children generally develop midline crossing from 8-12 months of age. Should children not show signs of midline crossing from the age of 7 years, this can affect their academics, physical activity and communication skills. The problems include but not limited to, difficulty perceiving left and right sides of objects and letters, uncertainty about personal left and right sides of the body, difficulty making decisions, difficulty reading, difficulty accepting a change in rule or direction once it has been made and difficulty comprehending instruction. Kinderkineticist play a major role as they can design activities such as catching and throwing and progress to tell the child the sit and try to throw the ball to the left or the right. Activities promoting torso and upper body rotation should be a focus, especially from a young age.

Strength

Muscular strength refers to the maximal force that muscle or muscle group can generate (Powers and Howley, 2009). This is important for children for development and growth as force on the muscles create force on bones which promote strengthening of bones. As children develop so does their muscles and strength. Strength is required for everyday activities such as running, jumping, carrying sports equipment and bags and playing sports. Overall muscular strength is necessary for all children to develop plays an important role in their growth and for injury prevention. A Kinderkineticist can assist in improving strength by incorporating activities that focus on body weight exercises that is enjoyable and stimulate growth and maximal effort from the child.

Number Patterns

Numbers patterns refer to number concept development and the operational sense built in numbers, relationships and operations. Geometric patterns include line, shapes and object sequences. This also includes patterns in the world and required knowledge of space and shape. This is an important Mathematical skill taught from Grade 1. Kinderkineticists can include number, line and shape patterns in various games and activities to help develop this knowledge which could further contribute to academic achievements.

Cardiovascular fitness

The cardiovascular system refers to the heart and how hard it works. While children are moving rapidly and playing, there are increasing their heart rate and breathing. The heart, therefore, needs to bear faster and distribute blood to all the necessary muscles meaning the heart needs to work harder than when at a resting state. This is important and beneficial for children as they are constantly moving, playing and participating in sport. A Kinderkineticist can help improve cardiovascular fitness through scientific designed programmes that focus solely on cardiovascular fitness. Activities should ensure children are moving and increasing their heart rate and breathing.

Hand-eye coordination

Hand eye-coordination and foot coordination are both aspects of coordination. Hand- eye coordination refers to the ability to direct the movement of the hands with the use of the eyes. This is important for children to develop as this is an essential skill used for learning to write and writing within the lines on a page. This skill is particularly important when learning sport specific kills. A Kinderkineticist can assist in developing coordination by regularly using visual stimulation and practising manual dexterity, and-eye coordination and foot-eye coordination movements such as fun games, sports.

Grouping and sharing

Grouping and sharing involves problem solving skills using equal sharing ad grouping. IN Grade 1 learners are taught grouping and sharing and involves grouping and sharing if whole numbers to answer a word sum. This includes answers with a remainder. Grouping and sharing lays the foundation for division and fractions as the learners progresses. A Kinderkineticist can assist in the development of grouping and sharing skills with the use of concrete objects and including word sums in fun games and activities designed. Improving this will lead to better mathematical understanding and skills.

Doubling

Repeated addition leadings to multiplication. Doubling is adding the same number twice. In Grade I learners need to be able to solve word problems in context and explain their own understanding and answers to problems involving repeated addition and later multiplication. A

Kinderkineticist can assist in this mathematical skill but including word sums into games and fun activities, especially with the use of concrete object, drawing images of the concept of doubling and then writing it down as a mathematical sum.

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Term 2 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 6 May 2019

Time: 30 minutes

Theme: Travelling in Cape Town

Focus: Laterality, letter- sound recognition and proprioception

Equipment:

- Hoops
- Beacons
- Beanbags
- Pictures of arrows
- Number

Warm Up: Ready to go on our Trip

"Are you ready for the trip, ready, set, go"

- Learners need to stand outside the hoops.
- When I blow the whistle, learners need to run around the hoops.
- When I blow the whistle again, learners need to find a hoop.
- Repeat 3 times, can start removing some hoops to make it more competitive.

Activity 1: Robot Direction (Laterality, proprioception, directionality, reaction time)

"We have come to a robot stop, but which way do we need to go"

- Each learner will stand in their hoop.
- When they hear the direction and see the presenter pointing in the direction "left, right", learners need to jump in that direction.

- Progress to forward and backwards if possible.
- POGRESSION: Decrease the time in between each direction command

Activity 2: Seeing the wonderful animals (Proprioception, laterality, directionality, listening skills, reaction time)

"Driving around, we get to see some animals and what they do"

- Learns need to sound out the alphabet sounds while hopping in the hoops with both legs together.
- Repeat by changing direction while doing frog jumps in a circle
- Learners then stand in their hoop and jump to the left while saying "left"
- Learners jump to the right while saying "right"
- PROGRESSION: Decrease the time between jumps and include forward and backward direction.

Activity 3: Sounds of the ocean (letter recognition, proprioception, bilateral coordination)

"Sounds like the ocean, what sound does the ocean make and what sounds do letter make"

- Learners need to sound out the alphabet
- They then need to run around the circle of hoops
- Learners then hop in the hoops while singing the alphabet song in a circle.
- PROGRESSION: Switch to hop in between hoops, when the whistle blows, ask learners what letter/sound comes after another eg, "What letter/ sound comes after B, answer= C"

Activity 4: Helping carry the load (Proprioception, laterality, directionality, team work, bilateral coordination)

"Oh no, this farmer needs help with his load, let's help him"

- Learners stand in a circle.
- Place one learners behind a partner
- Learners will then position themselves in the wheel barrow position
- The presenter will instruct a direct" left right, forward, backward" and learners will have to move together in the direction.
- Switch partners and repeat.
- PROGRESION: Add a beanbag on the back of learner as the "wheelbarrow" and/ or can increase the time between direction commands.
- PROGRESSION: Learners can walk in the position with their partner 5m from cone to cone and pick up the beanbag, then switch.

Cool Down: Time to go home (letter sound recognition)

"It is time to head back home and relax after a fun day"

- Learners will complete static stretches while engaging in letter-sound recognition
  - Neck stretches
    - Ask learners about the body part and ask to sound out the letter N for neck.
  - Should circles
    - Repeat as above
  - Back stretch
    - Repeat as above
  - Hip circles
    - Repeat as above
  - Quadriceps stretch
    - Repeat as above

- Ankle stretches
    - Repeat as above

Term 2 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 9 May 2019

Time: 30 minutes

Theme: Getting fit for the Army

Focus: Number Recognition, Proprioception and Reaction Time

Equipment:

- Hoops
- Beacons
- Number cards

Warm Up: Getting Ready for battle (Reaction time, running skills, proprioception)

"It's time to train and get ready"

- Learners need to run inside the circle of hoops.
- When the whistle blows twice, learners need to drop down to the ground on their tummies.
- Repeat 4 time- include star jumps after they drop.

Activity 1: Counting all the equipment (number recognition, team work, addition and counting, tactile stimulation, spatial awareness)

"We need to make sure we have all our equipment before we can go"

- Divide learners into 2 groups eg boys and girls
- Call out a single digit number, and as a group, learners need to create the number using their bodies.

- In between each number, create a sum with the number used. Eg. If the number was one, ask the learners a sum with 1, eg, 1+2=2, 1+2=3.
- PROGRESSION: Ask learners to group themselves into the number you called out.

Activity 2: Camouflage like animals (counting, proprioception, spatial awareness, number symbols, number sequencing)

"Camouflage is a great way to stay hidden from opponents, just like animals do"

- Place hoops in 2 separate lines.
- Learners need to count each hoop as they jump in the hoop.
- Vary exercise: foggy jumps, bunny hop, one legged hop.
- PROGRESION: Give learners a number between 0 and 20 on number cards and get learners to sequence the numbers

Activity 3: Rounding up the troops (proprioception, running skills, reaction time, counting)

"Let's get everyone together to get ready"

- Place 10 hoops to form a circle.
- Learners need to run outside the circle until the whistle blows.
- When the whistle blows, learners need to find a hoop.
- Once all learners have found a hoop, they need to count how many learners are standing at that hoop.
- PROGRESSION: remove a few hoops every time and allow leaners to count and indicate how many learners are at one hoop.

Activity 4: Training for battle (Counting, number recognition, proception, bilateral coordination, strength)

"It's very important that we train to get stronger and faster"

- Place 4 hoops spaced out in a line and place another 4 opposite it.
- Learners need to run to each hoop and complete an exercise amounting to the number indicated. Ie. The number is 10, learners need to complete 10 scissor jumps, star jumps, burpees, push ups.
- PROGRESSION: Increase the distance between the hoops and increase the number called out in small increments.

Cool Down: Relaxing after a hard day (dynamic stretches, team work, proprioception)

"It's time to relax after a hard day"

- Learners pair up
- Complete the following stretches as pair:
    - Back stretch
    - Lateral stretch
    - Upper back stretches
    - Chest stretches
    - Quadriceps stretches

Term 2 Environment: Field/Classroom

Presented by: Carynne Fisher Date: 13 May 2019

Time: 30 minutes

Theme: Our bodies

Focus: Laterality, Counting and Body awareness

Equipment:

- Hoops
- Counters
- Beanbags
- Cones
- Colour dots

Warm Up: Walking Around (Reaction time, spatial awareness, cardiovascular fitness, strength)

"Let's get moving"

- Learners need to run on the sound of the whistle.
- When the red dot is shown, learners need to freeze.
- When the yellow dot is shown learners need to do 5 star jumps
- When the green dot is shown learners need to do 5 push ups
- Ask learners to point out where certain body parts are= legs, knees, nose, eyes, ears, mouth, hands, feet, hips, ankles

Activity 1: different movements our bodies can do (Counting, number recognition, sequencing and patterns, counting backwards, proprioception, bilateral coordination, rhyme and timing)

"Let's explore the different movements that our bodies can do and see which ones we like the most"

- Learners will be taught a series of movement to count to.
- First movement will be straddle jump from the standing position, learners will then repeat the number 1.
- Second movement will be a scissor jump and learners will repeat the number 2.
- Third movement will be a star jump and while arms are extended above the head, learners repeat the number 3.
- Fourth movement will be a squat position, and learners will repeat the number 4.
- The fifth and last position will be a full 360◦ rotation and learner will repeat the number 5.
- PROGRESSION: Learners need to do the action to music while trying to stay on the count.

Activity 2: How many? (Number recognition, proprioception, organising and number sequencing, addition, number value and position)

"Let's keep moving our bodies and count together"

- Place hoops in a circle with a number inside. Numbers are 1, 3, and 5.
- Children will need to hop, skip and run around the circle or on the spot.
- When the whistle blows, learners need to stop and answer the question. Which number is the smallest number= 1
- Children then hop, skip or run around the circles until the whistle blows and answer which number is the biggest number=5

- Learners hop, skip or run around the circle until the whistle blows and answer, which number is the bigger than 1 but smaller than 5= 3 (Can use bean bags as the concrete objects they can count)
- PROGRESSION: Ask leaners to count how many ones make 3 and how many ones make 5. Increase the numbers in the middle, 15, 20, 25 Can ask learners to add numbers as well. PROGRESSION: Instead of run, learners can jump in the spot, run on the spot or do scissor jumps

Activity 3: How many body parts (proprioception, balance, body awareness, spatial awareness, colour recognition, counting)

"Counting can be fun, let's try to recognise the colours and count together"

- Learners need to run around the circle.
- When the whistle blows, learners need to freeze.
- A colour will be called out and learner need to run to that colour hoop.
- They then need to count how many learners are in their group and tell the teacher.
- PROGRESSION: Ask learners to count how many arms/ legs/ shoes are in their group.
- Provide counters for learners to be able to count concrete objects and indicate the

Activity 4: We have many body parts (body awareness, addition, counting, proprioception)

"Can you count the amount of body parts in your group"

- Divide learners into groups
- Learners need to count how many hands in their group.
- Then complete that amount of bunny hops.
- Learners need to count how many noses are in their group.

- The complete that amount of star jumps.

Cool Down: How to relax our bodies (dynamic stretches, body awareness)

“Our bodies can move but it can also move in ways that can relax us”

- Allow learners 5 minutes of free play.
- Gather all learners into a big circle.
- Learners need to follow the stretches:
  - Head and neck stretch
  - Hip circles
  - Touch the toes

Term 2 | Environment: Classroom/Field

Presented by: Carynne Fisher | Date: 15 May 2019

Time: 30 minutes

Theme: Fun in the Sun

Focus: Letter-Sound recognition, Proprioception, Body awareness,

Equipment:

- Music
- Alphabet mat
- Alphabet cards

Warm Up: Rise and Shine warm up time (proprioception, listening skills, counting)

"Rise and shine everyone, let's have some fun and get our bodies warn and moving"

- Learners line up in a rows.
- Play the "It's Warm Up time" song.
- Learners need to follow the instructions of the song.

Activity 1: Learning about the animals (letter recognition, letter-sound recognition, alphabet)

"We can always learn about the animals when we go outside"

- Sing the phonics song with children and include the actions of the animals and words, while standing in a circle.
- A is for ant, sound the a sound aaa

- B is bat, sound the b sound bbb
- C is for cat, sound the c sound ccc
- D is dog, sound the d sound ddd
- E is for elephant, sound the e sound eee
- F is fox, sound the f sound fff
- G is giraffe, sound the g sound ggg
- H is for hippo, sound the h sound hhh
- I is igloo, sound the I sound iii
- J is for jackal, sound the j sound jjj
- K is for kangroo, sound the k sound kkk
- L is for leopard, sound the l sound lll
- M is for mouse, sound the m sound mmm
- N is for net, sound the n sound nnn
- O is for octopus, sound the o sound ooo
- P is for penguin, sound the p sound ppp
- Q is for quick, sound the q sound qqq
- R is rabbit, sound the r sound rrr
- S is for snake, sound the s sound sss
- T is for tiger, sound the t sound ttt
- U is for umbrella, sound the u sound uuu
- V is for vampire, sound the v sound vvv
- W is for whale, sound the w sound www
- X is for x-ray, sound the x sound xxx
- Y is yellow, sound the y sound yyy

- Z is zebra, sound the z sound zzz

Activity 2: Building words in the sun (proprioception, dynamic balance, bilateral coordination, letter recognition, word building, laterality, directionality)

"let's build some words while we're in the sun"

- Learners stand in a circle
- A two-letter word will be given for learners to build using the alphabet mat.
- Group will be in a circle
- In between words need to complete 5 of the following exercises
  - Running
  - Bunny hopping
  - Hopping on one leg
  - Skipping
  - Bear crawls
- Give another 5 2 letter words for children to build.

Activity 3: More animal moves! (reaction time, cardiovascular fitness, proprioception, bilateral coordination)

"We can across some more animals while we were exploring outside"

- Divide learners into 4 groups and place them opposite each other.
- When the whistle blows, learners need to run the relay and tag their partner opposite.
- Vary exercises of the relay.
- Run, bear crawl, crab walk.

Activity 4: Free fun in the Sun (free time- unstructured play)

"Let's play in the sun"

- Allow the learners 5 minutes of free play.

Cool Down: Time to go home (mindfulness, listening skills, body awareness)

"We had some great fun in the sun and now it's time to head back home."

- Learners need to sit wit their eyes closed and follows the instructions.
  - Close your eyes and imagine a balloon blowing in the wind.
  - Follow the balloon as it flows in the sky, above the trees, into the clouds.
  - Lay down on your back and watch the balloon go into the clouds and disappear.
  - Lay quietly and still and listen to all the sounds around you.
  - Remain silent for 1 minute before asking the learner to slowly get back up.

Term 2 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 20 May 2019

Time: 30 minutes

Theme: Dance

Focus: Coordination, Body Awareness, Spatial Awareness, Proprioception and Letter-sound Recognition.

Equipment:

- Music

Warm Up: Animals (letter recognition, rhythm, body awareness, spatial awareness, letter-sound recognition)

"Can you dance like an anima?"

- Play the "Animal Song" and children need to follow the instructions.
- Pause in between and ask children what animal it is.
- Ask children to identify what letter the word starts with.
- Ask children to sound out the letter it starts with.
- Eg. Monkey, starts with an M, sounds mmmm

Activity 1: Hokey Pokey (body awareness, spatial awareness, laterality, directionality, reaction time, balance)

- Play the Hoke Pokey song and learner need to follow the instruction.
- Emphasis here is on laterality thus it is important to assist learners if they get confused with their leg and right.
- This is great for body awareness as well.

- PROGRESSION: Stop the music and sing the song together, sing the song faster and faster.

Activity 2: Baby Shark (coordination, dynamic and static balance, rhythm, laterality, directionality, proprioception)

"Sharks love to dance in the water, let's see if we can dance just like them"

- Play the song and children can freely move their bodies.
- Stop the music at any time, and learner will need to freeze.
- Provide a commandment for laterality eg, balance on your right leg, touch your left foot.
- Repeat and encourage learners to vary their movements and use their entire body eg, scissor jumps, hops on two legs.

Activity 3: Short Dance (coordination, rhythm, dynamic balance, proprioception, laterality, directionality, special awareness, body awareness, counting)

"Before we go, let's try to learn a fun dance you can do at any time of the day"

- Play any song with a consistent rhythm.
- Learners need to follow the instructions to learn the short dance.
- Step to the right and jump on two leg then step to the left and jump.
- Jump forwards and wiggle the body and the backwards and wiggle the body
- PROGRESSION: When jumping from left to right, whisper on 1 and shout on 2, and so forth to learn about counting in 2's. Can add a clap for every odd or even number.

Activity 4: The Animal Story (letter recognition, proprioception, measurement)

- Learners stand in a circle and follow the direction of the instructor.

- Learners need to follow the instructions of the story for different sounds and different proprioceptive feedback.
- The rabbit was hopping along the meadow fields smelling all the flowers- learners hop in circle.
- He then found an elephant walking, very heavily – learners need to stop hard and use their arms as a trunk.
- He walked to the watering hole where he found a bird flying- learners need to run and flap their arms like a bird.
- PROGRESSION: And bear walks and add the sounds of the animals and the sounds of the letters of the word. Ie, rrr for rabbit. Ask learners which is a heavier/bigger- the rabbit or the elephant etc.

Cool Down: Calming (rhythm, coordination, body awareness, spatial awareness, dynamic balance)

"Our bodies can dance slowly too, follow me"

- Play a calming song.
- Learner will follow the movements of the instructor.
- Ensure movements are fluid and in all directions.
- End with learners standing still and closing their eyes and think about what they did, what their bodies did and what they learnt.
- Take a group photo.

Term 2 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 24 May 2019

Time: 30 minutes

Theme: Animal Park

Focus: Proprioception, measurement, counting and letter-sound recognition.

Equipment:

- Sandbags x2
- Cones
- Music

Warm Up: Big and small (spatial awareness, measurement, proprioception)]

"While in the animal park, can see which animals small and which animals are big"

- Play the animal song
- Learners can sing along and ask learners which animals are smallest compared to the biggest animals mentioned in the song.

Activity 1: Dung beetles (proprioception, measurement, spatial awareness)

"Look at the beetles, they are able to push a lot of wright. Let's see how much weigh we can lift."

- Group sits in a circle
- Learners need to sit in a circle with knees touching.
- Slowly they need to pass the small sand bag to each other all the way around the circle.
- Switch the small bag for the big bag and ask learners which bag is heavier. (Ask what sound heavy starts with, answer= h)

- PROGRESSION: Use the smaller sandbag for them to pass around. When the whistle blows, the child holding the bag needs to sound out the following words (sun, sad, bed, mat, stop, shut, with, chop, chick when, flat, flag, flute,)
- PROGRESSION: Add a heavier sandbag to play catch, whereby one learner starts with the small ball and another starts with the big ball. Leaners need to try and get the big sandbag to catch the small bag.

Activity 2: Animal walks along (proception, bilateral coordination, dynamic balance, letter- sound recognition, spatial awareness, body awareness)

"All the animals in the park walk differently, let's try to walk like some of them."

- Learners stand in the circle
- Learners need to listen to the animal and to the right or left (state which direction) while doing the animal walk. On the whistle, they need to make the animal sounds as loud as they can.
    - Bear crawl
    - Crab walk
    - Monkey walk
    - Froggy jump
- PROGRESSION: Instead of the animal sound, learners need to sound out the letter of the word of the animal, i.e snake, ssss

Activity 3: Monkey run (colour recognition, proprioception, bilateral coordination, cardiovascular fitness, reaction)

"The monkeys are having race and want us to join them, let's go"

- Place 6 cones in the space.

- Children need to run around the space until the whistle blows, and a colour is called out.
- Once at the cone, they will need to complete an exercise for 15 seconds.
  - High knees
  - Star jumps
  - Scissor jumps
  - Tuck jumps

Cool Down: Animals can dance too (Body awareness, spatial awareness, rhythm, dynamic balance)

"Animals love to dance, dance before we say bye"

- Leaners need to sing the "**head, shoulders, knees**" song with the actions.
- PROGRESSION: Try sing the song faster and faster while doing the actions.

Term 2 Environment: Classroom/ Field

Presented by: Carynne Fisher Date: 27 May 2019

Time: 30 minutes

Theme: Numbers and Letters

Focus: coordination, letter recognition, number recognition, dynamic balance

Equipment:

- Music
- Counters
- Beanbag

Warm up: warm Up song (cardiovascular fitness, coordination, rhyme, dynamic balance, beat consistency)

"Time to warm up and walk and sound like the animals"

- Play the "Warm up" song and follow the instructions.
- Learners can be in a circle while doing this.
- Ask learners to identify animals from the song and what sound it starts with ie: tiger= t

Activity 1: Grouping Two's (counting in twos, number patterns, tactile stimulation, proprioception, upper body strength)

"Counting in two's can be so much fun"

- Learners stand in a circle.
- Instructor will stand in the middle and demonstrate counting in twos with the beanbags.
- Learner will count as well and count up to 10 in twos.
- Then complete 10 burpees.

- Divide learners into 5 groups and give each 10 counters.
- Learners need to use their counters to count in twos by grouping the counters in twos.
- If learners are not sure, learners can whisper the middle number and speak out the number representing the multiple of two.
- Leaners then need to complete 20 star jumps
- PROGRESSION: Add more counters so they count up to 20 in twos.

Activity 2: Painters and the Canvas (tactile stimulation, letter recognition, number recognition)

"We love to paint whenever we can. A painter always needs a canvas"

- Learners need to partner up
- One learner will be the artist and the partner will be the canvas.
- The artists will be shown a letter of the alphabet and then needs to draw this on the canvas back.
- The canvas needs to indicate what letter they think it is.
- PROGRESSION: include drawing numbers and two letter words.

Activity 3: slap count (counting, rhythm, beat consistency, proprioception, bilateral coordination)

"This is a fun new way to count, let's try it"

- Learners stand in a circle and follow the beat of the instructor
- Clap hands together and count
- Snap fingers and count
- Learners need to place their left hand over their partners and the right hand under the partners hand.

- The instructor will start by passing on the beat, all learners will first slap and past the beat with the left hand.
- Before switching hands and direction, learners need to complete the following sequence
    - 5 jumps
    - 5 star jumps
    - 5 scissor jumps

Cool down: Calming time (alphabet, sequencing and letter recognition, word building, imagery)

"Quietly singing and relaxing our bodies while we do so"

- Learners need to lie down on their back in a circle and whisper the "abc" song will eyes are closed.
- Ask learners to keep eyes closed afterward and write their name in the air using the writing hand.
- Learners to find a partner and give them a hug.

Term 2 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 4 June 2019

Time: 30 minutes

Theme: Stories with old man

Equipment:

- Cones
- Music

Warm Up: Old man and the Animals (proprioception, bilateral coordination, rhythm and beat consistency, spatial awareness, body awareness, static balance)

"Once upon a time there was an old man…"

- Story time
- Learners stand in a circle and start by walking.
- Tell an active story whereby learners need to keep moving.
    - One day an old man was walking hunching slowly in the forest.
    - He came across a big bear walking and growling as he was hungry.
    - The bear was walking and decide to stand up and growl- growl like a fierce bear.
    - Learners keep walking as bear can across a tall tree with it's branches waving – walk tall with arms waving in the air.
    - Next to the tree came a strong horse galloping -gallop along
    - The horse stopped suddenly- learners freeze, as he came across very big boulder rolling down the hill- curl into a ball on your back and roll back and forth

Activity 1: Two is better than one (proprioception, bilateral coordination, counting, addition, number recognition, balance)

"One is good, the old man told the children, however two is even better"

- Learners pair up and stand opposite their partners.
- Learners need to complete an exercise
    - Quick feet for 15 seconds
    - 10 jumping jacks
    - 10 scissor jumps
    - Balance one leg
- When they hear the whistle, they need to freeze, the instructor will call out a number and ask what number comes before or after that number. IE, called out number 5, ask what number is before it, answer= 4
- PROGRESSION: Ask the x2 number patterns and what number comes afterwards.

Activity 2: March and Count (counting, proprioception, beat consistency, bilateral consistency)

"The old man told a story of when we went marching in the old days"

- Learners will stand in a circle.
- Together they need to clap their hands and clap while counting.
- Include stomping of the feet on beat with the clapping.
- Learners can whisper the numbers while stomping and clamping, then vary to shouting the numbers out loud.
- Switch it up to scissor jumping while counting.
- PROGRESSION: whisper on the ones and shout on the x2 tables. Ie, whisper 1, shout 2, whisper 3, shout 4.

- PROGRESSION: Count backwards from 20 while clapping/ stomping feet

Activity 3: Paint and Draw (tactile stimulation, unilateral coordination, strength, proprioception, midline crossing, shape recognition, cardiovascular fitness)

"The old man continued to tell his story and said that he used to love drawing and painting. Let's user our bodies to try and paint"

- Each learner uses their writing hand as a pencil.
- Instructor will hold his/her pencil to demonstrate.
- Symbols to draw in the air
    - Circle – ask learners to describe shape, how many edge/corners= none
    - Square- ask learners to describe shape, how many edge/corners= 4 equal lengths.
    - Triangle- ask learners to describe shape, how many edge/corners= 3 equal lengths, 3 corners
    - X -
    - Figure 8
- In between each symbol learners need to complete an exercise- 10 per exercise
    - Squats
    - Push ups
    - Sit ups
    - Burpees

Cool down: Time to head back (proprioception, bilateral coordination, coordination, rhythm, listening and speaking, memory)

"The old man said he needs to head back.

- Play a calming song.

- Learners need to follow the fluid movements instructed by the instructor.
- While doing so the instructor needs to ask children to recall what they did in the lesson.

Term 2 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 7 June 2019

Time: 30 minutes

Theme: Wacky Relays

Focus: Bilateral coordination, cardiovascular fitness, letter-sound recognition

Equipment:

- Cones and Beacons
- 6 Hoops

Warm Up: Tag- You're It (Running, cardio-vascular fitness)

"Tag, you're it is the name of the game"

- Learners need to run to the end on the court on the whistle.
- On the whistle, learners need to play on- on

Activity 1: Collection (proprioception, counting, subtraction, cardiovascular fitness)

"Wacky Relay time! Collect as many beanbags as you can"

- Divide group into 6 groups.
- Learners start behind the cones.
- Learners need to run and fetch a bean bag in the hoop and run to their opposite cone
- When the learner gets to the other end, learner needs to sit down.
- Once all teams have got to the other side, learners need to add up how many bean bags they have in their group.
- PROGRESSION: Learners need to hop on one leg to collect the bean bags.

- POROGRESSION: Ask learners how many their beanbags are left in their hoops and ask them to minus it from the amount that they have in their group.

Activity 2: Cartwheeling through the day (bilateral coordination, dynamic balance, tactile and imagery stimulation, letter-sound recognition)

"Like a windmill turns, let's cartwheel!"

- Learners will practice how to do a cartwheel
- Learner need to learn the stance.
- Then indicate how the hands need to move onto the ground.
- Show learners how the legs need to move, start by moving legs together then showing the action of the cartwheel.
- Finally show the full movement in real time.
- PROGRESSION: In between every 2nd or 3rd cartwheel, ask learners to draw the letter C in the air and sound out the letter ccc.

Activity 3: Body parts (cardiovascular fitness, static balance, laterality, directionality, midline crossing, bilateral coordination, spelling)

"Body Parks and left and right, here we go"

- Learners stand in a circle and need to run as fast as they can, when the whistle blows, they need to freeze and follow the instructions:
  - Freeze on your left leg
  - Freeze on your right leg
  - Freeze and put your right hand in the air
  - Freeze and put your left arm in the air

- PROGRESSION: ask learns to sound on the word of the body part " if you are balancing in your left leg, sound out leg- l e g."

Activity 4: Pairs and Beanbags (hand-eye coordination, throwing and catching, perception, proprioception, measurement and estimation)

"Time to have some fun catching and throwing"

- Learners pair up and one bean bag is given to each pair.
- Learners will practice throwing and catching with each other.
- PROGRESSION: increase the distance between learners and ask learners to describe the distance between each other.
- PROGRESSION: increase the distance between learners and ask them to try clap their hands once before catching the beanbag.

Cool Down: Let's stretch our bodies (dynamic balance, flexibility)

"After all that fun, let's relax and take a deep breath"

- Learners need to follow the instructions and complete the following stretches with a partner:
    - Back stretch
    - Chest stretch
    - Quadricep stretch
    - Hamstring stretch

Term 2 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 11 June 2019

Time: 30 minutes

Theme: Mr Wonka's chocolate factory

Focus: Proprioception, strength, midline crossing

Equipment:

- Cotton balls
- Bottle tops
- Stones
- 10 Hoops

Warm Up: Heading to the chocolate factory (Proprioception, dynamic balance, cardiovascular fitness)

- Learners need to be lined up
- Learners need to jog in formation behind the instructor and follow the following actions:
    - Hop on left leg
    - Hop on right leg
    - Hop on two legs
    - Sprint

Activity 1: Candy balls (proprioception, counting, cardiovascular fitness, number recognition, tactile stimulation, midline crossing)

"Willy Wonka has lost all of his candies, and we need to try and help him collect of them"

- Divide learners into 10 groups.
- Learners will to run, one at time, to fetch a cotton ball and place it into their hoop.
- Once they have all their cotton balls, together they need to add the cotton balls.
- Learners need to understand the concept of units and that if they have 5 cotton balls, it is made up of five ones.
- PROGRESSION: ask them to draw the number of cotton balls with their arms in the air.

Activity 2: Willy Wonka can't remember his directions (proprioception, bilateral coordination, laterality, directionality, midline crossing)

"Willy Wonka can't seem to remember his directions and we need to help find his way back to the chocolate factory"

- Place hoops in a circle
- Learners need to crawl around the circle.
- When you blow the whistle, call out a direction, left or right hand and learners to lift that hand in the air. Do the same for the leg.
- Progress to hopping like a karoo and when you call out a direction, learners need to jump to the left or to the right.
- PROGRESSION: Ask learners to touch their left foot with their right arm.

Activity 3: (counting tens, addition, counting, proprioception, bilateral coordination)

- Split learners into 3 groups.
- Learners need to run from one cone to the next to fetch a card with a sum on it.
- Learners need to take it back to their group and together they need to complete the sum by counting the tens and adding the units.

- PROGRESSION: change up exercises to the cone from running to crab walk, bear walks, scissor jumps

Activity 3: How much Mr Wonka (measurement, proprioception, estimation, teamwork)

"Mr Wonka needs help with collecting the ingredients to make his chocolate"

- Split learners in 3 groups
- Learners need to hop on two legs from starting cone to fetch sand and fill their bucket.
- Each learner will get a chance to go.
- When the whistle blows, learners need to describe in their buckets are half full, full or empty.
- PROGRESSION: hop on one leg from starting cone and run back.

Activity 4: Building Strength with the Oompa-Loompas (proprioception, strength, bilateral coordination, dynamic balance, number recognition, cardiovascular fitness)

"The Oompa-Loompas needed help with their songs and their strength, let's help them"

- Learners stand in a circle, one learner at a time, will get a chance to roll the big dice.
- Learners need to throw their dice and then do the amount of the following exercises:
    - Scissor jumps
    - Burpees
    - Sit ups
    - Push ups
    - Quick feet
- PROGRESSION: Ask learners what number comes before and after the number they rolled.

Cool Down: Mindfulness (relaxation, body awareness, spatial awareness, spelling, letter recognition, midline crossing, shape recognition)

"It's time to head back home after a fun day at the chocolate factory"

- Learners can sit or lie down in a comfortable position with eyes closed
- They need to listen to the instructor who will indicate for learners to concentrate on how their body is feeling.
- Focus on breathing in through the nose and out through the mouth.
- Focus on visualising their name and the letters in their name.
- Ask learners to spell out their name in the air using the hands.
- Ask learners to make shapes indicating with their arms and feet
    - Circle- arms
    - Square- fingers
    - Triangle- legs
    - Rectangle- arms

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 15 July 2019

Time: 30 minutes

Theme: Alice in Wonderland

Focus: time, number patterns, proprioception and strength

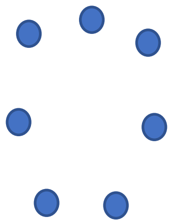
Equipment:

- Cones
- Beanbags
- Clock laminated sheets
- White board markers
- Number pattern charts
- Tissues

Warm Up: Running down the rabbit hole (running, galloping, proprioception, cardiovascular fitness, static balance, body awareness)

"Alice could not resist running in and out of the rabbit hole"

- Set cones in a circle
- Learners need to run around the cones.
- When the whistle blows learners need to freeze- ask learners need to freeze on left leg, right leg, to touch their knees, shoulders, elbows, left ear, right foot.



Activity 1: Alice helps the madhatter with his numbers (number patterns, counting, proprioception, bilateral coordination)

"The Madhatter is struggling with this numbers and Alice needs us to help him"

- Learners stand around the cones in the circle
- Learners need to count in 1's while doing star jumps
- Show learners the number patter chat in 1s
- Learners need to indicate what number is missing (16)
- Then complete that number of scissor jumps
- PROGRESSION: Learners need to count in 2's while jumping on the spot. Learners need to complete the missing number (20) of star jumps.

Activity 2: Alice, time and the clocks (proprioception, upper body strength, lower body strength, time, writing skills)

"Wonderland is all about time, clocks and adventure. Alice needs some help with time"

- Divide learners into 5 groups
- Each group will receive a clock laminated sheet with a white board marker
- Learners need to draw the hands on the clock to indicate the following times
    - 6 o'clock
    - Half past 8
    - 10 o'clock

- After they draw the hands, learners need to complete that amount of exercises
    - 6 – push ups
    - 8 lunges
    - 10 curl ups
- PROGRESSION: Let learners choose their own times to put into the clock and complete an exercise of their choice for the amount.

Activity 3: Alice in Wonderland (ordering, proprioception, bilateral coordination, measurement, upper and lower body strength)

"Wonderland has a lot of numbers floating around and we need to catch them and put work out the math"

- Learners stand in a circle
- Learners will be told a story sum with the bean bags and they need to calculate the answer together using the beanbags.
- "Alive found 13 clocks and then gave 5 to the rabbit. How many does she have left?"
- Learners need to then complete (8) squats.
- PROGRESSION: "Alive found 13 clocks and then lost 5. She then found 2. How many does she have left?
- Learners need to then complete (10) curl ups.

Cool Down: "Play time" (unstructured play)

"Alice and her wonderland friends love to have fun, it's time to just play and have fun"

- Allow learners 5 minutes of free time
- Take a group photo

Term 3 Environment: Classroom/ Field

Presented by: Carynne Fisher Date: 19 July 2019

Time: 30 minutes

Theme: Fun Games

Focus: cardiovascular fitness, hand eye coordination

Equipment:

- Word charts
- Cones
- Beanbags

Warm Up: Reaction Cone (cardiovascular fitness, body awareness, reaction time, bilateral coordination, hand eye coordination)

"This game is Reaction cone, try to bet your friend and get to the cone first to be the winner"

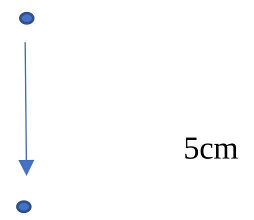
- Place cones in a line
- Pair learners up
- Lines stand in their pairs with the cones in between them
- Learners need to do fast feet.
- Call out body parts and learner need to touch the body parts while doing fast feet
- Call out "cone".

- Learners then need to try and get the cone first.
- The learner who does not get the cones, needs to complete 3 jumping jacks

Activity 1: Wheelbarrow (proprioception, teamwork, reading, upper body strength)

"The wheelbarrow race. One is the wheelbarrow and one is the farmer, the team that get back first is the winner"

- Divide players into pairs
- Line up cones 5 meters apart.
- When the whistle blows, learners need to wheelbarrow to the cone on the other end.
- Learners need to swap around and make it back to the cone.
- Show learners the word chart and ask learners to read the first column of words.
- Words on Word chart" us, we, the, box, spot, window, kitchen, bed, cat, bat, dog"
- PROGRESSION: Move onto the 5 letter words and ask learners to try and read them. Increase the distance between the cones.



Activity 2: Throw and Catch (hand eye coordination, throwing and catching,)

"The team that drops the bean bag the least, is the winner!" Time for Throw and catch"

- Pair up learners
- Each pair will get a bean bag
- Learners need to throw and catch the beanbag to each other
- PROGRESSION: Learner to clap their hand once before catching the bean bag. Clap twice before catching the beanbag.

Activity 3: Wacky Relays (cardiovascular fitness, teamwork, proprioception, reading, bilateral coordination)

"It's time for Crazy Wacky Relays!"

- Divide into 2 groups
- Place cone 10m apart.
- First leaner need to run to the opposite cone as fast as they can.
- Once they get to the other side, blow the whistle and the next person in the front of the line needs to run next.
- Team to get all their members to the other side, wins
- PROGRESSION: Place cones apart. In between, show the reading charts and ask learners to read the second column of words. Learners need to stand behind each other in their groups, holding each other's hips. Together they need to hop on two legs to the other cone, while holding onto to each other.

Cool Down: Tummy Teamwork (teamwork, abdominal strength)

"How strong are your tummy muscles?"

- Pair up learners
- Leaners need to sit opposite each other
- When the whilst blows, learners need to lift up their legs and touch the feet together and try to hold hands on the outside of their legs.
- Complete this five times
- Learners need to sit with their knees bent and feet touching and lying down on their backs.
- When the whistle blows, learners to lift into a sit up position and clap hands at the top position.

- Complete 5 times

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 23 July 2019

Time: 30 minutes

Theme: Fun with Numbers and Blends!

Focus: Spatial awareness, bilateral coordination

Equipment:

- Beanbags
- Cones
- 2 hoops

Warm Up: Body time (body awareness, cardiovascular fitness, reaction time)

"Let's see how well you know your body parts"

- Place cones in a circle
- Learner stand in front of a cone
- Learner need to do fast feet and listen for the body part
- When you call out a body part, learners need to touch the body part
    - Elbows
    - Hips
    - Eyes
    - Eyebrows

- Head
- Shoulders

- When you call out cone, learners need to pick up the cone in front of them as fast as they can.

Activity 1: Numbers Adding (counting, proprioception, bilateral coordination, addition, subtraction, upper body strength)

"Adding of the beanbags, let's do this!"

- Learners to be in a circle around the cones
- Place bean bags in the middle of the circle
- Learners need to count to 30 while doing star jumps
- Set out 6 bean bags in one pile and 7 bean bags in another. Ask learners to add the numbers together.
- Complete (13- answer above) tuck jumps
- Learners need to add 3 bean bags and 4 bean bags together = 7
- Learner then need to complete 7 push ups
- PROGRESSION: Add a subtraction sum and complete that amount of curl ups

Activity 2: Human Rope (Dynamic balance, body awareness, spatial awareness, teamwork)

"Can you hold the human rope without letting it break"

- Learners stand in a circle
- Leaner will hold hands in the circle
- Place a hoop in between 2 learners' hands.

- Learners need to try to get their bodies through the hoop without letting go of their hands
- When the whistle blows, ask learners to answer a question, what number comes after 15 if counting in ones.
- PROGRESSION: Add a second hoop. When the whistle blows, ask learners need to answer a question, what number comes after 18 if counting in twos.

Activity 3: Blending is so fun (blends, letter-recognition, object identification, proprioception, bilateral coordination)

"Blending can be so fun, our words use letters to create blends too. Let's see who many blends we can see in the words"

- Learners will be in the circle
- Show learners the blend **sh- shark**
- Learners need to identify the blend and the picture with it.
- Ask leaners to give words that have the blend in it.
- Sing baby shark with the actions.
- Show the blend **st- star**
- Learner need to identify the blend and the picture.
- Ask learners need to give words that have the blend in it.
- 10 Do star jumps
- Show learners the blend **fr**
- Learner need to identify the blend and the picture.
- Ask learners need to give words that have the blend in it
- Do 10 froggy jumps

Cool Down: Calming Down (dynamic stretching, breathing exercises, body awareness)

"Blending letters and number can make us tired, but we know how to relax"

- Learners need to stretch
    - Leg extensions
    - Toe touches
    - Knee hugs
    - Reach up on tippy toes
- Take a group photo

Term 3 Environment: Classroom/ Field

Presented by: Carynne Fisher Date: 25 July 2019

Time: 30 minutes

Theme: Fun builders

Focus: Bilateral coordination, cardiovascular fitness and letter-sound recognition

Equipment:

- Cones
- White boards
- Alphabet cards
- Paper Cups

Warm Up: Move and Freeze (dynamic balance, cardiovascular fitness, body awareness, laterality, reaction time)

"Can you move quickly and freeze quickly. Let's see how quickly you can move and freeze"

- Leaners will run in the circle
- When the whistle blows, learners need to freeze and follow the instruction

- Do the aeroplane on the left leg
- Aeroplane on the right leg
- Touch your back
- Touch your hips then ankles
- Touch your knees

Activity 1: Cone relays (Cardiovascular fitness, teamwork, bilateral coordination)

"How fast can your team run! Try to get your cone on the other side first"

- Divide class into 2 groups
- Place cones 10m apart
- Learners will be given beacons in their groups.
- Each learner needs to run and place the beacon on the last cone and then and run back to their group and sit down at the back of the line.
- The first group to get all their beacons on the cone, wins
- PROGRESSION: Place the last cone another 2-5m apart.

Activity 2: Word builders (Cardiovascular fitness, spelling, teamwork)

"How well can your team work together to build the words"

- Keep learners in their 2 groups
- Place 4 cones in a line for each group about 2m apart.
- Learners will need to run one at time to collect a letter by their cone.
- Once they return to their group.
- Each group needs to create the word given to them on a white board with the alphabet cards provided. One group word will be "**flag"** and the other will be **"jump"**
- Repeat and add words: **flute** and **ripe**

- PROGRESSION: Add the 5 letter words and letters that they do not need that they need to eliminate. Ask learners that need to spell their own word with the letters provided.
- PROGRESSION: Increase the distance of the cones.

Activity 3: Tower builders (spelling, bilateral coordination, teamwork, motor planning, cardiovascular fitness, bilateral coordination)

"A fun builder can build anything, let's try to build a tower"

- Divide learners into 2 groups
- Place cones 10m apart
- Stack paper cups in a formation, 5,4,3,2,1
- Leaners need to run and fetch one cup at a time and try to rebuild the tower on the other side
- PROGRESSION: Add letters on the cups and learners need to place the cups into the words
  - Jump
  - Shop
  - King
  - Sink

Cool Down: Body builders (body awareness)

"Can you build the awareness of your body"

- Learners to stand in a circle
- Play Simon say while focusing on the following body parts
  - Eyes
  - Elbows
  - Feet

  - Ears
  - Shoulders

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 26 July 2019

Time: 30 minutes

Theme: Fun in the forest

Focus: cardiovascular fitness, letter-sound recognition, proprioception

Equipment:

- Blend Cards
- Whiteboards pens
- Whiteboards
- Clock Cards
- Cones
- Beacons
- Speaker and music

Warm Up: The journey to the forest (body awareness, laterality, bilateral balance)

"Let' go to the forest"

- Learners line up behind each other in one line
- Learners will follow the instructor and follow the actions
- Start by running at a comfortable pace.
- Progress to hopping on the left leg.
- Then hop on the right leg.
- Continue to run while making alternative circle with the arms
- Continue to run backwards.
- Ask learners to identify the following body parts
- Left arm
- Right foot
- Left elbow
- Chest
- Hips

Activity 1: Caterpillars in the forest (proprioception, teamwork, spelling)

"Look at the caterpillars in the forest, let's help them with what they are doing"

- Divide learners into 2 groups
- Place 2 cones 10m apart
- Select the first five learners from each group.
- Together, each group needs to caterpillar hop to the other by crouching and holding onto each other' hips the entire the time.
- When leaners get to the cones, they need to identify the blend card.
- As a group they need to write down one word that has that blend in it.
- They then need to run back and sit at the back of the line.
- Blends to include:

- Ch
- Fl
- Ck
- Th
- PROGRESSION: Add 2 more learners for the caterpillar hop and ask learners to write down 2 or 3 words with the respective blend.

Activity 2: Frogs (proprioception, time, teamwork, laterality)

"Look at all the frogs hopping along the lake, can you hop like the frogs before the sun goes down"

- Learners to remain in their 2 groups by their cones
- First 5 learners will hop one at time to their opposite cone, by doing froggy jumps
- Once the learners get to the other side, they need to draw the hands on the clock cards to how that it says 08.30.
- Learners will run back to the back of the line.
- Include times:
- 06:30
- 10:30
- PROGRESSION: 2 learners need to frog jump together behind each other while the learner at the back hold onto the learner's hips or top.

Activity 3: Runners and caterpillars (cardiovascular fitness, proprioception)

"We have to catch the runners and save the caterpillars"

- Learners to remain in 2 groups
- Place cones 12m apart

- Learners need to run one at a time to the opposite cone as fast as they can.
- Once they get to the cone, they need to sit down.
- First team to have all their members seated at the end cone, wins!
- PROGRESSION: As a team they need to caterpillar hop to the other cone. First team to the other cone wins.

Cool Down: Loose Rhythm (rhythm, coordination, static balance, reaction time)

"Loosen up those muscles"

- Play song.
- Learners need to dance and move until the music stops, last one to freeze, sits down.
- Play until only 1 person left.

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 29 July 2019

Time: 30 minutes

Theme: Beach Games

Focus: Number pattern, cardiovascular fitness

Equipment:

- Cones
- Shape discs
- 5 Timecards
- White board markers
- 2 hoops

Warm Up: Fun on the sand (cardiovascular system, number recognition, proprioception)

"Look at the Starfish moving and jumping on the sand"

- Place 20 cones in a line
- Learners will pair up and stand opposite each other with the cone in between them
- Learners need to complete star jumps until the whistle blows

- When the whistle blows, learners need to try and pick up the cone first
- In between, ask learners to hold up their fingers indicating the called-out number
    - 5
    - 7
    - 8
    - 9
    - 10

Activity 1: Shapes on the sand (shape recognition, organising and sorting, cardiovascular fitness)

"Let's build shapes on the sand"

- Divide learners into 5 groups
- Place cones 10m apart from each group
- Learners need to run one at time to fetch a shape disc and sit down once they have picked up their shape.
- Once all learners are seated in their group, they need to organise their shapes into the shape groups
    - Ie; they need to place all the squares together
    - All the triangles together
    - All the circles together
- PROGRESSION: Learners need to crab walk to get from one cone to the next

Activity 2: Sand clocks (Time, cardiovascular fitness, team work)

"There are sand clocks with missing hands, let's add the hands to the clock"

- Divide learners into 5 groups
- Place 10m cones apart from each other for each group

- Learners to run from their starting cone to the opposite end cone
- Once their full group gets to the other side, learners need to use the white board marker to make the hands on the clock indicate the following times
    - Half past 8
    - Half past 10
- PROGRESSION: Learners need to bunny hop from cone to cone.

Activity 3: Sandy Shapes (shape recognition, organising, laterality, directionality)

"The shapes in the sand all need to be organised, let's get them"

- Keep learners in their groups
- Place 10m cones apart
- Learners need to hop on 2 legs to get from the starting cone to the end cone
- They need to pick up a shape
- Once their group is all seated, learners need to place shapes in the order instructed
    - Place all the square together, Place the triangles in front of the squares
    - Place the circles together, Place the square behind the circles
    - Place the circles together, place the squares to the left of the circles
- PROGRESSION: Learners need to hop on the left/ right leg

Cool Down: The sun is going down (spatial awareness, body awareness, motor planning, teamwork)

"The sun is going down and our time at the beach has ended"

- Learners need to stand in a circle holding hands
- Place the hoops around the arms of 2 learners
- Together they need to pass the hoops to each other only using their bodies

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 1 August 2019

Time: 30 minutes

Theme: Farmers working

Focus: proprioception, letter- sound, number pattern recognition

Equipment:

- Number pattern cards
- Alphabet cards
- Whiteboard and markers
- Cones and beacons
- Robot colour cards, yellow, green and red
- Sand Bags

Warm Up: Follow the robot (reaction time, colour recognition, static balance, laterality, body awareness, proprioception)

"There are many robots on the road, we need be quick as they are changing so fast"

- Learners line up on the line
- Instructor stands in front of them about 10m
- Learners need to run until the whistle blows and then freeze
- When learners see the green card, they need to run on the spot as fast as they can.
- When they see the yellow card, they need to do star jumps.
- When they see the red card, they need to freeze on their left leg.

Activity 1: Something is missing on the farm (cardiovascular fitness, number pattern recognition, counting)

“Oh no, these patterns have missing numbers, we need to complete the pattern”

- Divide learners into 4 groups
- Place starting cone and end one 10m apart
- Learners need to run to the other cone one by one.
- Once the group is on the other side, they need to identify the number pattern and right down the missing number
- PROGRESSION: Instead of running do the following;
    - Bunny hop
    - Crab walk

Activity 2: The farms needs building (Proprioception, letter recognition, word recognition, reading, sounding, strength, cardiovascular fitness)

“every time we build a word, the farm gets repaired. Let’s do it”

- Place learners in a circle
- Each one to stand by a cone or beacon
- Place alphabet cards in the middle

- Write a word on the whiteboard and ask learners to read it
- Then select a few learners to build the word with the alphabet cards
- Words to build
    - Flute- fl
    - Shop- sh
    - King- ng
    - St- star
- In between each blend, complete the following exercises
    - 10 star jumps
    - 10 scissor jumps
    - Plank for 10 seconds
- PROGRESSION: Don't write the word on the whiteboard, try to let the learners build the word on their own by sounding out.
- PROGRESSION: Increase exercises to 15

Activity 3: Farmer and the Rabbit (proprioception, measurement, teamwork)

"The farmer needs help catching the rabbit that keeps eating his vegetables. Let's help him catch it"

- Learners stand in a circle
- They need to pass around the light sandbag
- When the whistle blows, they need to freeze, and learners need to answer a question:
    - Is an elephant lighter or heavy than an ant?
    - Is a dog heavier than a mouse?
    - Is a lion heavier than a cat?
- PROGRESSION: Add the heavier sandbag in the circle

Cool Down: We have restored the farm (dynamic stretching, breathing exercises)

"We helped the farmer restore his farm Hooray!"

- Allow learners some free time
- Take group photo

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 6 August 2019

Time: 30 minutes

Theme: Alphabet land: Words and their meanings

Focus: cardiovascular fitness, strength

Equipment:

- Alphabet cards
- Whiteboards and markers
- Cones and beacons
- Colour balls
- Math cards

Warm Up: Cone freeze (cardiovascular fitness, reaction time)

"Time to move as fast as you can and freeze as fast as you can"

- Place beacons around the open area
- Children need to run around until the whistle blows.
- They then need to find a cone to stand by as quickly as they can.

- Start removing cones and eliminating learners if they are the last one to find a cone.
- In between, last leaners to provide a word that starts with the letter "a" "d" "g" "k"

Activity 1: Building words (cardiovascular fitness, sounding, writing)

"In alphabet land, we need to build words to keep moving."

- Divide learners into 6 groups
- Place a starting cone in front of each group, a cone 10m away and another cone 5m further.
- Learners need to run from the first cone to the second, pick up a letter and then sit down.
- Once all the learners are there, they need to build the given word with their letters.
    - Window
    - Garden
    - Present
- They then need to run to the last cone to write the word that they built.
- PROGRESSION: Crab walk

Activity 2: Words and Colours (cardiovascular fitness, colour recognition, organising, maths vocabulary)

"The land is filled with letters and colours, but the colours have lost their partners, we need to get all the colours back together"

- Divide into 6 groups
- Place colour balls in between 2 cones 10m apart
- Learners need to run and collect one ball and run to the end cone
- Once the entire group has made it to the end cone, they need to organise the balls according to colour.

- PROGRESSION: learners need to indicate using the cards, which ball group has "more" or "less"

Cool Down: Alphabet lands has been such fun (dynamic stretching, sounding)

"Time to get going home"

- Learners need to stretch
  - Head and neck
  - Arm circles
  - Chest and back stretch
  - Ankle stretch
- Ask learners about what they learnt today

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 8 August 2019

Time: 30 minutes

Theme: Mathematics Land

Focus: cardiovascular fitness, strength, counting

Equipment:

- Word sum cards
- Whiteboards and markers
- Cones and beacons
- Pebbles
- Bean bags

Warm Up: Find the cone (cardiovascular fitness)

"Pick up as many as you can for us to get to Math City"

- Place beacons around the open area
- On the whistle children need to try and pick up as many cones and beacons as they can.

- The one with the greatest number of cones and beacons is the winner

Activity 1: Can you solve it! (counting, addition, subtraction, upper body strength, abdominal strength)

"We have arrived in Math City and now we need to solve the word sum problems"

- Place cones in a circle
- Learners need to stand by a cone or beacon
- Read through the first word sum problem and select 2 learners to put out the amount of bean bags mentioned in the word sum.
- Learners need to complete the word sum with the use of the bean bags to add and subtract.
- Complete the following for the answer:
    - Push up
    - Curl ups
    - Tuck jumps
    - Scissor jumps
- PROGRESSION: Divide into 5 groups and learners need to use the pebbles to work out the answer of the sum. Leaners need to write down the answer on their whiteboard

Activity 2: Colourful Math lake (strength, counting, number patterns, proprioception, listening skills, subtraction)

"Jumping on the lippy pads of the lake will get us across and to the new road"

- Learner stand in the circle again
- Learners to count in 5s up to 100 while completing star jumps
- Learners then need to count in 3s while jumping on 2 legs

- PROGRESSION: Give learners a word sum to complete and then complete the amount of push ups.
    - If Kate has 15 sweets and she gives 3 to Mark, how many does Kate have left.

Cool Down: Flex and Stretch towards the bus (dynamic stretching, flexibility, laterality)

"Let's see you flex and stretch your muscles to get the bus here and head back to school"

- Learners need to place their right hand over the shoulder and behind their back, they then need to bend the left hand and go behind their back to try and touch their fingertips together.
- Switch sides
- Complete the following stretches:
    - Hamstring stretches
    - Chest stretches
    - Arm circles
- Hug a friend
- Ask learners about what they learnt today

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 12 August 2019

Time: 30 minutes

Theme: Fun Land

Focus: Sounding, cardiovascular fitness, strength

Equipment:

- Cones and beacons
- Colour balls
- Hoops

Warm Up: Grab a ball (cardiovascular fitness, colour recognition, counting)

"Fun land is filled with many things, like colourful balls. Let's try to get as many as we can"

- Place balls in an open area
- Place 4 hoops within the area
- When the whistle blows, learners need to run and fetch one ball at a time and place it in a hoop
- Ask learners to count how many balls are in the hoops

- Vary between running, jumping, galloping and hopping

Activity 1: To open the fun door, we must move all the sand in front of it using the wheelbarrow (proprioception, strength, teamwork)

"Let's wheelbarrow and get that door open everyone"

- Divide learners into 6 groups
- In the groups, pair the learners up
- Learners need to wheel-barrow from one to the next and then switch sides and make their way back to the first cone
- PROGRESSION: Increase the distance of the 2 cones

Activity 2: Pass it on (strength, proprioception, directionality)

"Oh no, there are boulders blocking the way to the fun pool, we need to move them"

- Divide learners into 2 groups
- Learners need to pass the sandbag over their heads to the person behind them
- Change the direction from behind and start at the back to move the sandbag forward
- PROGRESSION: Switch to the heavier sandbag

Activity 3: Balls of fun (cardiovascular fitness, counting, proprioception, dynamic balance, hand-eye coordination)

"These balls do not like to stay in one hoop. Let's move them"

- Place 4 hoops in the open space
- Learners must run and collect one ball at a time and fill a different hoop
- When the whistle blows, learners need to count the balls in each hoop and see which hoop as the most and the least

- PROGRESSION: Learners need to hop on one leg, and switch legs when the whistle blows twice

Cool Down: Fun land is closing for the day (dynamic stretching, flexibility, laterality)

"We had so much fun today and it's time for fun land to close"

- Learners need to place their right hand over the shoulder and behind their back, they then need to bend the left hand and go behind their back to try and touch their fingertips together.
- Switch sides
- Complete the following stretches:
    - Hamstring stretches
    - Chest stretches
    - Arm circles
- Hug a friend
- Ask learners about what they learnt today

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 14 August 2019

Time: 30 minutes

Theme: Sharing with friends

Focus: cardiovascular fitness, sharing, strength, proprioception, grouping and sharing

Equipment:

- Cones and beacons
- Beanbags
- Pebble

Warm Up: Running with our friends (cardiovascular fitness, laterality, reaction time)

“Who is the fastest runner”

- Place hoops and cones in one big circle
- Learners need to run to the left of the circle
- When the whistle blows, learners need to find a cone and stand behind it
- Repeat to the right.
- Start eliminating cones until there is only one left.
- The first one to the last cone is the winner

Activity 1: Sweets bowl (proprioception, strength, sharing, word sums)

"There are many sweets in the sweets bowl, let's see how we can share them with our friends"

- Learners stand in the circle by their cones
- Place beanbags in the circle for the story sum
- Select 3 learners to perform the story sum
- Story sum: (First child's name) has 10 sweets (beanbags) and wants to share them equally with her (second child's name) and (third child's name). How many will each friend have?
- The first learner needs to share the bean bags one by one, with each friend.
- Ask the children, how many beanbags does each child have: Answer = 5
- Complete 5 star jumps
- Make 2 more of your own story sums involving sharing and complete that number of
    - Push ups
    - Curl ups
    - Tuck jumps
- PROGRESSION: Increase the number of repetitions learners need to do.

Activity 2: Sweetie Run (cardiovascular fitness, hand eye coordination, grouping)

"Our friend, Anne, dropped all the sweets on the ground, so we need to help her collect them"

- Divide learners into 6 groups.
- Place a starting cone and an end cone 5m apart.
- Place 6-8 beanbags in between their start and end cone
- Learners need to run one at a time and collect one bean bag and sit down at the end cone

- Once all learners are at the end cone, they need to group the beanbags as follows
  - Make groups of twos
  - Makes groups of threes
  - Make groups of fours.
- PROGRESSION: Increase cones to 10m and tell learners they need to run as fast as they can

Activity 3: Group Sharing (strength, sharing, teamwork)

"So many sweets have fallen out of the bowl, so let' group them and share them with all our friends"

- Divide learners into 6 groups and give each group a word sum card with pebbles
- Each group needs to use the pebbles to work out their answer.
- PROGRESSION: In relation to the answer, do the amount of:
  - Push ups
  - Curl ups
- PROGRESSION: Give a more difficulty story sum

Cool Down: What did we learn today (dynamic stretching, flexibility, laterality, body awareness)

"Sharing with friends and groups can be so much fun"

- Learners need to place their right hand over the shoulder and behind their back, they then need to bend the left hand and go behind their back to try and touch their fingertips together.
- Switch sides
- Complete the following stretches and ask learners what they learnt today about sharing and grouping:

- Hamstring stretches
- Chest stretches
- Arm circles

Term 3 Environment: Classroom/Field

Presented by: Carynne Fisher Date: 19 August 2019

Time: 30 minutes

Theme: Going Camping

Focus: Proprioception, Grouping

Equipment:

- Colour balls
- Hoops
- Sacks/ pillowcases
- Cones
- Rope

Warm Up: Let's go camping (proprioception, team work, cardiovascular fitness)

"Let's go camping boy and girls, on the road we go!"

- Place learners in 2 groups
- Place 4 cones in a square
- Learners need to line up one behind the other and crouch down onto their haunches.
- They need to place their hands on to person's hips in front of them.
- Together they need to caterpillar hop around the square

Activity 1: Sharing (proprioception, strength, grouping, word sums)

"We have made it to camp site, now we need to collect all the equipment"

- Place learners into 6 groups, each group lined up behind a starting cone.
- Place a starting cone and an end cone 8m apart, with 6-10 colour balls at the end cone
- Learners need to step into the sack or pillowcase and hop when the whistle blows, pick up a bean bag at the end cone and hop back to their group
- Once learners are collected their beanbags, they need to make groups of
    - 2
    - 3
    - 5
- PROGRESSION: Make groups that have a remainder

Activity 2: Collecting firewood (proprioception, cardiovascular fitness, sharing, teamwork)

"Time to collect wood for the fire everyone"

- Keep learners in their groups, in pairs
- Place starting and end cones for each group 5m apart
- Each pair needs to wheelbarrow from their starting cone to the end cone. They then need to switch and wheelbarrow back to the start cone.
- Then learners need to run one at a time to the end cone and collect a colour ball.
- Once back in their groups, learners need to group the balls
    - According to colour blue
    - According to colour purple
- PROGRESSION: Make groups of 3 and 5

Activity 3: Exploring the campsite (proprioception, motor planning)

“Let’s explore the campsite”

- Keep learners in their groups
- Place hoola hoops anywhere in the open space
- Learners need to froggy jump and find their own way to the end cones to pick up a colour ball
- And then make run back to the groups
- Once back in the groups, together, leaners make groups of
    - 2
    - 4
- PROGRESSION: Using the balls, learners need to calculate the following sum
    - Share 6 balls equally between 3 friends.

Cool Down: what fun it is to camp (dynamic stretching, flexibility, laterality, midline crossing)

“Camping has been so much fun. I can’t wait until we do it again”

- Learners need to sit in a circle with legs stretched out
- Leaners to follow the following stretches
    - Seated hamstring stretch.
    - Close their eyes and focus on breathing in and out
    - Touch left ear with right hand
    - Touch right foot with left hand
    - Cross left arm over right
    - Cross right foot over left foot

Term 3 | Environment: Classroom/ Field

Presented by: Carynne Fisher | Date: 26 August 2019

Time: 30 minutes

Theme: Fruit basket

Focus: dynamic balance, halving, cardiovascular fitness

Equipment:

- apple
- laminated circles
- scissors
- 4 rope
- 2 hoops
- cones
- beacon

Warm Up: Fun fruit run (cardiovascular fitness, colour recognition)

"The fruit jumped out of the basket, let's get them"

- Divide learners into 2 groups
- Place balls into open space

  Place one opposite each group of cones about 15m away from the cone
- Learners need to run one by one, when the whistle blows, and collect the provided colour ball ie: "Collect one blue ball"

- Learners then need to run and place the ball in their hoop and sit down by their cone

Activity 1: Sharing fruit (strength, sharing, static balance)

“We have so many fruits but not enough fruit. I know, lets share them”

- Place cones and beacons in a circle
- Each learner needs to stand by a cone to form the circle
- Use the apple to cut it into halves to explain that when you cut an apple in half, you will have 2 halves. Learners can stand on one leg while listening
- Complete 2 push ups
- Show learners that when you place it together, it is a “whole”
- Cut another apple and ask learners how many halves there are = answer 4
- Complete 4 tuck jumps
- PROGRESSION: Use another apple and cut it up to indicate how many halves there are and how many whole apples there are when the halves are placed back together.

Activity 2: Fruit pizza (upper body strength, sharing, teamwork, fine motor skills)

“Can you make a fruit pizza and share it with your friends”

- Group learners into 6 groups
- Each group will receive circle
- Ask learners to draw a line to show the 2 halves.
- Ask learners to then cut it and show how many halves they have= 2
- Complete 2 push ups
- PROGRESSION: Ask learners to half the 2 halves and how many halves there are now= 4
- Complete 4 push ups

Activity 3: fruit salad (strength, halving, sharing, teamwork, dynamic balance)

"Let's make a fruit salad. But first we need all the ingredients before we can make it and share it with everyone"

- Divide learners into 6 groups
- Learners need to run to their hoops, pick up a ball, balance on the ropes and run to the cone
- Once all learners are at their cone, they need to share the balls so that each person as the exact same amount
- Complete that amount of push ups
- PROGRESSION: Add more balls and ask learners to share them equally.
    - Complete the amount of tuck jumps

Cool Down: Can you Flex and stretch (unstructured play, laterality, proprioception, directionality)

- Ask learners about what they learnt today
- 5 minutes of unstructured play encourage learners to interact and discuss what they learnt.
- Make a circle and hold hands, together learners need to lean to the right, left, back and forwards.

Term 3 Environment: Classroom/ Field

Presented by: Carynne Fisher Date:22 August 2019

Time: 30 minutes

Theme: Whatalotigot Land

Focus: Doubling and Cardiovascular fitness

Equipment:

- Hoops
- Colour Balls
- Word cards
- Basket

Warm Up: Collectors (colour recognition, cardiovascular fitness, hand eye coordination, teamwork)

"How many smarties can you collect?"

- Scatter bean bags/ balls on the other end of the court.
- Divide into 2 groups.
- Place 2 cones 10m apart
- Place one hoop in between the two sets of cones, and balls inside
- Learners need to run one at a time pick up a colour ball and then run to their cone on the other side and sit down

Activity 1: The fastest rascal (cardiovascular fitness. reading, sounding, word recognition, colour recognition)

"Who is the fastest rascal in Whatalotigot Land"

- Divide learners into 6 groups.
- Place cones 5m apart
- Learners need to run one at time to collect a ball.
- They then need to run and place the ball into the basket
- PROGRESSION: The last learner in the group will be given a word card that they need to take to their group. Once there, the group needs to try and read the word
- PROGRESSION: Ask learners to make a sentence with the word in it

Activity 2: Time to make more (Proprioception, letter recognition, word recognition, reading, sounding, coordination, dynamic balance)

"Whatalotigot Land has so many sweets and smarties, but we need to make more"

- Divide learners into 6 groups
- Place cones 8m apart
- Place a basket of with balls in it
- Learners need to run one at time to collect one ball and run to their end cone
- Once all the learners are back, demonstrate the concept of doubling using the balls
    - First double 1
    - Then 2- complete 2 tuck jumps
    - Then 4- complete 4 frog jumps
    - Then 8- complete 8 scissor jumps
- PROGRESSION: Add more balls and add learners to double odd numbers such as 7 1/2

Activity 3: Gummy bears and star fish (proprioception, cardiovascular, spatial awareness)

"Look at gummy bears and star fishes playing, let's join them"

- Place learners in 6 groups with start and end cone.
- Place cones 10m apart and a hoop in between the cones.
- Learners need to run to the hoop and step inside, then pick up the hoops and take over their head and place it back down.
- Learners then run to the end cone.
- At the end cone they need to complete a star fish roll to the left and then to the right. (Sit on the group with legs in the butterfly position, place hands on ankles and roll over to the left or right and try to come up to the initial positon)
- Learners then need to run back to the back of the line at their start cone.

Cool Down: Bye-Bye Whatalotigot Land (dynamic stretching, breathing exercises)

"What fun it is in Whatalotigot Land"

- Each learner should have a ball in the hand
- Demonstrate to learners to massage their own body with the ball, in a circular motion.
- Massage the head, shoulders, arms, legs and hands
- Take a group photo
- Hand out party bags as per last session