COMPARING TEACHING THROUGH PLAY AND PEER-TEACHING FOR CHILDREN WITH ADHD IN THE SOUTH AFRICAN CLASSROOM

by

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the degree of

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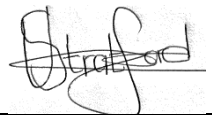
Plagiarism Declaration

I, Vanessa Stratford, declare that this dissertation, Comparing Teaching through Play and Peer-teaching for Children with ADHD in The South African Classroom, submitted in accordance with the requirements for the degree of Master of Science in Psychology with specialisation in Research Consultation, is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements for originality. I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.



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Abstract

ADHD negatively impacts academic performance, and the traditional classroom setting conflicts with the symptoms of ADHD. This research examined the potential of teaching through play and peer-teaching as alternative teaching methods to improve the mathematical performance of Grade 1 children with symptoms of ADHD; by answering, would adapting teaching methods to include teaching through play and/or peer-teaching, in the South African classroom, improve the mathematical performance of children with symptoms of ADHD? A pre-test-post-test control group design was employed in this comparative experimental study. Participants were purposively selected then randomly assigned to one of three intervention groups. An eight-week intervention was implemented as teaching through play or peer-teaching. Pre-test and post-test scores were analysed using a dependent t-test, a Wilcoxon Signed Rank test, and a Kruskal-Wallis test. Teaching through play and peer-teaching have the potential to improve the mathematical performance of Grade 1 children with symptoms of ADHD. Special precautions were taken in the process of minor research participants, adhering to the ethical principles of beneficence and non-maleficence, justice, and autonomy.

Keywords: Attention Deficit/Hyperactivity Disorder (ADHD), mathematical performance, teaching through play, peer-teaching, alternative teaching methods, academic intervention, comparison, South African classroom, Grade 1, pre-test-post-test control group design.

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List of Tables

List of Figures

Table of Contents

Chapter 1 Introduction

Education is the most powerful weapon which you can use to change the world.

– Nelson Mandela, University of the Witwatersrand, South Africa, 2003.

1.1 Background

Education in South Africa falls within the purview of the Department of Basic Education, with the vision of "a South Africa in which all our people will have access to lifelong learning, education and training opportunities, which will, in turn, contribute towards improving the quality of life and building a peaceful, prosperous and democratic South Africa" (Department of Basic Education (DBE), 2020, par. 2). The DBE has four outcome based strategic goals aimed at improving the quality of basic education in South Africa. In short, these strategic goals focus on improving teaching capacity and learning materials; standardised testing; a greater focus on early education; and accountability (DBE, 2020). Yet, on an international comparison of basic education South Africa fails to meet standards. The Progress in International Reading Literacy Study (PIRLS), creates an international benchmark for education, by measuring reading comprehension at five-year intervals, last conducted in 2016 (Howie & Combrinck, 2018). The results of PIRLS (2016) found that 78% of grade 4 leaners in South Africa did not meet the international benchmark for reading, compared to only 4% of children across the 50 countries included in the study. In addition, South Africa was the lowest ranked country for reading skills in the 2016 study (Howie & Combrinck, 2018). These statistics paint a dire picture of the progress of education in South Africa. Although it would be unjust to compare South African education to the rest of the world without acknowledging the daily challenges faced by the DBE, such as severe

inequality and a lack of resources (Pillay, 2019). Although the system remains problematic, some children face learning challenges above and beyond those of the system, such as uneducated parents, severe poverty, a lack of access to resources, or learning difficulties. The current research focuses on learning difficulties, specifically those children that exhibit symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD), with regard to their mathematical performance by comparing alternative teaching methods that may have a positive influence on their academic outcomes.

ADHD is a childhood disorder involving problems with activity regulation and attention, that are inconsistent with the developmental age of the individual (American Psychiatric Association [APA], 2013). Children diagnosed with ADHD may have hyperactive or impulsive behavioural problems, attentional problems, or both. ADHD has the potential to impact individuals' academic performance from preschool, to childhood, to adolescence and all the way through to adulthood (APA, 2013; Asherson, 2016; Sadock et al., 2015). The main symptoms of ADHD relate to inattention and hyperactivity or impulsivity and interfere with an individual's functioning in various settings, as well as with their functioning and/or development in social, academic, and/or occupational areas (Asherson, 2016; Sadock et al., 2015). Attentional problems are manifested in those affected by the symptoms of ADHD when they are unable to sustain attention or lose track of the task at hand. Hyperactivity refers to unusually high levels of activity or talkativeness, in comparison to what the norm would be for the chronological age of the individual, resulting in an individual that always seems to be on the go. More concerning, impulsive behaviour is considered to be dangerous actions without any forethought of the consequences, such as running across a street without looking or climbing on to dangerous objects (APA, 2013; Asherson, 2016; Sadock et al., 2015). As mentioned, a substantial number or all of these symptoms are presented by individuals diagnosed with ADHD.

According to the *Diagnostic and Statistical Manual of Mental Disorders Fifth Edition* (DSM 5) prevalence rates of ADHD vary greatly among studies, yet it reports that approximately 5% of school-aged children globally are diagnosed with ADHD and approximately 2.5% of these children continue to show symptoms of ADHD as adults (APA, 2013). Schoeman and De Beer (2017) estimate that one in 20 or 5% of South African children show symptoms of ADHD consistent with the DSM 5 diagnostic criteria. Additionally, the sex ratio found in Western countries, 2:1 male to female closely resembles the ratio found in South Africa (APA, 2013; Meyer, 2005).

Children with symptoms of ADHD often experience complications in several aspects of their functioning within the classroom setting such as difficulties with sustained attention or disruptive behaviours (Dreckmeier-Meiring, 2012; Sadock et al., 2015). Additionally, these children often experience delays in their development, such as social and language delays, in comparison to their non-ADHD affected peers (APA, 2013; Dreckmeier-Meiring, 2012; Sadock et al., 2015). Their inattention, hyperactivity and/or impulsivity interfere with their optimal learning potential in the traditional classroom setting, which involves verbal instructions, demonstrations, questions, tests and so forth. The traditional classroom setting, as defined in this research study, requires young children to remain seated and work quietly for prolonged periods, which is incompatible with the symptoms of ADHD. Poor academic performance has far reaching consequences as illustrated by the DSM 5 and other sources which report that children diagnosed with ADHD are less likely to complete their schooling and achieve occupational success when compared to their non-affected peers (APA, 2013; Dreckmeier-Meiring, 2012; Louw & Kail, 2014; Meyer, 2005; Sadock et al., 2015). Failing to address the above-mentioned problems related to poor academic performance and achievement during childhood, the symptoms of ADHD may lead to occupational problems or even unemployment later in life (APA, 2013; Dreckmeier-Meiring, 2012; Louw & Kail,

2014; Meyer, 2005; Sadock et al., 2015). The DSM-V reports that individuals with ADHD generally have poorer achievement in occupational settings and lower IQ scores than their peers, as a result of an inability to sustain attention (APA, 2013; Dreckmeier-Meiring, 2012; Louw & Kail, 2014; Meyer, 2005; Sadock et al., 2015). As adults, over activity, impulsive behaviour and/or attentional problems may result in others holding a very negative view of the individual such as thinking that they are lazy or uncooperative in the workplace (APA, 2013; Dreckmeier-Meiring, 2012; Louw & Kail, 2014; Meyer, 2005; Sadock et al., 2015). The need to treat or inhibit the symptoms of ADHD becomes paramount to the quality of life of those affected.

The first resort to treating the symptoms of ADHD is often a pharmaceutical approach. Although some may find relief, this is not necessarily the case for all. Dreckmeier-Meiring (2012) stated that although prescribed medication has proven effective in treating the symptoms of ADHD, the underlying disorder remains and therefore, without the medication the symptomatic behaviour will continue to persist. A study done by Prasad et al. (2013) concluded that drugs prescribed to individuals with ADHD to assist them to complete more seat work (the work completed while seated at a desk), may have a positive effect on their productivity, but the seat work completed was not necessarily done correctly (Prasad et al., 2013). This means that, although the productivity levels of these individuals improved, the accuracy of their work did not necessarily improve as well. These findings were, however, not conclusive across different academic settings (Prasad et al., 2013). Broken down, their improvement in the arithmetic section showed significant results, while results related to reading and spelling were inconclusive (Prasad et al., 2013). There seemed to be no long-term academic benefits related to the consumption of medication prescribed for ADHD (Prasad et al., 2013). Along with the long-term ineffectiveness, these medications often have severe side-effects such as diminished mood, loss of appetite, physical aches, and

tiredness (Dreckmeier-Meiring, 2012). Reasonably, it would be safe to assume that all the side-effects will likely impact on a child's academic performance, for instance, a child cannot be expected to perform adequately on an academic level when they are malnourished and tired. Logically then, children who experience severe side-effects from ADHD medication are therefore likely to perform worse in the academic environment while medicated. Thus, although prescribed medications can improve the symptoms of ADHD for some children as well as improve certain aspects of their academic performance such as productivity levels, it is not an all-encompassing solution to the problem or suitable for all.

Reaching the conclusion that medication may not be the answer to improve the academic performance of children with symptoms ADHD, further research into possible solutions to long-term benefits regarding academic performance is required. Various strategies have been suggested by authors such as Regan (n.d.), Mulrine and Flores-Marti (2014), and Bulunuz (2013), to improve the academic inclusion and performance of children with symptoms of ADHD, comprising of physical activity, integration steps, and/or alternative teaching methods.

Mulrine and Flores-Marti (2014) recommended physical activity or physical education (activities that involve physical exercise) as an alternative strategy for teaching children with ADHD because of its ability to reduce anxiety, encourage better social interactions, and improve academic achievement. Alternatively, Regan (n.d.) suggested integration techniques that may improve the behaviour and/or attention of children with symptoms of ADHD in the traditional classroom setting by strategically placing a learner that exhibits symptoms of ADHD in the classroom, as well as minimising the environmental distractions. These strategies are discussed more comprehensively in Chapter 2. Other researchers such as Bulunuz (2013) and Burton (2012) have, however, opted to look at alternative teaching methods, instead of integration strategies, to encourage improved

behaviour and/or academic performance of children with ADHD in the traditional classroom setting.

In this regard, Bulunuz (2013) conducted a study comparing a traditional classroom setting to a teaching through play classroom, specifically to teach science related subjects to preschool children. The results of the study indicated that the children in the teaching through play classroom obtained significantly more knowledge about science related concepts compared to their peers in a traditional classroom. Similarly, Tucker (2014) argued that as play is an integral part of learning for young children it may be beneficial to encourage more play activities within the academic setting. The transition from preschool playing to Grade 1 learning can be difficult for some children, making it important for teachers to understand the value of play in learning, specifically, in terms of mathematical skills (Tucker, 2014). Play is not only about what children learn, but also about how they learn. For this reason, play may be used more effectively in teaching Grade 1 children and may be more age-appropriate than subject-focused learning in the lower school grades (Tucker, 2014).

As a further alternative teaching method, Burton (2012) conducted a study investigating the impact of peer-teaching as a strategy to get children that have lost interest in school to re-engage in school and classroom activities. Burton (2012) made use of older children to teach younger children and found that peer-teaching increased the engagement of children in an anti-bullying campaign. Furthermore, several behavioural changes were found in the children involved in the project such as increased confidence levels as well as augmented levels of interaction in the classroom setting. An additional form of peer-teaching, where one learner is the coach and the other performs a skill in a physical education class, is recommended in a study done by Mulrine and Flores-Marti (2014) as a

strategy for teaching children with ADHD. Literature searches of similar studies conducted in a South African context came up non resultant.

Although the studies of teaching through play and peer-teaching conducted by Bulunuz (2013) and Burton (2012) were not specifically conducted on children with symptoms of ADHD, the current study intends using amended versions of teaching through play and peer-teaching as alternatives to teaching in the traditional South African classroom. In the current study, the focus is on the research participants' mathematical performance and the peer-teaching is done by children of the same age cohort. The study is aimed specifically at improving the mathematical achievement of young children, aged six to eight years with symptoms of ADHD, by teaching in a way that is more interactive than the traditional classroom activities. This is achieved by involving the children either in active play or peer-teaching roles and addresses the specific cognitive and/or learning deficits associated with ADHD, such as a lack of sustained attention. All the activities engaged in are to the benefit of the children as the activities are all in line with their current curriculum for Grade 1 children.

Presently, the South African DBE uses the Curriculum Assessment Policy Statements (CAPS) system in all public primary schools as a means to educate Grade 1 children (Mokotong et al., 2017). The CAPS system standardises foundation phase education throughout the country and Annual National Assessments (ANAs) are written to evaluate the academic performance of primary school children in a standardised manner (Platinum, 2017). All learning activities engaged in during the current study are based on the CAPS education system to ensure that any possible academic improvement will be to the benefit of the research participants in the ANA tests written later in the year.

1.2 Research problem

Children with ADHD symptoms often struggle to keep up with their peers in the academic setting as a result of the symptoms associated with ADHD such as inattention and hyperactive behaviour (APA, 2013). Some children who exhibit symptoms of ADHD may fall behind their peers early on in their school career, even as early as preschool level. Thus, these children start primary school with inferior skills in the academic setting, for example an inability to count accurately (Zendarski et al., 2020). Several of the difficulties these children experience in the academic setting are related to their problems with attention and/or hyperactivity, impacting on their ability to sustain attention and absorb information, in comparison to their peers. Such difficulties may result in children who exhibit the symptoms of ADHD progressively falling further behind their peers as they continue through the schooling system (Dreckmeier-Meiring, 2012; Zendarski et al., 2020). Adapting the teaching methods that are currently used in the South African classroom setting, to include approaches aimed at the specific cognitive challenges of children who exhibit symptoms of ADHD, may improve the academic outcome of these children. Although, several recent studies have addressed the topic of ADHD, to date, no studies comparing teaching through play and peer-teaching have been conducted in South Africa.

1.3 Research question

The current research study focuses on the influence of two specific alternative teaching methods, namely teaching through play and peer-teaching, on the mathematical performance of Grade 1 children with symptoms of ADHD in the South African classroom. The research question addressed in this study is: Will adapting teaching methods to include teaching through play and/or peer-teaching, in the South African classroom, improve the mathematical performance of Grade 1 children with symptoms of ADHD?

In order to address the main research question, it is segmented into three answerable questions:

1. Does teaching through play improve the mathematical performance of children with symptoms of ADHD?
2. Does peer-teaching improve the mathematical performance of children with symptoms of ADHD?
3. Is either teaching through play or peer-teaching more effective in improving the mathematical performance of children with symptoms of ADHD?

1.4 Hypotheses

In order to answer the questions above, the following hypotheses were formulated:

$H_{0(1)}$: Teaching through play does not improve the mathematical performance of children with symptoms of ADHD.

H_1: Teaching through play does improve the mathematical performance of children with symptoms of ADHD.

$H_{0(2)}$: Peer-teaching does not improve the mathematical performance of children with symptoms of ADHD.

H_2: Peer-teaching does improve the mathematical performance of children with symptoms of ADHD.

$H_{0(3)}$: There is no difference between teaching through play and peer-teaching with regard to the improvement of mathematical performance of children with symptoms of ADHD.

H_3: Teaching through play is more effective than peer-teaching with regard to the improvement of the mathematical performance of children with symptoms of ADHD.

1.5 Research aims and objectives

The current study aims to find out whether changing the teaching methods in the traditional South African classroom setting to include teaching through play and/or peer-teaching, improves the mathematical performance of Grade 1 children who exhibit the symptoms of ADHD, ultimately, preventing the academic gap between these vulnerable children and their peers from occurring and/or getting progressively larger as they continue through their academic careers.

The initial objective of the current research is to identify children that may be vulnerable to, or already diagnosed with, ADHD based on the opinion of their parents; children are from the surrounding public schools in the central and eastern parts of Pretoria, Gauteng, South Africa. Next, to administer an intervention based on either teaching through play or peer-teaching. Based on the research problem, a further objective is to measure the results of the two intervention methods, as well as to compare these results, both to each other and to a control group. The result comparisons within and between the three groups determine if the alternative teaching methods lead to a statistically significant improvement in the mathematical performance of the research participants and if so, which intervention leads to the most improvement.

1.6 Significance of study

The consequences of ADHD as mentioned earlier, are far reaching and may affect an individual's entire life, including their prospects in terms of academic and/or occupational achievement. The DSM 5 (APA, 2013) reports that there are social and interpersonal consequences of ADHD that may also affect academic achievement or occur as a result of poor academic achievement and involvement. Children who exhibit symptoms of ADHD are more likely than their peers to experience rejection from others as they are often

labelled as problem children and as a result they are more likely to develop other behavioural and personality disorders, such as conduct disorder and antisocial personality disorder (APA, 2013; Hoza et al., 2005).

The current study contributes to the body of knowledge related to the education of children with symptoms of ADHD and indicates whether teaching through play or peer-teaching has the potential to improve the academic futures of children suffering from the symptoms of ADHD. The results of the study may inform curriculum development in the future or assist teachers and tutors in teaching children with symptoms of ADHD more effectively, either within the classroom or in addition to the classroom.

1.7 Scope of study

The purpose of this comparative research study is to describe and compare the possible influence of teaching through play and peer-teaching on the mathematical performance of Grade 1 children with symptoms of ADHD to that of the traditional classroom setting in a South African context. This study does not compare the use of teaching through play or peer-teaching of non-ADHD peers to the use of these teaching methods for children with symptoms of ADHD.

1.8 Definition of key terms

Below is a table (Table 1.1) of the key terms as they are used in this study.

Table 1.1

Definition of Key Terms

Term	Definition
ADHD	Attention Deficit/Hyperactivity Disorder, Childhood neuropsychological disorder characterised by inattention, hyperactivity and impulsivity. There are three types of ADHD namely, ADHD predominantly inattentive type, ADHD predominantly hyperactive/impulsive type, and ADHD combined type. This study does not distinguish between the different types (Sadock et al., 2015).
Alternative teaching method	A teaching method based on anything other than the traditional classroom.
ANAs	Annual National Assessments
APA	American Psychiatric Association
CAPS	Curriculum Assessment Policy Statements refers to the teaching system currently used in South African Public Schools, which standardises education across the country (Mokotong et al., 2017).

Term	Definition
DSM 5	Diagnostic and Statistical Manual of Mental Disorders, 5th edition was published by the APA in 2013 (American Psychiatric Association, 2013).
Gamification	Gamification refers to the use of the elements usually involved in games, such as point scoring, rules etcetera, to motivate engagement with an activity in the classroom (Buckley & Doyle, 2014).
Hyperactivity	Unusually high levels of activity (American Psychiatric Association, 2013).
Impulsivity	Making rash decisions without any consideration of the consequences of those actions (American Psychiatric Association, 2013).
Immaturity hypothesis	The immaturity hypothesis states that, because children with ADHD have reduced prefrontal cortical volume, they are mentally less mature than their peers, causing their symptoms (Nolen-Hoeksema, 2011).
Inattention	The inability to sustain focus on a task, being easily distracted from the task at hand (American Psychiatric Association, 2013).

Term	Definition
Seat work	The academic work completed while seated at a desk.
Peer-teaching	An alternative teaching method in which children, in a similar cohort, act as teachers to each other, as well as learn themselves (Schuetz et al., 2017).
Teaching through play	An alternative teaching method in which learning activities are completed and skills learnt by engaging in play or games.
Traditional classroom setting	The traditional classroom setting involves verbal instruction, demonstration and is followed by questions or tests.
Working memory	The part of memory that has a limited capacity and is used to recall old information, manipulate it, and integrate it with new information (Goldstein, 2015).

1.9 Chapter overview

The remainder of the study is divided into four chapters. Chapter 2 focuses on the current literature on ADHD, ADHD in the classroom, teaching through play, and peer-teaching. The theoretical framework, on which the intervention methods used in this study

are based, is also explicated in Chapter 2. Teaching through play is based on the " immaturity hypothesis", which states that because children with ADHD have reduced prefrontal cortical volume in comparison to their non-ADHD peers they are mentally less mature than their peers, causing their cognitive symptoms (Nolen-Hoeksema, 2016). Peer-teaching is based on the theory that working memory is the main deficit in individuals with ADHD, which suggests that children with symptoms of ADHD have trouble recalling old information and integrating this information with new information, leading to the symptoms of ADHD exhibited by them (Miller et al., 2013).

Chapter 3 discusses the research design and methodology used in this study. The sampling takes place based on access to surrounding public schools in the central and eastern parts of Pretoria, Gauteng, South Africa, after which research participants were randomly assigned to one of the three research groups (teaching through play, peer-teaching or control). This study uses a pre-test-post-test control group design. A pre-test is administered to the sample, followed by an eight-week intervention, using either teaching through play or peer-teaching as a method of educational intervention. The control group continues with their normal schooling. Finally, a post-test is administered to the research participants and the mean scores are compared within and between the three groups.

Chapter 4 presents the results of the analysis of the research hypotheses. The pre-test and post-test scores of research participants are compared using a dependent t-test or a Wilcoxon Signed Rank test to indicate whether either teaching through play or peer-teaching resulted in a significant improvement in the mathematical performance of research participants. The scores of individuals in the two intervention groups were then compared to the post-test scores of participants in the control group, using a Kruskal-Wallis test, to account for the normal learning curve of participants over the eight weeks of intervention.

Chapter 5 includes the discussion of the results indicated in Chapter 4. The results are interpreted in terms of the hypotheses indicated in Chapter 3. The limitations, strengths, and weaknesses of the study are discussed. Conclusions are drawn from the results and recommendations for future research are made.

Chapter 2 Literature Review

This chapter begins with a brief discussion of three different approaches to cognitive development, followed by the current state of the education system in South Africa, as well as comparing it to the education system in Finland. The Finnish education system faced many of the same challenges, such as a segregated past and a lack of resources, evident in the current South African education system. The chapter further discusses the current literature available on the long-term academic outcomes of children with symptoms of ADHD, as well as how these outcomes are likely to affect their futures. Attention is paid to the use of medication for children with symptoms of ADHD, in addition to the current strategies used to integrate children with symptoms of ADHD into the classroom. Two alternative teaching methods namely, teaching through play and peer-teaching, are investigated further as possible alternative teaching methods to the traditional classroom, in their ability to improve academic performance. Lastly, the theoretical background of the interventions utilised in the study, is discussed.

2.1 Cognitive development of children

Cognition is defined as “the mental processes by which knowledge is acquired” (Oxford Medical Dictionary, 2010, p. 53). Development refers to “the process in which someone or something grows or changes and becomes more advanced” (Cambridge Dictionary, 2020, par. 1). Therefore, cognitive development refers to the process through which new knowledge is attained. It is the process through which progressive learning occurs. Cognitive development encompasses how information is acquired through the use of senses, how it is interpreted, and saved, as well as how it is later recalled in an attempt to

understand and know the world. This process includes cognitive functions, such as perception memory, thinking, creativity, intelligence, learning, and language (Louw & Kail, 2014).

The cognitive development of children has historically been studied from different psychological perspectives, such as a social cognitive approach and a social cultural cognitive approach. Through these psychological approaches the process of learning is explained in several ways.

2.1.1 Piaget's theory of cognitive development

One of the most referred to cognitive theories of learning was postulated by the Swiss psychologist, Jean Piaget. Piaget (1964) contended that learning forms part of development and development is a crucial process made up of discrete learning experiences. "In general, learning is provoked by situations provoked by a psychological experimenter; or by a teacher, with respect to some didactic point; or by an external situation." (Piaget, 1964, p. 176). This means that learning occurs through experimental involvement with surroundings and new situations. Piaget's theory of cognitive development is based on the belief that children want to make sense of the world by their nature. Accordingly, he believed that children act as scientists in their exploration of the physical and social world around them. Piaget suggested four stages of cognitive development during which children fundamentally change the way they interpret and understand the world. These four stages are roughly divided according to the chronological age of children. The four stages are the sensory-motor, pre-verbal stage (birth – 18 months); pre-operational thought (18 months – 6 years); concrete operational thought (6 years – 11 years); and formal operational thought (12 years and older). Piaget (1964) warns that although these stages are ordered and constant, the age at which children move from one stage to the next can be systematically delayed by up to four years, depending on the society in which a child is raised. Therefore, cognitive development consists of brain

maturity (biological) and personal experiences. Piaget explains this through the use of schemas. Schemas are ways in which the mind orders thought processes about the world. In order to obtain cognitive development new information or experiences need to be incorporated into existing schemas, referred to as assimilation. Additionally, new information or experiences will require the change of current schemas, referred to as accommodation (Frye et al., 2014; Goswami, 2011; Piaget, 1964).

2.1.2 Bandura's social cognitive theory of cognitive development

In contrast to the theory proposed by Piaget (1964), Bandura (1977) believed that learning does not occur in the trial and error (experimental) way described in the previous section. Rather, according to him, learning mostly takes the form of imitation of a model, including parents, teachers or peers (Miller, 2011). Although observation can produce direct imitation, it may also result in abstract imitation. This is a more complex form of imitation in which the observer can extract rules from behaviour and manipulate these into an unlimited number of different combinations of behaviour (Bandura, 1977; Miller, 2011). Bandura (1977) uses the example of a child learning to speak. At first the child can only directly imitate the speech of others, however, at a certain point the child can extract the rules of grammar from observing others and form an unlimited number of sentences using their expanding vocabulary. Additionally, an individual has to believe that they are capable of performing the modelled behaviour and achieving their desired outcomes, termed self-efficacy (Bandura, 1969). Modelling is seen as a four-step process, starting by paying attention to a model, retaining the information, the capability of repeating the behaviour, and motivation to engage in the behaviour (Passer et al., 2009). While Bandura (1977) recognises the role that classical conditioning and operant conditioning play in learning, environmental aspects and observation are included in this theory. Reinforcement or a lack of reinforcement

acts only as information to the child. Cognitive skills are usually developed by beginning to conduct operations on physical objects, for instance, learning to add or subtract by adding and removing physical objects. Later these physical objects are replaced systematically with symbolic objects, such as numbers on a page, eventually leading to the ability to conduct arithmetic without external stimuli (Bandura, 1977). Bandura (1977) agrees with Piaget (1964) that certain capabilities are necessary prior to learning to make learning possible. According to the social cognitive theory of learning, "psychological functioning is a continuous reciprocal interaction between personal, behavioural, and environmental determinants" (Bandura, 1977, p. 194).

2.1.3 Vygotsky's social cultural theory of cognitive development

Vygotsky (1978) supposes that learning and development are interlinked from as early as birth. Children begin to learn long before they attend formal schooling and what they learn at school is based on previous learning experiences. Vygotsky (1978) coined the term Zone of Proximal Development (ZPD), to explain the cognitive development of children. The ZPD is "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Cognitive development cannot be measured by only assessing the cognitive tasks that a child can perform at any given point in time, but should rather include the potential of the child in performing tasks with assistance. ZPD then includes the skills that are in the processes of development, as well as skills that have fully developed. Cognitive development is determined prospectively by the ZPD. Additionally, cognitive development occurs within a social context. "Human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them" (Vygotsky, 1978, p. 88).

Imitation allows children to accomplish more in a collaborative or guided manner than they would be able to do on their own. Worthy learning can only take place in advance of development, as learning evokes the ZPD, including developmental processes that can only take place during interaction with peers. Therefore, learning results in cognitive development that would not be possible without learning (Churcher et al., 2014; Vygotsky, 1978).

Although cognitive, social cognitive and sociocultural approaches view cognitive development and learning in different ways, they agree that cognitive development and learning are necessary in order to progress.

2.2 Education in South Africa

The responsibility of basic education in South Africa falls under the DBE, which aims to develop, maintain and support an education system accessible to all. Moreover, the DBE aims to improve education in South Africa (DBE, 2020). The DBE replaced the previous Department of Education when it was split into the Department of Basic Education and the Department of Higher Education and Training in 2009. The DBE oversees all public schools covering Grade R to Grade 12. According to the current Minister of Basic Education Angie Motshekga, 788 717 children wrote the National Senior Certificate (final matric exam) in 2019, of which 81,3% passed (Motshekga, 7 January 2020). Although this appears to be a good pass rate, these numbers are misleading in terms of the overall basic education completion rate in South Africa. Africa Check (2015) reported that of the Grade 2 children registered in 2004, only 49% remained in school to write their final matric exam. Of these 49%, 75,8% passed the matriculation exam indicating that approximately 37% of the registered Grade 2 children in 2004, passed matric in 2014. According to these calculations, South Africa has a 37% school completion rate. Grade 2 is used as a benchmark, as Grade 1 numbers are skewed by the high level of grade repetition associated with the first year of

formal schooling (Africa Check, 2015). Similarly, the PIRLS, measures reading comprehension and trends in reading literacy in 50 countries, administered at five-year intervals (Howie & Combrinck, 2018), essentially, creating an international benchmark against which any of the participating countries could be measured. The 2016 test was conducted on a representative sample of Grade 4 and Grade 5 children, in all the 11 official South African languages (ensuring that language was not a factor contributing to low test scores). The results of PIRLS 2016 indicated that 78% of Grade 4 leaners in South Africa did not meet the international benchmark, compared to only 4% globally. In addition, South Africa was the lowest ranked country in the 2016 study (Howie & Combrinck, 2018).

These issues are not limited to reading comprehension. The Trends in Mathematics and Science Study (TIMMS) creates an international benchmark for Grade 4 and Grade 8 mathematics and science performance (Mullis et al., 2020). South Africa has taken part in this study since its inception in 1995 (Jojo, 2019). In the 2019 TIMMS "South Africa and its benchmarking systems assessed fifth and ninth grade students to better match their curricula and to maintain trend measurement." (Mullis et al., 2020, p. 11). The results of the TIMMS are categorised, based on scores, into low international benchmark (400), intermediate international benchmark (475), high international benchmark (550), and advanced international benchmark (625). Although, Grade 5 participants were used, the average mathematics score for South African participants was 374, below the low international benchmark score of 400. Additionally, 37% of the Grade 5 participants scored below the low benchmark and only 1% at the advanced benchmark level in their overall mathematics performance (Mullis et al., 2020).

Mathematics has become indispensable knowledge in South Africa (Jojo, 2019). The understanding and application of mathematics is important in everyday life, as well as assisting in the understanding of other academic subjects. Mathematics improves overall

intellectual development by stimulating the development of skills such as problem-solving, logical thinking, deductive and inductive reasoning, and effective communication of information (Haylock, 2019). The development of these skills ultimately influences broader society in terms of productivity (economics, engineering, technology, etcetera) and the level of knowledge in South Africa. This is even more important in the data driven 21st century labour market (Jojo, 2019).

These statistics, and the importance of mathematics, indicate a need for education reform in South Africa. Education reform may be an area in which South Africa can learn from strategies used in countries with a similar educational history. Finland, for example, has proven that national education reform is possible. Finland's education system is considered to be one of the best in the world, with children scoring exceptionally high on standardised tests (Morgan, 2014).

2.3 Education in Finland

The current education system in Finland was implemented in 1972, replacing a classist system of education (Morgan, 2014). This classist system could be compared to the separated education system enforced during Apartheid. In 1972 Finland faced similar problems to those faced by the South African education system, such as inequality and a lack of resources (Morgan, 2014). It is precisely inequality that remains one of the biggest challenges in the South African education system, as evidenced by the availability of the best technology at some schools compared to pit toilets at others (Pillay, 2019). In addition, both the South African and the Finnish education systems consist of nine years of compulsory schooling, followed by three years to complete the National Senior Certificate or equivalent. Morgan (2014) states that 99% of Finnish children complete their compulsory schooling, while 95% complete secondary schooling, after which these children can write a national

exam to gain entry into a university. This means that 95% of Finnish children complete schooling at a level equivalent to matric/Grade 12 in South Africa, in stark contrast to the previously mentioned 37% of South African children who complete matric. Comparing South Africa to a first world country, may seem inappropriate, however, Finland has faced similar social problems as those faced by South Africa. Finland was a poor and struggling nation, oppressed, and ruled by outsiders (Louw, 1 July 2019). At the moment South Africa can be considered a struggling nation, attempting to rebuild from the oppressive regime of Apartheid. More specifically, the former education system in Finland was split according to socio-economic background, based on the belief that talent in society was unevenly distributed. The Finnish education system was divided into an academic stream and a more practical, vocational stream (Morgan, 2014). In many ways this split education system in Finland resembles the Apartheid education system of South Africa, with different race groups receiving differential education. The education system has however not, to date, corrected the inequalities in the education system of the past. An important aspect of the Finnish education system, that may also apply to the current South African education system, is the attempt to provide equal education to all children, regardless of socio-economic background (DBE, 2021). Equality is paramount to education in Finland, and all political parties agree on this. As part of the objective of equal education, each child is provided with school supplies, lunch, and social support, at no cost (Hancock, 2011; Kapadia, 2014; Kager, 2011). Finland, currently one of the wealthiest nations in the world, used education reform as part of their strategy to turn their economic situation around (Louw, 1 July 2019).

The current education system in Finland required adjustments to the training of teachers, in order to equip teachers with the ability to offer alternative teaching methods to a wide variety of children from divergent backgrounds (Morgan, 2014). The selection process of teachers in Finland is rigorous, followed by an intensive training programme, sponsored by

the government. Finland's teachers represent the top 10% of high school graduates and are required to obtain a master's degree in education (Hancock, 2011). As a result of a well-trained teaching force, more autonomy exists within the classroom, allowing teachers to teach in the most appropriate manner, with regard to the subject material and cohort of students (Sahlberg, 2011). This flexibility in teaching style allows for the academic potential of all children to be achieved.

As indicated above, there are several lessons South Africa can take from Finland in terms of education reform. South Africa continues to struggle with extreme levels of inequality in terms of poverty, a lack of resources, and low retention rates within the education system. The current research study focuses on flexibility in teaching approaches as a way of making the classroom more inclusive to those children who struggle with learning difficulties and who, therefore, do not cope in the traditional classroom setting. More specifically, this research study examines possibilities for effective teaching of children with symptoms of ADHD in the South African classroom beginning by reviewing various sources of information explicating several ways of creating a more academically inclusive classroom. The prevalence rate of ADHD in South Africa justifies the need for this kind of investigation. It is estimated that approximately one in twenty, or 5%, of South African children suffer from symptoms of ADHD (Schoeman & De Beer, 2017). De Milander et al. (2020) found higher rates among Grade 1 learners in South Africa. Their results indicated that 7.7% of their participants met the criteria for a diagnosis of ADHD combined type, 6.7% suffered from hyperactivity and impulsivity, while 11% demonstrated inattentiveness (De Milander et al., 2020).

2.4 Understanding ADHD

In 1798, Sir Alexander Crichton first described ‘mental restlessness’ (Crichton, 2008). In 1844, Heinrich Hoffman authored the children’s book titled *Fidgety Philip*, which has become a parable for children with symptoms of ADHD (Warnke et al., 2008).

ADHD, involving problems with activity regulation and attention, has historically been considered a childhood disorder, but the disorder is now accepted to persist into adulthood (Mackenzie, 2017). The symptoms of ADHD are most often associated with hyperactive or impulsive behavioural problems, attentional problems, or a combination of these (APA, 2013; Mackenzie, 2017; Sadock et al., 2015). The specific symptoms of ADHD are indicated in Table 2.1, which provides a list of symptoms related to inattention, as well as a list of symptoms related to hyperactivity or impulsivity. Children may suffer from predominantly inattentive symptoms, predominantly hyperactivity and/or impulsivity, or a combination of these ranging in severity from mild to severe. These problems are present in many settings and negatively affect the wellbeing of the individual. Assessment of ADHD usually includes various sources, such as parents and teachers, who have access to the individual in different contexts (APA, 2013; Mackenzie, 2017; Sadock et al., 2015).

Table 2.1

Attention-Deficit/Hyperactivity Disorder diagnostic criteria (APA, 2013, pp. 59-61)

Diagnostic Criteria
A. A persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development, as characterised by (1) and/or (2):
1. Inattention: Six (or more) of the following symptoms have persisted for at least six months to a degree that is inconsistent with developmental level and that negatively impacts directly on social and academic/occupational activities:

Diagnostic Criteria

Note: The symptoms are not solely a manifestation of oppositional behaviour, defiance, hostility, or failure to understand tasks or instructions. For older adolescents and adults (age 17 and older), at least five symptoms are required.

a. Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or during other activities (e.g., overlooks or misses details, work is inaccurate).

b. Often has difficulty sustaining attention in tasks or play activities (e.g., has difficulty remaining focused during lectures, conversations, or lengthy reading).

c. Often does not seem to listen when spoken to directly (e.g., mind seems elsewhere, even in the absence of any obvious distraction).

d. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., starts tasks but quickly loses focus and is easily side-tracked).

e. Often has difficulty organising tasks and activities (e.g., difficulty managing sequential tasks; difficulty keeping materials and belongings in order; messy, disorganised work; has poor time management; fails to meet deadlines).

f. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (e.g., schoolwork or homework; for older adolescents and adults, preparing reports, completing forms, reviewing lengthy papers).

g. Often loses things necessary for tasks or activities (e.g., school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones).

h. Is often easily distracted by extraneous stimuli (for older adolescents and adults, may include unrelated thoughts).

Diagnostic Criteria

i. Is often forgetful in daily activities (e.g., doing chores, running errands; for older adolescents and adults, returning calls, paying bills, keeping appointments).

B. Hyperactivity and impulsivity: Six (or more) of the following symptoms have persisted for at least six months to a degree that is inconsistent with developmental level and that negatively impacts directly on social and academic/occupational activities: Note: The symptoms are not solely a manifestation of oppositional behaviour, defiance, hostility, or a failure to understand tasks or instructions. For older adolescents and adults (age 17 and older), at least five symptoms are required.

a. Often fidgets with or taps hands or feet or squirms in seat.

b. Often leaves seat in situations when remaining seated is expected (e.g., leaves his or her place in the classroom, in the office or other workplace, or in other situations that require remaining in place).

c. Often runs about or climbs in situations where it is inappropriate. (Note: In adolescents or adults, may be limited to feeling restless.)

d. Often unable to play or engage in leisure activities quietly.

e. Is often “on the go,” acting as if “driven by a motor” (e.g., is unable to be or uncomfortable being still for extended time, as in restaurants, meetings; may be experienced by others as being restless or difficult to keep up with).

f. Often talks excessively.

g. Often blurts out an answer before a question has been completed (e.g., completes people’s sentences; cannot wait for turn in conversation).

h. Often has difficulty waiting his or her turn (e.g., while waiting in line).

Diagnostic Criteria

i. Often interrupts or intrudes on others (e.g., butts into conversations, games, or activities; may start using other people's things without asking or receiving permission; for adolescents and adults, may intrude into or take over what others are doing).

A. Several inattentive or hyperactive-impulsive symptoms were present prior to age 12 years.

B. Several inattentive or hyperactive-impulsive symptoms are present in two or more settings (e.g., at home, school, or work; with friends or relatives; in other activities).

C. There is clear evidence that the symptoms interfere with, or reduce the quality of, social, academic, or occupational functioning.

D. The symptoms do not occur exclusively during the course of schizophrenia or another psychotic disorder and are not better explained by another mental disorder (e.g., mood disorder, anxiety disorder, dissociative disorder, personality disorder, substance intoxication or withdrawal).

Specify whether:

314.01 (F90.2) Combined presentation: If both Criterion A1 (inattention) and Criterion A2 (hyperactivity-impulsivity) are met for the past six months.

314.00 (F90.0) Predominantly inattentive presentation: If Criterion A1 (inattention) is met but Criterion

A2 (hyperactivity-impulsivity) is not met for the past six months.

314.01 (F90.1) Predominantly hyperactive/impulsive presentation: If Criterion A2 (hyperactivity-impulsivity) is met and Criterion A1 (inattention) is not met for the past six months.

Specify if:

Diagnostic Criteria
In partial remission: When full criteria were previously met, fewer than the full criteria have been met for the past six months, and the symptoms still result in impairment in social, academic, or occupational functioning.
Specify current severity:
Mild: Few, if any, symptoms in excess of those required to make the diagnosis are present, and symptoms result in no more than minor impairments in social or occupational functioning.
Moderate: Symptoms or functional impairment between “mild” and “severe” are present.
Severe: Many symptoms in excess of those required to make the diagnosis, or several symptoms that are particularly severe, are present, or the symptoms result in marked impairment in social or occupational functioning.

2.5 Contextualising ADHD in the classroom

“Learning in the early years provides children with a toolkit of skills, knowledge and dispositions that set the foundation for life-long learning” (Kettle & Ross, 2018, p. 34). Foundational learning is required to build the neural pathways that support learning during the rest of an individual’s life (Kettle & Ross, 2018; Moser, 2018). Children begin to build their learning abilities during their foundational schooling, creating the knowledge base upon which future learning builds (Garvis, 2020). The importance of childhood learning is evidenced by the aforementioned statements, indicating that a lack of optimal learning in early childhood may negatively impact an individual’s ability to learn later in life. The central symptoms of ADHD impair the learning ability of children in the traditional classroom setting.

Attentional problems impact learning ability by impeding an individual's ability to sustain attention or keep track of the activity they are performing. Hyperactivity impacts learning ability by unusually high levels of activity interfering with the amount of academic work that can be completed. Impulsive behaviour impacts learning ability by an inability to control behaviour, without any forethought of the consequences, such as interrupting the class or playing during class time (APA, 2013; Sadock et al., 2015). The symptoms of ADHD have been linked to lower test scores and academic achievement. These symptoms often become the origin of the significant difficulties children with symptoms of ADHD experience in the academic setting (APA, 2013; De Zeeuw et al., 2017; Dreckmeier-Meiring, 2012). The greater the severity of ADHD symptoms experienced, the more likely a lower level of educational achievement was found at ages 14 to 16 (De Zeeuw et al., 2017). ADHD has been found to be a significant predictor of incomplete schoolwork, suspension or expulsion from school, and school changes. Furthermore, ADHD is a partial predictor in the repetition of grades (Martin, 2014).

Children with symptoms of ADHD often also experience delays in other aspects of development, including social and language delays, which inevitably have an impact on academic performance (APA, 2013; Mackenzie, 2017; Sadock et al., 2015). Several academic activities require reading comprehension, which is negatively affected by language delays. Similarly, social delays may negatively impact a learner's ability to work effectively within a group setting or beneficially interact with their peers and/or teachers (APA, 2013; Mackenzie, 2017; Sadock et al., 2015). As ADHD is likely to continue throughout the lifespan of an individual, the long-term consequences of this condition are of great concern. If the problems discussed above are left unaddressed, the individual will likely continue struggling with academic achievement, which in turn affects future occupational prospects. In addition, there seems to be a strong relationship between poor academic performance and

delinquency as individuals with attentional problems are unable to imagine the consequences or alternatives to their behaviour (Felson & Staff, 2006). For some children the symptoms associated with ADHD can lead to a more negative educational and/or school experience, which is likely to result in harsher forms of punishment, which tends to result in involvement with the criminal justice system across various life stages (Behnken, 2014).

2.6 Long-term consequences of ADHD

As adults, overactivity, impulsive behaviour and/or attentional problems may have consequences in every aspect of an individual's life. Individuals with symptoms of ADHD are more prone to being laid off, impulsively quitting or switching jobs, being unemployed, taking extensive amounts of sick leave, as well as applying for disability benefits (APA, 2013; Mackenzie, 2017; Sadock et al., 2015). This may lead others to have a very negative view of the individual with ADHD symptoms, such as assuming that they are lazy or uncooperative. The DSM-V reports that individuals with symptoms of ADHD have poorer achievement in occupational settings as well as lower IQ scores than their peers (APA, 2013). Likewise, a higher than expected rate of suicide attempts and completions have been reported for individuals suffering from ADHD as suicides are often linked to impulsivity (Kim et al., 2003). Therefore, in addition to the human brain's ability to more effectively create neural pathways at a young age, the sooner any form of intervention can take place, the less likely the negative long-term impact of ADHD symptoms will be.

Arnold et al. (2015) performed a systematic review of the literature available on the long-term (two years or more) effects of ADHD on academic achievement. A distinction was made between treated and untreated ADHD. All the studies included in the review had performed some form of a comparison, for example untreated ADHD compared to treated ADHD, or untreated ADHD compared to non-ADHD peers. The results showed that ADHD

had an unpropitious impact on long-term academic outcomes, with individuals with untreated ADHD having poorer outcomes than those with treated ADHD in terms of both academic achievement and academic performance. Improvement in long-term academic outcomes were associated with multimodal treatment approaches (Arnold et al., 2015). In response to Arnold et al.'s (2015) review, Langberg and Becker (2015) pointed out that studies on the long-term consequences of ADHD, treated or untreated, are sparse. Langberg and Becker (2015) indicated that the conclusions reached by Arnold et al. (2015) are in conflict with their own systematic review done in 2012, with the most discernible issue being the impact of medication on long-term academic achievement of those that experience symptoms of ADHD. Langberg and Becker (2015) found that although long-term academic improvement was statistically significant when treated with medication, it was educationally negligible. This means that the long-term benefits of pharmaceutical treatment were not practically significant in terms of improved educational outcomes, demonstrating that the effectiveness of pharmaceutical treatment of ADHD requires further investigation.

2.7 Pharmaceutical treatment of ADHD symptoms

Most children diagnosed with ADHD receive treatment in the form of stimulant medication. South Africa has been reported to have one of the highest medication prescription rates for ADHD internationally (Attention Deficit and Hyperactivity Support Group South Africa [ADHASA], 2014). A meta-analysis conducted by Prasad et al. (2012) included four different types of medication (three stimulant and one non-stimulant) used in the treatment of ADHD. There was a lack of literature available on the use of non-stimulant medication to come to a conclusion regarding its effectiveness. The study did, nevertheless, find that the stimulant medication, prescribed to children with symptoms of ADHD, may have a positive effect on their academic achievement by increasing the amount of work an

individual is able to complete at once. However, the completed work was not found to be more accurate. Yet, Prasad et al. (2012) reached the conclusion that pharmaceutical treatment of ADHD does have a positive impact on academic performance. Due to a policy change in Quebec, Canada, the use of stimulant medication for ADHD increased substantially (Currie et al., 2014). The aforementioned policy was adjusted to allow medical insurance to cover a wider variety of medication prescribed to individuals with ADHD. Currie et al. (2014) examined whether the increase in the use of stimulant medication would lead to improved academic outcomes for children with symptoms of ADHD. They found that there were no significant improvements in academic outcomes, as well as that there was a decline in grade attainment and mathematical scores over the same period.

Additionally, it is important to point out that, although medication may be effective in treating the symptoms of ADHD, the underlying disorder remains (Dreckmeier-Meiring, 2012). Sadock et al. (2015) argue that even though there were no direct academic benefits to taking ADHD medication, improved attention may help these children learn more effectively. This will, however, not be the case for children with predominately hyperactive symptoms. In addition to no concrete long-term evidence for academic improvement, stimulant medications may have severe side-effects including insomnia, headaches and stomach aches. Long-term usage of stimulant medications have also been linked to growth suppression. Individuals taking stimulant medications are advised to take breaks from their medication and have regular check-ups with their doctors. Medications for ADHD may also increase tics in children (Sadock et al., 2015). The use of stimulant medication in childhood is associated with a higher risk of substance and/or alcohol abuse in adulthood (Dalsgaard et al., 2014a; Dalsgaard et al., 2014b; Molina & Pelham, 2003). Thus, although medications can improve symptoms, they come with serious side-effects and have not been proven effective in improving academic outcomes beyond any reasonable doubt. As a result of ineffective

pharmaceutical treatment of ADHD, practical strategies have been suggested to better accommodate children with ADHD in the classrooms as opposed to treating their symptoms.

2.8 Accommodating ADHD children in the traditional classroom setting

Regan (n.d.) claimed that it would be a mistake to assume that all children know what paying attention means as paying attention does not come naturally to everyone. They suggested techniques that may improve the behaviour and/or attention of children with symptoms of ADHD in the traditional classroom setting. These techniques aim to use a set of steps that can be taken to integrate a child with symptoms of ADHD into the traditional classroom more effectively. These steps include:

- placing the child near the teacher in the classroom, but still keeping them as part of the class;
- seating the child at the front of the class, with good role models around them;
- trying to place the child in an area with little or no distracting stimuli;
- always making sure that the child clearly understands the task, and breaking complex commands down to single commands; and
- allowing the child to feel comfortable enough to ask for assistance when needed (Regan, n.d).

The *Guidelines for Inclusive Teaching and Learning* provide by the DBE in the Education Whitepaper 6, provides teachers of children with special needs with a framework of teaching methodologies underpinned by a set of principles. These principles amplify that teaching should be centred around the needs of the learner, encouraging full participation of all children. Within this the importance of treating all children equally, working at the child's pace, and teaching in the way each learner learns

best is outlined (DBE, 2010). Table 2.2 demonstrates the strategies for inclusion specifically for children with symptoms of ADHD.

Table 2.2

Strategies for inclusion (DBE, 2010, pp. 94-95)

Characteristics or observed behaviours	Implication	Strategies
- Has difficulty sustaining attention. - Often makes careless mistakes. - Is often distracted from completing an activity. - Does not seem to listen when spoken to. - Often fidgets with hands and feet. - Often talks excessively. - Often cannot remain seated. - Has outbursts and is impatient. - Often interrupts and intrudes on others.	- Handwriting problems - Memory problems. - Concentration difficulties. - Underachievement. - Encoding problems. - Poor behavioural planning. - Disruption of classroom activities.	- Reinforce good behaviour by praise. - Reward every positive behaviour immediately after it occurs. - Divide the work into small steps. - Make the learner sit where you can observe all the time. The child's desk may be not far away from the teacher's table. - Allow for a range of activities. These will help keep the hyperactive learner involved in educational activities. - Make the lesson interesting.

Characteristics or observed behaviours	Implication	Strategies
		- Use diagrams, graphs, visual aids (e.g., projectors, written information, pictures, programmed instruction). These allow for reinforcement and improved self-esteem. - Use alternative strategies to punishment, as punishment may increase the unwanted behaviours. - Give the hyperactive learner a variety of activities to prevent them from becoming bored or lose concentration while doing the same task for a long time. - Teach the learner organisational skills.

Characteristics or observed behaviours	Implication	Strategies
		Establish a structure of what is to be expected and be consistent. - Do not exempt the child from requirements, expectations and planning applicable to other children. - Create an environmental structure along with consistent rules and expected consequences that can help control a variety of problem behaviours. - Have the learner rephrase and/or repeat directions. - Colour-code notebooks, folders and text covers for different subjects. - Reinforce study skills. - Provide frequent breaks, combined

Characteristics or observed behaviours	Implication	Strategies
		with stretching activities to channel motor excess. -Teach problem-solving, conflict resolution and peer mediation skills. - Establish a non-threatening classroom environment, using subtle cues for transitions.

Granted that these steps may improve the experience or achievement of a child with symptoms of ADHD in the classroom, they are time consuming to implement and it might not always be possible to pay this level of attention to a single child in a classroom with many children. The average number of children in South African public schools are 31.3 per teacher (South African Market Insights, 2019) making individual attention to a single learner a practical impossibility.

Another approach to accommodating a learner with the symptoms of ADHD into the classroom, is to make use of academic red-shirting for children with symptoms of ADHD. Academic red-shirting refers to the decision, made by parents, to voluntarily delay their child's entrance to school (Barnard-Brak et al., 2017). This decision is usually based on a number of factors, allowing parents to give their children more time to become school-ready. Barnard-Brak et al. (2017) looked at the use and impact of academic red-shirting on the academic outcomes of children with symptoms of ADHD. They found that children with

symptoms of ADHD were more likely to be red-shirted than their non-ADHD peers, yet, these children did not perform substantially better than those with symptoms of ADHD who were not red-shirted. Thus, there were no substantial benefits to giving children with ADHD more time to become school-ready (Barnard-Brak et al., 2017).

Furthermore, physical activity is suggested as a way to control the symptoms of ADHD. According to Mulrine and Flores-Marti (2014), exercise is suggested to increase mental performance in the areas of the brain involved in attention and memory. They suggest physical activity or physical education as a strategy for teaching children with symptoms of ADHD, because of its ability to reduce anxiety, encourage better social interactions, and improve academic achievement (Mulrine & Flores-Marti, 2014). Physical activity may be useful in cases where children with symptoms of ADHD experience high levels of activity or social rejection. If the poor academic performance of a learner with symptoms of ADHD is, however, due to attentional problems unrelated to anxiety, physical activity may not provide them with any academic improvement. Integration into the traditional classroom setting may not be the best approach to improving the academic outcomes of children with symptoms of ADHD. Several studies, such as those conducted by Bulunuz (2013), Tucker (2014), Burton (2012), and Schuetz et al. (2017), among others, have considered the use of alternative teaching methods to improve academic performance of children with symptoms of ADHD. For the purposes of the current study, teaching through play and peer-teaching are further explored.

2.9 Alternative teaching methods

"Targeted teaching and consolidation of skills does not have to happen at a desk" (Jones & Terry, 2017, p. 28). Alternative teaching methods aim to change the way instruction and/or learning takes place within the classroom. The next part of this discussion will focus

on two alternative teaching methods, namely teaching through play and peer-teaching, which are believed to have the potential to improve the long-term academic outcomes of children with symptoms of ADHD.

2.9.1 Teaching through play

Play is the built-in psychological process that fosters neural pathways by testing, practicing, and creating complex tasks in a context meaningful to a child (Moser, 2018; United Nations Children's Fund, 2018; Zosh et al., 2017). "Action in the imaginative sphere, in an imaginary situation, the creation of voluntary intentions, and the formation of real-life plans and volitional motives-all appear in play and make it the highest level of preschool development" (Vygotsky, 1978, p.102). Expecting young children to sit still, listen to a teacher, complete the work given to them, and to do this without disrupting others, disregards the natural development of young children and the potential learning provided by the social context (Riley & Jones, 2010). In 1981, David Elkind already stated that children are losing out on their childhood, by being rushed toward adulthood by schools and society. They maintained that all of this was sure to create pressure and stress in young children. Which led to the recommendation that play be used to create a more relaxed classroom environment. Elkind (1981) reasoned that a classroom environment characterised by play could show children the joy that could come from learning, as well as make them more confident in their growing abilities. More recent studies, such as that of Tucker (2014), McFeetors and Ireland (2016) and others discussed below, have come to similar conclusions.

Tucker (2014) argued that play is an integral part of learning for young children. They stated that the transition from preschool playing to Grade 1 learning can be difficult for some children. It is therefore important for teachers to understand the value of play in learning, for example in mathematical skills. According to Tucker (2014), play is not only

about what children learn, but also about how they learn. Play can be used effectively in teaching Grade 1 children and may even be more age-appropriate than subject-focused learning; “The influence of play on a child's development is enormous” (Vygotsky, 1978, p. 96). The brain is mostly experience based during early childhood (Moser, 2018; Piaget, 1964). Play allows for more engaging and enjoyable learning, by doing activities. Additionally, play encourages the development and/or refinement of other skills, for instance dexterity (Jones & Terry, 2017). O’Neill et al. (2012) argued that play serves an important role in the social, emotional and cognitive development of young children. Children develop critical skills during play, such as taking turns, working with others, being flexible, taking a perspective, and compromising. Playing allows learning to happen in the interactive space described by Vygotsky (1978). Through play children are able to spot patterns, look for common elements, explain relationships, and analyse different arrangements (Forster, 2017; Goodfellow, 2017). Play has often been used in the therapeutic process of addressing the symptoms of ADHD (O’Neill et al., 2012). If therapy based on play is effective in treating ADHD, bringing more play into the everyday lives (such as in the classroom) of children with symptoms of ADHD could potentially be beneficial to their cognitive development.

Riley and Jones (2010) found that through exploration of the world around them, children learn and grow. Play also seems to assist children to understand abstract mathematical concepts. For example, in their study children were asked to create a trapezoid by placing three triangles together. By playing with differently shaped blocks the research participants were assisted in the discovery and understanding of geometric shapes. It was, therefore, possible for learning and play to co-exist in the classroom. According to Riley and Jones (2010), it was clear that deeper levels of learning were achieved by the active involvement of participants. This is supported by the experiential approach to learning described by Piaget (1964), as well as the interactive learning described by Vygotsky (1978).

Yet, when Fesseha and Pyle (2016) sent a survey to pre-school teachers in Ontario, Canada, most of the research participants indicated that although play was common in their classroom, only a few reported that play was purposefully used in their academic programme. The researchers included the responses of 69 of these teachers in their results. The questions included topics related to the potential of teaching through play, the role of the teacher, examples of teaching through play, and the challenges faced by teachers. Time was the most common challenge reported by teachers, followed by play being separate from learning, and play being used only for social development (Fesseha & Pyle, 2016).

Bulunuz (2013) conducted a study comparing the traditional classroom to a teaching through play classroom. Pre-school children were taught science through interactive play scenarios that encouraged them to ask questions, make observations and draw pictures of their experiences. This approach allowed participants to learn by experimenting with their surroundings in a trial and error manner (Piaget, 1964). The results of the study showed that the children in the teaching through play classroom obtained significantly more knowledge about science than the children in the traditional classroom. In this group, the children were asked to make predictions and observations of their science experiments (Bulunuz, 2013). In essence, demonstrating the ZPD and potential learning described by the social cultural theory of cognitive development, by encouraging participants to learn in a guided manner (Vygotsky, 1978). The children were able to better their understanding of science, as well as how to conduct experiments. The final findings included evidence that the children were more enthusiastic and confident in their scientific abilities (Bulunuz, 2013).

Similarly, McFeetors and Ireland (2016) studied the impact of implementing the game SET, a game that is based on the ability to discriminate and sort cards in a visual manner, in teaching mathematics. SET is easy to learn in a short period of time. Twelve cards are set out on a surface, facing up. Players attempt to make a set of three cards using the cards laid out.

A set must contain three cards that either have similar attributes (shape, colour, shading or quantity) or all have different attributes. The remaining players have to identify whether the active player has indeed identified a set. Every time a set is identified, the cards are removed by the active player and replaced by cards from the deck. The player that identified the most sets during the game, is the winner (McFeetors and Ireland, 2016). Here learning occurs not only in a playful manner, but in the interaction between peers (Vygotsky, 1978). McFeetors and Ireland (2016) found that the research participants showed improvement in their communication, visualisation, and reasoning skills in terms of mathematics after playing the game of SET. Communication skills were improved when a player identified a set and then proceeded to defend that set to their fellow players. Players used visualisation to identify a set by manipulating the cards in their minds, as well as having to discriminate and classify the attributes of the cards, often engaging in deductive reasoning as they played (McFeetors & Ireland, 2016).

The studies discussed above have certain limitations, for example, the study by Bulunuz (2013) used small groups of children and they were already in a pre-set environment. McFeetors and Ireland (2016) made use of an already existing mathematics club, thus the children were already interested in mathematics beyond their normal classroom exposure to the subject. Their results were based only on interviews with three participants who self-identified as experts in the game of SET.

Mishra and Kotecha (2017) took an alternative approach to teaching through play by comparing the use of normal grading to reverse grading, essentially, turning the grading scale into a game. Normal grading awards a participant a point when they perform an activity correctly, while reverse grading subtracts a point when a participant performs an activity incorrectly (Mishra & Kotecha, 2017). The results showed that research participants performed better when reverse grading was used. Participants were more motivated to retain

their marks, than they were to gain marks, thus, indicating that research participants were more motivated by the avoidance of loss (Mishra & Kotecha, 2017).

Gamification has become increasingly popular in a variety of activities. Gamification refers to the use of gaming elements in contexts where gaming would usually be considered inappropriate (Turan et al., 2016). Gamification is used to motivate and engage people, to promote learning, and encourage the use of problem-solving skills by relying on game-based mechanics, aesthetics, and game thinking to improve performance (Buckley et al., 2014; Kapp, 2012; Urh et al., 2015). In order to create educational content for gamification emphasis should be placed on interactivity and engagement. The content should be tailored to the learning objectives and allow multiple performances, achievability, increasing difficulty, as well as various pathways to success. The activities need to be designed in such a way that participants are allowed to repeat them, if they have a failed attempt. The activity goals should be achievable and designed to suit the skill level of the participants. Each follow up activity should increase in difficulty, allowing participants to use their newly acquired skills and knowledge. Multiple paths to reaching the activity goals allow participants to make use of their own strategies and take part in active learning (Nicholson, 2015; Sailor, 2017; Simões et al., 2013). These authors have created a guide to the introduction of gamification, or in this research, play into the academic setting.

The practical success of teaching through play is evidenced by the Finnish education system, discussed earlier in this chapter. Learning through play is a fundamental aspect of Finland's education system. Children are provided with more time to play in Finnish schools, students have shorter school days, as well as minimal homework (Cooper, 2014; Kager, 2011). Finland's Basic Education Act states: "the pupil's workload in basic education must be such as to allow him or her enough time for rest, recreation and hobbies over and above the time spent in school, school travel and homework" (Finland Basic Education Act, 2011,

p. 11). Teachers feel that extracurricular activities add to the overall growth and development of children (Kager, 2011). The approach to learning in Finland is based on the natural curiosity of children, in other words, the experimental aspect of cognitive development. Teachers aim to inspire curiosity and nurture a desire to learn, similar to the ZPD proposed by Vygotsky (1978), creating the potential to learn. Learning occurs by exposing children to various perspectives on a subject, through play, singing, physical movement, and out-side exploration. Informal assessments and individualised feedback ensure that no pressure is added to children (Louw, 2019). The effectiveness of this approach along with other educational policies, such as equality and well-trained teachers, is further evidenced by the high success rate of Finnish students, and eventually Finnish adults. Some South African schools, such as Funda Ujabule in Soweto and Laerskool Die Krans in Pretoria, have already implemented a form of teaching through play in the classroom (Louw, 1 July 2019). No further research was available on the success of this approach in these two schools.

Teaching through play is one way that children can be inspired to learn in a collaborative and experimental way as an alternative to the traditional classroom. Similarly, peer-teaching can be used to create this collaborative learning environment.

2.9.2 Peer-teaching

Teaching is learning - Lucius Annaeus Seneca, Letters from a Stoic (AD 65)

He who teaches learns – Comenius on Education (1631)

To teach is to learn twice - Joseph Joubert. in Joubert: A Selection from His Thoughts (1899), Chapter XVIII of Education

Although a multitude of studies have been done on the topic of peer-teaching, as well as the benefits to both the teacher and the student in this regard, these studies have mostly

been done using university students as participants. Due to the sparsity of literature involving peer-teaching for younger children, the literature discussed below focusses on findings based on older participants.

According to Schuetz et al. (2017) peer-teaching refers to an instance in which someone that is not a professional teacher, but from a similar cohort as the student, teaches, and by doing so improves their own knowledge of the material as well. Hill and Tanveer (1981) found that through teaching others (tutoring) participants improved their own knowledge and understanding, therefore, creating the interaction needed to increase the learning potential of both children. Peer-teaching creates an informal environment in which a student may ask questions that they may not have felt comfortable asking in a traditional classroom. Schuetz et al. (2017) conducted a large-scale peer-teaching programme using university students, in which volunteer peer-‘teachers’ presented tutorial sessions based on the subject matter covered in the classroom, to their peers. Tutorial participation was voluntary, and 70% of the students enrolled between 2012 and 2014 attended at least one of these tutorial sessions. Scheutz et al. (2017) used the first test score of each research participant and compared it to each participant’s retest score. They found that participants of the peer-teaching programme achieved about 20% more on average than those that did not make use of a peer teacher. Additionally, those that attended the tutorial sessions had a 20% higher pass rate in the retest than those who did not attend. Using school aged children, Burton (2012) conducted a study investigating the influence of peer-teaching as a strategy to get children that had lost interest in school, re-engaged in school. Older children formed groups and then visited the classes of younger children to teach them about the topic of ‘bullying’. Burton (2012) found that peer-teaching increased the engagement of students in the subject of ‘bullying’. Many behavioural changes were also found in the children, such as increased confidence levels and more interaction in the classroom. An additional form of

peer-teaching, where one learner is the coach and the other performs a skill in a physical education class, was also recommended in the study mentioned earlier by Mulrine and Flores-Marti (2014) as a strategy for teaching children with symptoms of ADHD.

As early as the 1960s, Cloward (1967) found that peer teachers' academic performance improved even more than those of the peers learning from them. Research by Duran (2016) indicated that teaching created a more enriching experience than simply learning for yourself. Teaching involves different mental processes to learning, because the information needs to be retrieved, revised and organised in order to teach it. This can be explained by the way modelling is used in the social cognitive theory of development, as information (from a model) will first need to be attended to, retained and reproduced by the learner in order to teach a peer (Bandura, 1977). Explaining something to another is also a test of your own knowledge. Duran (2016) divided the research participants into three different groups namely a control group, those that were told to prepare to teach, and those that were told to prepare to teach and engaged in teaching. The results indicated that students that prepared to teach others performed better, and those that actually taught their peers, performed even better. Thus, the interaction between the teacher and the student is a crucial part in the learning process. Explaining content seems to lead to cognitive processes that improve knowledge, because the one receiving the information can ask questions or demand clarification. This is reflective knowledge building as the peer teacher can recognise where they themselves need improvement, re-organise the information and fix errors. It allows the peer teacher to assess whether their understanding of the knowledge makes sense and is logical. The peer teacher may also ask the student questions to guide them and assess their understanding. Knowledge is built in collaboration and this creates an environment where everyone learns from each other and teaches each other (Duran, 2016). Peer-teaching made

positive contributions to the academic achievement of research participants (Nawaz & Rehman, 2017).

Although the research conducted on alternative teaching methods, discussed in this literature review, were not all done by using children with symptoms of ADHD, the current study uses adjusted versions of teaching through play and peer-teaching as alternatives to teaching in the traditional South African classroom. These teaching methods are adjusted to be age appropriate, as well as to cover the relevant mathematical material. In the case of the current study, the focus is on mathematical performance, and the peer-teaching will be done by children of the same age. This study aims specifically at improving the mathematical performance of Grade 1, six- to eight-year-old, children with symptoms of ADHD, by teaching in a way that is more interactive and addresses their specific cognitive and/or learning deficits, such as a lack of sustained attention. Both teaching through play and peer-teaching are based on specific theoretical assumptions regarding the main causes of the symptoms of ADHD. These theoretical assumptions are discussed below.

2.10 Theoretical assumptions as the basis for teaching through play and peer-teaching

A wide range of theories have been suggested, to explain the main cause of the symptoms of ADHD. These theories include, but are not limited to, neurochemical factors, neurophysiological factors, neuroanatomical factors, genetic factors, developmental factors, and psychosocial factors (Sadock et al., 2015). The current study, however, uses two theoretical assumptions as the basis for teaching through play and peer-teaching to improve the mathematical performance of children with symptoms of ADHD. The current study is based on the immaturity hypothesis and working memory as the main deficit in ADHD.

2.10.1 Immaturity hypothesis

The first of the theoretical assumptions for learning difficulties associated to ADHD, is the immaturity hypothesis according to which children with symptoms of ADHD are mentally less mature than their peers (Nolen-Hoeksema, 2011). Evidence for this is found in research findings by Sheridan et al. (2007), which established that children with symptoms of ADHD have differences in the size of their prefrontal cortex and the activation in this area, in comparison to their non-ADHD peers. The prefrontal cortex continues to develop well into adolescence. Therefore, these researchers hypothesised that the prefrontal cortex of children with symptoms of ADHD is less mature than that of other children their age. The immaturity hypothesis additionally explains why children with symptoms of ADHD are more active and struggle with sustained attention as they are mentally younger than their peers, they behave in a way expected from younger children (Nolen-Hoeksema, 2011). More recent research by Vaidya (2012), Rubia et al. (2014), and Kumar et al. (2017), have come to a similar conclusion, specifically that neuroanatomically the brain of those affected by symptoms of ADHD develops slower than those of their peers. The DSM 5 reports that children with symptoms of ADHD have a decreased total brain volume compared to non-ADHD peers, as measured by magnetic resonance imaging (APA, 2013; Baroni & Castellanos, 2015).

This theoretical assumption becomes the basis for using play as an alternative teaching method. If the immaturity hypothesis is accurate, Grade 1 children with symptoms of ADHD will learn more effectively through play compared to the traditional classroom setting, because play is the main form of learning used for pre-primary school children. Furthermore, play allows for the experiential learning suggested for cognitive development to progress (Piaget, 1964). It allows for the interaction learning that permits children to learn from each other (Vygotsky, 1978). Play also allows children to imitate the behaviour of their peers, parents or teachers in direct or abstract ways (Bandura, 1977). The use of play as an

alternative teaching method, therefore, implements aspects of all three of the approaches to cognitive development and learning discussed earlier.

2.10.2 Working memory

The second theoretical assumption is that working memory is the main deficit related to symptoms of ADHD. The process of perceiving, understanding, storing, and applying information depends on several interrelated cognitive processes, such as attention, as well as the required skills such as the ability to read. The discussion here is a simplification of the actual process focussing on only working memory and retrieval practice.

The deficit in working memory is evidenced by Re et al. (2016) who compared the ability of 14 children with ADHD, to their non-ADHD peers, in completing word mathematical problems, as word problems require the use of a mental map of the problem, while constantly updating this map as new information is received. The results found by Re et al. (2016) confirmed the assumption that working memory is the main deficit related to symptoms of ADHD. Alloway and Cockcroft (2014) found that working memory was below par in children with ADHD, even when age and IQ were accounted for. In their large-scale study of working memory in children. Fried et al. (2016) found that deficits in working memory were detrimental to children with ADHD.

Miller et al. (2013) conducted a study on the various cognitive functions involved in the symptoms of ADHD and the poor academic performance usually related to it. Working memory was the only mental variable found to be implicated in the symptoms of ADHD (Miller et al., 2013). Re et al. (2010) compared visuospatial working memory between two groups of 23 five-year olds. The two groups were matched in terms of age, sex, and socioeconomic status, with the difference between the two groups being the presence of

ADHD symptoms. The comparison provided evidence for the deficit in working memory of children with symptoms of ADHD, when compared to their typically developing peers.

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The increase in cognitive load as tasks become more complex results in higher error rates in children with ADHD when compared to their non-ADHD peers (Re et al., 2014). Cognitive load refers to the resources of working memory that are used during the processing of information. Working memory enables people to hold information in their minds while receiving new information and integrating all the information into a whole. Working memory has a limited capacity to hold and manipulate information. Working memory is, precisely, our ability to manipulate complex information, as well as combine information learned in the past with new information (Goldstein, 2015). Information is entered into sensory memory, then into working memory and after a short period encoded into long-term memory. The information can then be recalled into working memory at a later stage to be used again (Goldstein, 2015). This is an important function in the successful application of mathematics as new information (mathematical problem) is integrated with previous information (knowledge of required calculation) to solve the problem. This is exactly the ability tested in the traditional classroom setting. Failure of retrieval is often the cause for failures of memory (Goldstein, 2015).

Karpicke (2012) found that practicing the retrieval of information by testing self-knowledge often leads to better memory. This is known as the testing effect and has been proven to be more effective than merely re-reading information (Karpicke, 2012). The assumption that working memory is the main deficit related to symptoms of ADHD together with the testing effect is the basis for the use of peer-teaching as an alternative method of learning. By recalling information to teach it to another research participant, the research participants are testing their own knowledge retrieval practice, which is considered to be advantageous in the encoding of long-term memory (Goldstein, 2015). This alternative teaching method is also underpinned by the social cognitive theory of cognitive development. As the researcher initially introduces new information to the first participant, the participant is required to pay attention to the manner in which the researcher models the transfer of the information. Next, the participant is required to retain the information modelled, before reproducing the modelled behaviour (teaching) to the second participant. Furthermore, the first participant must demonstrate a belief in their own ability to reproduce the teaching (Bandura, 1977). In the instance that the first participant requires more assistance from the researcher to master the information presented to them, the ZPD is used to allow the participant to reach their potential mathematical ability (Vygotsky, 1978).

2.11 Conclusion

This chapter begins by examining various approaches to cognitive development and learning. The South African education system is compared to the Finnish education system, as Finland shared many of the same concerns facing South Africa, such as inequality, a history of violence, and an uneven spread of resources. This comparison demonstrates the possibility of education reform in a country like South Africa. The current literature available on the long-term academic outcomes of children with ADHD, the use of medication for

ADHD, current strategies used to integrate children with ADHD into the classroom, teaching through play and peer-teaching are considered. The theoretical assumptions, deliberated above, inform the current study, as well as justifying the use of teaching through play and peer-teaching as alternative teaching methods for children with symptoms of ADHD. The following chapter explicates the methods and procedures used during the sampling, data collection, and data analysis phases of the current study.

Chapter 3 Research Methodology

3.1 Introduction

According to the Cambridge English Dictionary methodology refers to "a system of ways of doing, teaching, or studying something; a set of methods used in a particular area of study" (Cambridge English Dictionary Online, 2020, par. 1). This chapter focuses on the methodology employed in the current research study. The population and sample for this study as well as the inclusion and exclusion criteria are outlined. The aim of this chapter is to position the current study within the chosen ontology, epistemology, and methodology. The research instruments are described, and data collection and analysis procedures are explained.

3.2 Aims and objectives of the research study

This study aimed to explore whether changing the teaching methods used in the South African school classroom, to include play or peer-teaching, can improve the mathematical performance of children with symptoms of ADHD and thus prevent the academic gap between these vulnerable children and their peers from occurring and/or getting progressively larger as they progress through their schooling.

The objectives of this study were to identify children who exhibit symptoms of ADHD, enrolled at public schools in Pretoria, Gauteng Province, South Africa. First, to measure the current mathematical performance of each research participant through the administration of a pre-test. Next, to administer an intervention, as either teaching through play or peer-teaching, to each participant, excluding the participants in the control group. Then, to measure the results of the post-test scores obtained from each research participant, as well as to compare the pre-test and post-test scores to the scores obtained from the control

group, as well as between the two intervention groups. As a result, a conclusion was reached as to whether the teaching methods used as interventions led to a change in the mathematical performance of the research participants. The comparison between the post-test scores of the two intervention groups provided an indication of the most effective intervention, with regard to improving the mathematical performance of children with symptoms of ADHD.

3.3 Research questions

The focus of this study was on the potential influence of alternative teaching methods on the mathematical performance of children with symptoms of ADHD in South African classrooms. More specifically, this study compared the alternative teaching methods, teaching through play and peer-teaching, to the traditional teaching methods used in the classroom with regard to the mathematical performance of Grade 1. Based on the research problem and research objective the main research question was: “Will adapting teaching methods in the South African classroom to include teaching through play or peer-teaching, improve the mathematical performance of children with symptoms of ADHD?” The research question above consists of three different components resulting in the following three answerable questions:

1. Does teaching through play improve the mathematical performance of children with symptoms of ADHD?
2. Does peer-teaching improve the mathematical performance of children with symptoms of ADHD?
3. Is either teaching through play or peer-teaching more effective in improving the mathematical performance of children with symptoms of ADHD?

3.4 Research hypotheses

A hypothesis is formulated as a specific testable expectation based on what the researcher envisages to observe in nature, derived from theories relevant to an area of study. It is therefore a statement of what ought to be seen when a theory is correct (Babbie, 2016). The three questions discussed above each require their own set of hypotheses.

Table 3.1

Hypotheses per Question

Research Question	Null and Alternative Hypothesis
Question 1	$H_{0(1)}$: Teaching through play does not improve the mathematical performance of children with symptoms of ADHD. H_1: Teaching through play does improve the mathematical performance of children with symptoms of ADHD.
Question 2	$H_{0(2)}$: Peer-teaching does not improve the mathematical performance of children with symptoms of ADHD. H_2: Peer-teaching does improve the mathematical performance of children with symptoms of ADHD.
Question 3	$H_{0(3)}$: There is no difference between teaching through play and peer-teaching with regard to the improvement of mathematical performance of children with symptoms of ADHD. H_3: Peer-teaching is more effective than teaching through play with regard to the improvement of the mathematical performance of children with symptoms of ADHD.

3.5 Research paradigm

A paradigm refers to the lens or frame of reference through which the world is observed and understood. Paradigms are implicit to the way in which the world is viewed. Paradigms become restricting, resisting major changes, and then become replaced by new paradigms (Babbie, 2016). This research study made use of post-positivism, which cannot be understood without the context of positivism.

3.5.1 Positivism and post-positivism

Positivism maintains that knowledge is derived from direct observation through empirical or experimental means. Positivism assumes that nature is stable and patterned and there for us to discover. The aim is to find facts and/or causes of behaviour with no regard for the subjective experiences of the participants. The researcher is an objective outsider in this approach (Aliyu et al., 2014). Positivism, however, has been criticised for its many shortcomings in terms of studying human behaviour. Firstly, positivism is criticised for its disregard of the human experience within the pursuit of knowledge. Secondly, positivism assumes that generalisations can be made regardless of setting, or across various settings, discounting the role of context. Thirdly, positivism aims to describe the social world as a single truth. Finally, positivism does not allow space for the reflexivity of researchers, as research is meant to be completely objective (Fox, 2008). In response to these criticisms of positivism, post-positivism has emerged.

Post-positivism assumes that nature exists, and that measurement of nature is possible, however, an absolute truth of nature is more aspirational than an outcome of scientific enquiry (Fox, 2008). Additionally, post-positivism acknowledges the role the researcher plays in the interpretation of data, allowing for reflexivity (Fox, 2008). Thus, post-

positivism accepts that there is an objective reality, that researchers are able to study, but our tools are “inevitably value-laden, theory-laden and context-dependent” (Fox, 2008, p. 8).

The current study took a post-positivistic stance to research. Although this research aims to answer the research question posed by means of measurement, it does not discount the role the researcher has played in the selection of the topic, the intervention methods, as well as in the design of the pre-test and post-test. Additionally, the research acknowledges its limitations in terms of the effectiveness with which the researcher has implemented the intervention methods. Furthermore, the current study recognises that the context in which the research takes place, classrooms within public schools in South Africa, will inevitably have an impact on the results of the study. Post-positivism maintains that knowledge is acquired through “rigour, multiple data analysis and theory-building and testing” (Fox, 2008, p. 7). Post-positivism supposes that its methodologies predominantly represent a way in which a representation of reality may be measured. Post-positivism allows the use of the most appropriate methods to answer the research question, which in this case would be a quantitative method (Ryan, 2006).

3.5.2 Quantitative research studies

A quantitative research study collects numerical data in an attempt to answer research questions, with variables as the fundamental aspects of quantitative research (Christensen et al., 2014). The quantitative research question aims to determine what the relationship between variables are. The quantification of information eases the process of aggregation, summarisation, and comparison. Additionally, quantification allows for statistical analysis. Thus, quantification offers a number of benefits as discussed above, however, during quantification the expanded or deeper meaning of data is often lost (Babbie, 2016). The research question: “Will adapting teaching methods in the South African

classroom to include teaching through play or peer-teaching, improve the mathematical performance of children with symptoms of ADHD", is most appropriately answered using a quantitative research method as the research question seeks to measure and compare the mathematical performance of participants.

The aim of the current study was to determine whether teaching through play and/or peer-teaching, would improve the mathematical performance of children with symptoms of ADHD, as well as whether either of these teaching methods would be more effective in improving the mathematical performance of children with symptoms of ADHD. The independent variable refers to the variable "presumed (the) cause of another variable", while the dependent variable is the "presumed effect or outcome" (Christensen et al., 2014, p. 47). The independent variable in the current study was the intervention condition, in other words, the teaching method assigned to each individual, while the dependent variables were the pre-test and post-test scores of each individual.

3.5.3 Research design

Once the research question has been refined, the research study needs to be designed. The research design refers to the "outline, plan, or strategy that specifies the procedure to be used in seeking an answer to your research question(s)" (Christensen et al., 2014, p. 238). The design of the research study includes various decisions, such as the characteristics of the required sample; what the size of the sample will be; what data collection techniques to use; what data analysis method to use (Neuman, 2014).

A longitudinal design measures a dependent variable at multiple points in time (Babbie 2016; Christensen et al., 2014; Neuman, 2014). The mathematical performance of children with symptoms of ADHD is measured at two points in time − during the pre-test

phase of the study, followed by an eight-week intervention, then during the post-test phase of the study. Therefore, this research study is considered longitudinal in nature.

3.5.4 Experimental research

Quantitative research is divided into experimental and non-experimental research (Christensen et al., 2014). Experimental research is the most appropriate to answer questions of cause and effect (Babbie, 2016; Christensen et al., 2014; Neuman, 2014). An experiment has three main aspects namely: dependent and independent variables; pre-tests and post-tests; and experimental and control groups (Babbie, 2016). An experimental design is the most appropriate to answer the research question of the current study. The current study contains all three of the main aspects of an experimental design. The independent variable in the current study was the intervention condition, while the dependent variables were the scores of each research participant. The study made use of pre-test and post-test scores as well as two experimental groups and one control group. Therefore, the study meets the necessary requirements of an experimental design.

3.5.5 Pre-test-post-test control group experimental design

The pre-test-post-test control group experimental design requires a minimum of two groups, as well as the random assignment of participants to groups (Mertler, 2019). Each participant is administered a pre-test, after which the respective groups receive either an intervention or no intervention, followed by a post-test (Christensen et al., 2014). The use of random assignment, a pre-test, as well as comparison groups, allows this to be the most appropriate experimental design (Mertler, 2019). The pre-test-post-test control group experimental design may be considered a mixed design as it allows for between-subject comparison, as well as for within-subject comparison (Christensen et al., 2014). The current

study employed the use of two intervention groups and one control (comparison) group. The pre-test and post-test mean scores of each intervention group were compared thus a within-subjects-comparison was conducted. Additionally, the post-test mean scores of the two intervention groups were compared to each other, as well as to the control group thus a between-subjects comparison was conducted. Therefore, the pre-test-post-test control group design was the most fitting design for this research study. More specifically, a dependent t-test was used to statistically compare the pre-test mean score of each group with their mean post-test score. In the cases where the data did not meet the assumptions of the t-test, the Wilcoxon Signed Rank nonparametric test was used as an equivalent analysis. An analysis of variance (ANOVA) was planned to provide a comparison between the post-test scores of the three intervention groups, teaching through play, peer-teaching, and control groups. The assumptions of the ANOVA were not met by the data set, requiring the use of a non-parametric equivalent test. The Kruskal-Wallis test was used to complete the comparison between the post-test means of the three groups.

3.5.6 Strengths and weaknesses of the research design

Experimental designs have various strengths as opposed to other research designs. Most importantly, the experimental design lends itself to logical rigour, resembling scientific research (Babbie, 2016). Experiments isolate the experimental variables' impact over time, allowing for stronger cause and effect conclusions (Babbie, 2016; Mertler, 2019). As experiments require a relatively small sample of participants, relatively little time, and can be conducted relatively inexpensively, they can often be replicated, increasing the validity of the study. As a consequence of higher validity, the results of a study are more generalisable to the population (Babbie, 2016). More specifically, the use of pre-tests allows the researcher to determine whether random assignment has resulted in equivalent groups. Through the use of

a pre-test, researchers are able to identify any potential problems with regard to the ceiling effect and/or floor effect. The ceiling effect occurs "when the participants' scores on the dependent variable are so high that they cannot go up from pre-test to post-test" **(**Christensen et al., 2014, p. 253), while the floor effect occurs when "scores are so low that they cannot go down from pre-test to post-test" **(**Christensen et al., 2014, p. 253). Furthermore, pre-tests provide a baseline measure against which the outcome of an intervention can be measured **(**Christensen et al., 2014). However, as with any research design, experiments have limitations.

Experiments have limitations in terms of design, as a consequence of the stringent processes of the scientific method, prohibiting the deeper investigation of human behaviour or the expansion of data. Furthermore, great care needs to be taken during the design, sampling, data collection, and conclusions to ensure that the validity of the study does not become threatened (Mertler, 2019).

3.5.7 Validity

Validity refers to the degree to which an instrument or research study measures what it was intended to measure. Validity is, however, apportioned into various forms of validity, namely face validity, construct validity, predictive validity, content validity, internal validity, and external validity (Babbie, 2016; Christensen et al., 2014; Mertler, 2019; Neuman, 2014).

Face validity refers to the extent to which an instrument appears to measure what it is meant to measure, based on a superficial examination of the instrument (Christensen et al., 2014). The instrument (pre-test and post-test) used in the current study, has a high level of face validity, as it is based on the CAPS education system that is implemented throughout public South African primary schools. Construct validity refers to the degree to which the questions satisfactorily represent the construct being measured (Christensen et al., 2014). The

questions posed to participants in the current study were all mathematical in nature, as well as adaptations of the CAPS workbook, thus they adequately measured mathematical constructs for Grade 1 children. Predictive validity is the degree to which scores obtained from participants can be used to predict future behaviour (Christensen et al., 2014). The mathematical performance score calculated for each participant in the pre-test and post-test was used as a predictor of overall past and future mathematical performance. Content validity is closely related to construct validity, referring to the degree to which the range of meanings attributed to a construct is covered (Babbie, 2016). The current study made use of several different aspects of mathematical performance, namely shorter and longer, double and divide, add and subtract, time, direction, bigger and smaller, sorting of objects, and days and months, to reach a comprehensive score of mathematical performance on a level appropriate to the participants' age and schooling level.

Internal validity refers to the extent to which the observed results reflect the relationship between the experimental variables to the exclusion of any other extraneous or confounding variables (Mertler, 2018). In terms of the current study, this refers to the extent to which improvements in mathematical performance can be linked to the respective intervention methods, to the exclusion of any other extraneous or confounding variables. Mertler (2019) identified eight threats to internal validity namely history, maturation, differential selection of participants, testing effects, instruments, statistical regression, attrition, and an interaction of the threats above. When research studies extend over a period of time, other factors have the opportunity to influence the results of the study, known as the threat of history (Mertler, 2019). The current study extended over a period of 10 weeks, pre-test-week, eight weeks of intervention, followed by post-test-week. As 10 weeks can be considered a relatively short time frame, the current study was able to circumvent the threat of history. It is, however, important to note that the use of participants between the ages of

six and eight years, did allow the threat of history to become more prominent, as young children learn at a relatively expeditious rate. Similarly, the threat of maturation, growth, and psychological development over time (Christensen et al., 2014), may have impacted the results of the current study. This was circumvented by the relatively short duration of the study, as well as the comparison of the intervention groups to the control group. Furthermore, differential selection of participants becomes a threat to internal validity, as a result of characteristics that are unknown about participants. Testing effects refer to the ability of participants to learn from a pre-test, inevitably improving their post-test scores (Christensen et al., 2014). The current study only made use of mathematical concepts that all participants had already been exposed to during the course of their normal schooling, as well as the use of a comparison group, to reduce the impact of testing effects on the results of the study. Instrumentation may become a threat to internal validity when the instrument is unreliable or inaccurate (Mertler, 2019). As the instrument (pre-test and post-test) used in the current study was designed according to the CAPS education system, the nationally accepted standard of education, the results of the study were unlikely to be inaccurate. Statistical regression occurs when pre-test scores are so high or so low that the post-test scores cannot increase or decrease any more (Mertler, 2019). Christensen et al. (2014) refer to this phenomenon as regression toward the mean, as the scores cannot move in any other direction. During the pre-test phase of the current research none of the participants' scores were considered too high or too low to allow for the observation of the impact of the intervention (teaching methods) on mathematical performance. The use of a longitudinal study (pre-test, intervention, post-test) creates the opportunity for attrition, the dropout of participants (Mertler, 2019). Christensen et al. (2014) expanded on this threat to internal validity, by raising the issue of differential participant dropout rates between the various experimental groups. The research attempted to thwart attrition by sending reminder messages to the parents of participants on a weekly

basis, as well as asking teachers to remind participants of their participation in the teaching through play and peer-teaching groups. Additionally, participants were required to attend six of the eight intervention sessions to remain part of the study. Although the current study did experience some dropout of participants, the groups remained approximately equivalent in size throughout the study.

In addition to the threats to internal validity discussed above, Babbie (2016) identified demoralisation as a threat to internal validity. Demoralisation refers to the loss of interest by participants in the control group in the completion of the study. The control group in the current study was offered the same intervention, teaching through play or peer-teaching, following the completion of the study. Parents were informed that children in the control group will be offered a choice of which teaching method they would prefer, following the release of the preliminary results of the study, allowing them to make an informed decision. This strategy ensured that the attrition in the control group was comparable to that of the intervention groups.

Neuman (2014) furthermore, identified contamination of treatment as a threat to internal validity, referring to the impact of an intervention on those that are in the control group. The current research avoided contamination by providing the intervention, by means of additional math classes, to research participants after school, once those in the control group had already left for the day. Neuman (2014) also identified compensatory behaviour and researcher expectancies, both referring to modified behaviour from the researcher, as possible threats to internal validity. The researcher attempted to keep the pre-test, post-test and intervention conditions as stable as possible, as well as paying attention to any behaviour modifications during the study. Moreover, the knowledge that the control group will be offered the same intervention, removed the need to compensate them in any way.

A tension exists between internal validity and external validity − as the one increases the other is sacrificed. For example, to ensure that results are transferable to different contexts, times, and populations, a larger sample is required in a more flexible context, yet, the control required for high internal validity is surrendered. External validity refers to the generalisability of a research study to other populations, contexts, times etc. (Babbie, 2016; Christensen et al., 2014; Mertler, 2019; Neuman, 2014). Several threats may impinge on the distinct categories of external validity, namely population validity, ecological validity, outcome validity, and temporal validity.

Quantitative research aims to represent the population in a random sample, allowing the results to be generalised back to the population upon completion of a study (Gravetter et al., 2018). In spite of this, researchers do not always have access to the entire population. Therefore, the sample is drawn from the accessible population, yet the results are generalised to the entire population, creating a threat to population validity (Christensen et al., 2014). The population of the current study is all first-grade children attending public South African schools who exhibit symptoms of ADHD. The accessible population consists of the first-grade children attending the six public schools that agreed to participate in the study, who exhibit symptoms of ADHD. The sample for the current study was selected from the accessible population. Ecological validity refers to the transferability of the study (with the same outcome) from one context to another (Christensen et al., 2014). The current study, and the results, should theoretically be transferable to any public South African school, to provide a teaching intervention (teaching through play or peer-teaching) for children with symptoms of ADHD, improving their mathematical performance. The practical transferability would depend on contextual factors, such as teachers, resources, types of ADHD, and so forth. Outcome validity refers to the extent to which the outcomes of a study can be generalised to other but interconnected dependent variables (Christensen et al., 2014). It is unclear whether

the teaching methods, teaching through play and peer-teaching, could be used to improve areas of academic performance other than mathematics, within the South African public school context. Though, both teaching through play and peer-teaching have been used in literature to respond to a range of academic concerns. Temporal validity refers to the extent of the generalisability of the results to different times (Christensen et al., 2014). The results of the current study can be expected if the study were replicated at a different time, but only if all the other elements are kept constant. Alongside validity, good research studies have to have reliability.

3.5.8 Reliability

Reliability is determined by two measures, the extent to which the instrument produces stable scores over time, and the extent to which the various items in the instrument are consistent (Woods, 2019). Reliability is apportioned into measurement reliability, stability reliability, and representative reliability (Neuman, 2014).

The consistency with which the instrument measures a variable, is known as measurement reliability (Neuman, 2014). As a consequence of the mathematical nature of the instrument used in the current study, as well as the use of the national standardised learning guide in the design, very little room is left for misinterpretation, thus, the assumption can be made that the measure reliably measures mathematical performance. Stability reliability is determined by comparing the scores of the measurement over time (Neuman, 2014). As the current study aims to measure mathematical improvement over time, stability reliability is not applicable. Representative reliability refers to the extent to which the measurement remains consistent across a diverse group of individuals (Neuman, 2014). The study included children attending six different primary schools, located in six different neighbourhoods, receiving

their education in Afrikaans or English, ensuring a relatively high level of representative validity.

3.6 Population and sample

3.6.1 Population

According to the Oxford English Dictionary a population refers to “a finite or infinite collection of items under consideration” (Oxford English Dictionary Online, n.d.). The population of the current study are Grade 1 children attending South African public schools diagnosed with or vulnerable to ADHD (demonstrating symptoms of ADHD). According to Market Insights South Africa (2019) approximately 1,2 million children are enrolled in Grade 1 at public schools in South Africa annually. Assuming that Schoeman and De Beer (2017) are accurate in their estimation of the rate of ADHD symptoms present in approximately 5% of children, the population for the current study was around 60 000 South African Grade 1 children. As it is impractical to conduct a study with all these children as participants a sample of these children was used.

3.6.2 Sample

A sample refers to the set of individuals that are selected from a population, usually these individuals represent the population in terms of certain characteristics (Gravetter et al., 2018). Sampling is a technique through which a researcher systematically selects a small group of individuals to represent the population in a measure (Sharma, 2017). A sample of the population, children with symptoms of ADHD attending public South African schools, was used in the current study. This study made use of a nonprobability sampling technique in the selection of the sample.

3.6.3 Nonprobability sampling

In probability sampling each individual in the population has an equal, nonzero chance of being selected (Robertson & Sibley, 2019). Although probability sampling is considered to provide more accurate results, every individual in the population has to be known in order for each individual to have an equal, nonzero chance of selection (Sharma, 2017). Every child in South Africa with symptoms of ADHD is not known to the researcher. Therefore, this research employs non-probability sampling.

Non-probability sampling refers to a set of sampling techniques in which the sample is selected based on the researcher's judgement of individuals that will provide the most appropriate information to answer the research questions (Dattalo, 2010). In other words, individuals are selected to match criteria set out by the researcher.

The specific nonprobability sampling technique used in this study was purposive sampling. Purposive sampling, "also known as judgmental, selective or subjective sampling" (Sharma, 2017, p. 751), selects individuals deliberately based on the research questions of the study. Purposive sampling emphasises diversity in selection, as well as typical cases, to ensure that the sample is as representative of the population as possible (Dattalo, 2010).

The researcher set the criteria for inclusion in the current study, listed in Section 3.6.4, based on the DSM 5 symptoms of ADHD. Access was requested to 22 public schools in Gauteng, Pretoria, South Africa, with six schools agreeing to participate in the research. Diversity was emphasised by including schools in various neighbourhoods, attended by a diverse range of children, from diverse backgrounds, using either English or Afrikaans as their language of instruction.

Parents of children from participating schools were given an information letter (Appendix A), describing the symptoms of ADHD in comprehensible terms, as well as practical examples of behaviours that could be considered problematic within the classroom

setting, to ensure that the participants in the study are either diagnosed with ADHD or exhibit the symptoms associated with ADHD. Parents of children that met the inclusion criteria were subsequently invited to allow their children to participate in the study.

3.6.4 Sampling criteria

Inclusion criteria for the study included characteristics stated by the DSM-V (APA, 2013) under the diagnosis of ADHD. Participants had to exhibit at least six of the following behaviours on a regular basis:

- Making careless mistakes in schoolwork or failing to pay attention to details;
- Often struggling to keep attention focused on a task (e.g. getting distracted during long conversations);
- Often seeming to not listen to instructions (e.g. being in their own world);
- Often starting something, but failing to complete it;
- Difficulty doing a list of tasks (e.g. difficulty doing one thing before another);
- Often trying to avoid tasks that require sustained attention (e.g. avoids doing schoolwork);
- Often losing the things necessary to complete tasks (e.g. loses school books);
- Easily distracted by other things (e.g. sounds outside);
- Often forgetting to do the things that they were told to do;
- Struggling to sit still when it is necessary (e.g. in church);
- Is permanently “on the go”;
- Always running and climbing on things when they should not;
- Struggling to play quietly;
- Blurting out answers;
- Talking too much;

- Cannot wait for their turn; and
- Interrupting others.

All participants had to be between six and eight years old, as the year of entering Grade 1 should be the year that the child turns seven years old according to the South African Schools Act, 1996 (Act No. 84 of 1996) and National Education Department (DBE, 1998). The age range of six to eight years old, then takes into account those that are in Grade 1, but have not yet turned seven, as well as those that were held back at some point during their education and are now eight years old. The final requirements of inclusion were the attendance of one of the six schools that agreed to participate in the research, as well as exposure to the CAPS education system during the first school term of 2018, the year in which data collection took place. However, certain children had to be excluded from the study based on specific characteristics.

The exclusion criteria for this study included children with other learning difficulties for example reading difficulties, as well as children with mental disorders other than ADHD that might have influenced their academic performance for example depression, mental retardation, or anxiety disorders. These children were excluded from the study as any of these difficulties or issues may have influenced their mathematical performance that may not be impacted by the teaching methods used in the two intervention groups.

3.6.5 Sample size

The current study aimed to obtain a sample of 90 research participants, 30 participants in each of the groups, namely teaching trough play, peer-teaching, and control. Twenty-six participants per group is suggested by Cohen (1992) to ensure a large effect size at a power level of 0.80 and an alpha level of 0.05. However, the current study had an initial sample size of 88 participants, which means approximately 29 participants per research group. As a result

of attrition, and the loss of participants due to dropout during the course of a research study, the final sample consisted of 63 participants. A risk associated with attrition is differential attrition, the imbalanced dropout of participants across the different research groups (Christensen et al., 2014). The current research did, however, experience relatively equivalent dropout among the research groups. The participants completing the research study consisted of 20 participants in the teaching through play group, 23 participants in the peer-teaching group, and 20 participants in the control group. This level of completed participation, still remained close enough to meet the requirements of the statistical techniques used for data analysis as discussed in Section 3.9. Additionally, having around 20 participants per research group had a practical advantage, as controlling a larger group of Grade 1 children that show symptoms of ADHD would have been difficult. The current sample size was statistically sufficient, evidenced by a normal distribution in each research group, as well as equivalent variances, in terms of the pre-test scores, further discussed in Chapter 4. Next, the sample is described in terms of their characteristics.

3.6.6 Characteristics of sample

All the research participants were between the ages of six and eight years old. Forty-five of the participants were male, while 18 were female. This is closely related to what the DSM-V suggests in terms of the ratio of ADHD diagnoses of approximately 2:1 male to female for children in the general population, which has been found to be consistent with sex ratios in South Africa (APA, 2013; Meyer, 2005). All the research participants exhibited at least six of the behaviours for an ADHD diagnosis as listed in Section 3.6.4. Twenty-eight of the participants' language of instruction was English, while 45 of the participants received their formal education in Afrikaans. The language used during the intervention sessions matched each participants' language of instruction.

The schools that participated in the current study were situated in the Eastern and Central areas of Pretoria, Gauteng, South Africa. All the participants attended school at one of the six schools that agreed to participate in the study. The number of participants from each school ranged from three to 26 as illustrated below:

Table 3.2

Language of Instruction and Number of Participants per School

School	Language of instruction	Number of participants
School A	Afrikaans	12
School B	English	23
School C	Afrikaans	3
School D	Afrikaans	5
School E	English	5
School F	Afrikaans	15
Total		63

3.7 Research instruments

An instrument is a means to measure an occurrence, ultimately to collect and document information, inform decision making, and increase understanding (Colton & Covert, 2007). Measurement refers to the "process of assigning numbers or other symbols to the things in such a way that relationships of the numbers or symbols reflect relationships of the attributes of the things being measured" (Sarle, 1997, p. 2). Measurement requires a set of rules by which symbols or numbers are assigned to objects or concepts (Christensen et al.,

2014). The concept under examination in this study was the mathematical performance of Grade 1 children, exhibiting symptoms of ADHD.

The *Survival Guide to CAPS*, published by Platinum (n.d.), provides a breakdown of the requirements to be met by children by grade, based on the CAPS education system. The mathematical requirements tested by the current study are the ability to compare and order objects according to length; add and subtract numbers up to 20; divide and multiply numbers up to 20; order regular events from everyday life; compare lengths of time and sequence events; follow directions around the classroom; describe, compare and order up to 20 objects based on size; describe, sort and compare two dimensional objects; and name the days of the week and months of the year, as well as placing own birthday on a calendar. Additionally, the DBE (2011) has established assessment guidelines by grade. The type of assessment used in this study is referred to as a summative study as it provides a summary of a learner's achievement at any given point, usually at the end of a term. The summative assessment provides a glimpse of a learner's progress at a certain point, also known as an assessment of learning (DBE, 2011). The instruments used in this study were designed to measure the current mathematical progress of each participant at a given time, which was at the beginning of the second school term, thus measuring the progress made within the first school term of 2018. Various assessment techniques are suggested, such as observation, written activities, and performance-based assessments. Children are not exposed to formal testing conditions until Grade 4 (DBE, 2011). Based on this, the current study made use of a written activity, administered as a classroom activity, with the researcher explaining a single question to participants at a time, providing time for all participants to complete the question before moving to the next.

The content of the research instruments (pre-test and post-test) were based on the CAPS first term mathematics textbook, taking the requirements provided in the *Survival*

Guide to CAPS into consideration, in the determination of the mark allocation. The instruments were not uniquely designed, but rather the same questions as those in the textbook, using unique examples of the work that the participants had already been exposed to during the first school term of 2018. The language used in the instrument was similar, if not, the same as the language used in the CAPS Grade 1 Mathematics workbook. This workbook was used in the design of both the English and Afrikaans versions of the instrument. This ensured that the participants were exposed to the language they were already accustomed to in their regular classroom as well as voiding the need for backward and forward translation of the instrument. The researcher is bilingual and proficient in English and Afrikaans. Grade 1 teachers confirmed that all the participants in the study had been exposed to the content of the first term of the CAPS mathematics textbook. This ensures that none of the participants were exposed to the content of the pre-test for the first time, as first-time exposure would undoubtedly lead to skewed pre-test scores. Furthermore, the research instrument aimed to measure current mathematics performance, and not novel problem-solving skills. In other words, the pre-test measured mathematical performance based on knowledge and skill acquisition, requiring pre-exposure to the content. To meet the requirements of an experiment the research instrument had to meet the criteria for validity and reliability.

The research instruments utilised in this study, have a high level of content validity, the degree to which the questions or activities represent the construct that it is intended to measure, as the questions were directly taken from the CAPS workbook (Christensen et al., 2015). Similarly, the scores obtained on the instruments, would be closely related to the scores obtained in the normal, everyday classroom, as the same mathematical performance is measured by the instruments and in the classroom, thus a high level of convergent validity is expected (Christensen et al., 2015). Known groups validity evidence, the degree to which the

different groups that are known to differ actually differ according to the test, is provided by the comparison between the post-test scores of the different intervention groups (Christensen et al., 2015).

Reliability refers to the consistency of the items in terms of measuring constructs, the consistency over time, as well as the consistency in administration and scoring of the results (Creswell & Creswell, 2018). The research instrument used in the pre-test was based on the different aspects that are required according to the CAPS system, therefore the items were consistently measuring mathematical performance. The comparison of the pre-test and post-test scores of the control group, demonstrated the test-retest reliability, without any intervention, of the instruments. The post-test was administered in the same classroom, at the same time of day, on the same day of the week, by the same researcher as the pre-test, ensuring consistency in the administration. The same researcher scored all of the pre-tests and post-tests, using the same structure, ensuring consistency in scoring.

It is important to note that working with children complicates the process of control during the pre-test and post-test, as it is near impossible to predict the behaviour of children, let alone those with symptoms of ADHD on any given day. All possible measures were however, taken to control the pre-test and post-test environments to the highest possible extent. Practically, certain unpredictable and uncontrollable factors had an influence on the effectivity of the intervention. These variables included the participants becoming familiar with the researcher, external factors such as a school outing causing excitement, a class party with sugary snacks, and a school concert distracting some participants. As the pre-test was scheduled 10 weeks before the post-test, the likelihood that practice effects played a role in the results was slim-to-none. Attempts were made to control for confounding variables such as the differences between participants' learning capabilities by randomising the assignment process. Random assignment is one of the most effective ways to maximise internal validity.

The random assignment model refers to a “nonrandomly sampled subgroup of a population (n). Half of this subgroup of participants (n/2) is randomly assigned to an experimental group, and the remaining participants (n/2) are assigned to a control group” (Dattalo, 2010, p. 168). This random assignment process took place before any physical contact was made with participants, in an attempt to minimise researcher bias.

Meyer (2015) found that the prevalence of ADHD in the Limpopo province, South Africa was similar to the rates reported by Western countries, providing evidence for the non-racial presence of ADHD. The current research study included participants from different race groups, although the study did not record the race of participants. Based on the conclusion of Meyer (2015) that ADHD has a non-racial presence in South Africa, as well as the inclusion of different race groups, the results remain relatively generalisable to other South African children.

The sample did include both males and females, receiving education in both English and Afrikaans, from six different public schools. Yet, the participation varied from school to school, and all the participants reside in the Eastern and Central areas of Pretoria, Gauteng South Africa. Due to a lack of resources, it was not possible to make use of a more representative sample, including children from all nine provinces in South Africa, in various towns or cities across the country.

3.8 Data collection

3.8.1 Procedures

Once permission was obtained to include participants in the study, each research participant in the sample was randomly assigned to a group (teaching through play group, peer-teaching group, and control group). Dates and times were set up to administer the pre-test, intervention sessions, and post-test, in both Afrikaans and English. The pre- and post-test

was conducted in a group setting regardless of the intervention group (teaching through play group, peer-teaching group, and control group) an individual was assigned. The random assignment of individuals to intervention groups (teaching through play group, peer-teaching group, and control group) took place before the pre-test to avoid any bias in the process of random assignment.

The initial data collection took place during the pre-test phase of the research. The pre-test was administered in week one of the study, followed by the teaching interventions (teaching through play and peer-teaching respectively) administered in week two through nine, completing data collection with the post-test in week 10. The pre-test and post-test are similar, differing only in the numbers and/or pictures used, to allow comparison between the scores. The content of the pre-test and post-test were broken down into eight of the themes covered in the first term of the CAPS curriculum, which are:

- shorter and longer;
- addition and subtraction;
- double and divide;
- time;
- direction;
- bigger and smaller;
- sorting of objects; and
- months and days.

Both the pre-test and post-test scores of each participant were calculated out of a possible 20 marks, converted into a percentage mark. This percentage was used in the data analysis phase of the study. The interventions, administered as an additional class for one hour a week, were designed based on the two teaching methods tested in this study, teaching

through play and peer-teaching, and implemented according to a set of procedural guidelines created for this study.

3.8.2 Procedures for interventions

The procedures used in each of the intervention groups were broken down to a step-by-step guide, explicated in Appendix G. The content of the pre-test, broken down into the eight themes, namely shorter and longer; addition and subtraction; double and divide; time; direction; bigger and smaller; sorting of objects; and months and days, were each focused on in a single intervention session. In other words, the first intervention session focused on the aspect of shorter and longer, as a required skill in overall mathematical performance. The second intervention session then focused on addition and subtraction, and so forth.

The first intervention group was provided with eight weeks of additional classes, one hour a week, using the method of teaching through play. As explained above, one of the eight selected themes was covered per session. All the information was given to the participants through the use of play scenarios. At the end of each session, the participants completed a worksheet (Appendix E) based on the theme that was covered during the intervention session. The participants were encouraged to work together, if needed, to complete the worksheet and the researcher was available to assist them.

The second intervention group, peer-teaching, was provided with eight weeks of additional classes, one hour a week, using the method of peer-teaching. The themes group two were exposed to, matched those that the first group was exposed to week by week. This intervention method matched participants in groups of two, instructing each participant to act as either the “teacher” or the “student”. The “teacher” was provided an opportunity to engage with and understand the theme and content, then returns to the “student” to teach them what they had just learnt. The researcher ensured that turns were taken, allowing each participant

the opportunity to act as both the “teacher” and “student” during each intervention session. Subsequently, participants were expected to work together to complete the worksheets given to them based on the theme covered during that intervention session.

The control group continued with their normal education and only returned for the post-test conducted during week 10. Once the additional classes had been completed, all the first grade children in the sample were given the post-test to evaluate their mathematical performance at that point in time. The content of the post-test was broken down into the same eight themes, namely shorter and longer; addition and subtraction; double and divide; time; direction; bigger and smaller; sorting of objects; and months and days, as the pre-test. The post-test can be found in Appendix F.

The data collected during the pre-test and post-test phases of the research was then analysed to answer the research questions.

3.9 Data analysis

Generally, parametric tests are used to analyse quantitative data. In order for accurate parametric tests to be used a set of assumptions needs to be met. These assumptions are based on the distribution of the data and population parameters. In instances where these parametric assumptions are not met, a nonparametric alternative can be used to conduct the analysis. Nonparametric assumptions are not based on these specific distribution shapes required for parametric tests (Levin & Fox, 2014). Before any parametric or nonparametric tests were conducted, the assumptions were tested, and the most appropriate type of analysis was selected based on the data set characteristics.

Firstly, the pre-test and post-test scores were compared within each group. Thus, the mean pre-test score of each group was compared to that group’s mean post-test score, using a dependent t-test, replaced by a Wilcoxon Signed Rank test where the assumptions of a t-test

were not met. This same comparison was done for the teaching through play, peer-teaching and control groups respectively. A dependent t-test was used to determine whether any statistically significant improvements were made within any of the groups (Levin & Fox, 2014). The presence of any statistically significant improvement found between the pre-test scores and the post-test scores, indicated that the intervention employed had an impact on the mathematical performance of the participants in that particular research group (teaching through play or peer-teaching). The dependent t-test was similarly used to ensure that no significant improvements were made within the control group, as this would reduce the ability of the researcher to determine the impact of the interventions (teaching through play and peer-teaching) on mathematical performance. However, before a t-test could be conducted, the assumptions of the t-test needed to be met. These assumptions were: (1) that the data was normally distributed, (2) that an adequate number of participants had been used, and (3) that the data of the two sets of scores being compared had equal variances (Gravetter et al., 2018). The control group data met the assumptions of the t-test, while the teaching through play and peer-teaching groups, required the use of the nonparametric Wilcoxon Signed Rank test (Levin & Fox, 2014).

In order to ensure that this improvement was not due to the natural development of the participants, the mean post-test scores of the two intervention groups (teaching through play and peer-teaching) were compared to the mean post-test score of the control group. An analysis of variance (ANOVA) was used to determine if there were any statistically significant differences between the various groups' post-test scores (Levin & Fox, 2014). The comparison of the mean post-test scores of the teaching through play group and the mean post-test scores of the peer-teaching group illustrated whether either intervention was more effective than the other. Similarly, the assumptions of the ANOVA had to be met before the analysis technique could be used. The assumptions of the ANOVA were: (1) that the data

was normally distributed, (2) that the data of the two scores being compared had equal variances, and (3) that the groups tested were independent (Gravetter et al., 2018). As demonstrated in Chapter 4, the data set did not meet the assumptions of a one-way ANOVA. As such, the nonparametric equivalent of the ANOVA had to be used in the analysis instead – in this case the Kruskal-Wallis test was used (Levin & Fox, 2014).

All research done in the field of psychology has to adhere to certain ethical standards provided by the Health Professionals Council of South Africa (HPCSA). The ethical considerations taken into account during the course of this study are discussed below.

3.10 Ethical considerations

The ethical guidelines set out by the HPCSA are based on the principles of autonomy and respect, nonmaleficence, beneficence, and justice. The following discussion explicates how this study adhered to each of these principles.

The principle of autonomy and respect refers to a participant's free will to participate in any study. Before the children could agree to participate, permission to conduct this research was obtained from the institutional ethics committee at the University of South Africa, the Department of Education of South Africa, the school boards and/or principles of the schools involved, and the parents of the participants (APA, 2010; HPCSA, 2004). A consent form (Appendix B) was given to parents explaining the research purpose and aims, the risks, and potential advantages. The parents were ensured that participation is voluntary and that they may withdraw their children from the study at any time. An assent form (Appendix C) was given to the children explaining, at a level that they can understand, that they were participating in the study at free will and that they could choose to withdraw at any time, that their personal scores would remain confidential, and that they were free to raise any concerns with the researcher (APA, 2010; HPCSA, 2004).

The principle of nonmaleficence means that no harm should be done to research participants. The study aimed to do no harm to any of the participants or their families. All potential risks and costs were explained before the commencement of the study. Some unanticipated risks arose during the study, such as children accidentally injuring each other during the course of the intervention. A situation occurred wherein three participants were behaving inappropriately toward each other, the parents of these participants were informed immediately, as well as the school board. A report was written to the school board and a social worker was brought in by the school to consult with all the relevant parties.

In cases where any parent of a participant felt that they needed additional psychological services, the free UNISA psychological counselling services were made available to them. Research done with children requires additional measures to ensure that no child laws are bridged (APA, 2010; HPCSA, 2004). Additional time was set aside to ask participants whether they would like to continue with the activities. All the necessary activity supplies were brought to the sessions by the researcher, to avoid the exclusion of those that may not be able to afford supplies. Participants were encouraged to do their best and all efforts were rewarded with praise.

The principle of beneficence requires that all activities engaged in during the research process are to the benefit of the participant. By making use of the CAPS mathematical textbook, the participants were exposed only to the work that forms part of their curriculum. The additional exposure to this content, added to the basic building blocks of mathematics, and may be to the benefit of the participants in their future mathematic schooling.

The principle of justice was adhered to through offering the same benefits to participants in the control group. Those participants in the control group who wished to do so, made use of the additional classes provided to the participants in group one or two, after the

study had been completed and they had been provided with the results (APA, 2010; HPCSA, 2004).

Confidentiality of the personal information of all participants was maintained. The research assistants were asked to sign a non-disclosure agreement. In addition, only the de-identified scores were made available to the statistician for the purposes of analysis. All the activities (pre-test, post-test and intervention worksheets) were numbered, the personal data and list of names of participants was stored on a password protected laptop.

Debriefing was done with all participants after the research was completed and the control group was offered the same treatment given to the experimental groups, after they were provided with the preliminary results. These results were supplied to the parents of participants in the form of an infographic (Appendix G).

Ethical clearance was provided by the University of South Africa (Ref. No: PERC-17035) and the Gauteng Department of Education which can be found in Appendix I and J respectively.

3.11 Conclusion

This chapter has explicated the epistemology and ontology of the current study. The sample was described in terms of the population, sampling method, sampling size, inclusion criteria, and characteristics. The research intervention was discussed with regard to the procedures that were followed. A breakdown is provided of the research instrument, the data collection method, as well as the data analysis methods. The ethical guidelines, and their application, are included in this chapter.

Chapter 4 Results

In this chapter the results of the data collected are presented, based on the methodology described in Chapter 3. This chapter begins with a description of the sample using descriptive statistics, subsequently answering the research questions by using inferential statistics.

4.1 The Sample

The sample of this study consisted of 63 children from six different public schools located in the east and central areas of Pretoria, Gauteng, South Africa.

4.1.1 Number of participants from each school

A breakdown of the number of participants from each of the schools is illustrated in Table 4.1 and Figure 4.1 below. School A had 23 children participate in this study, School B had 15, School C had 12, School D had 5, School E had 5, and School F had 3.

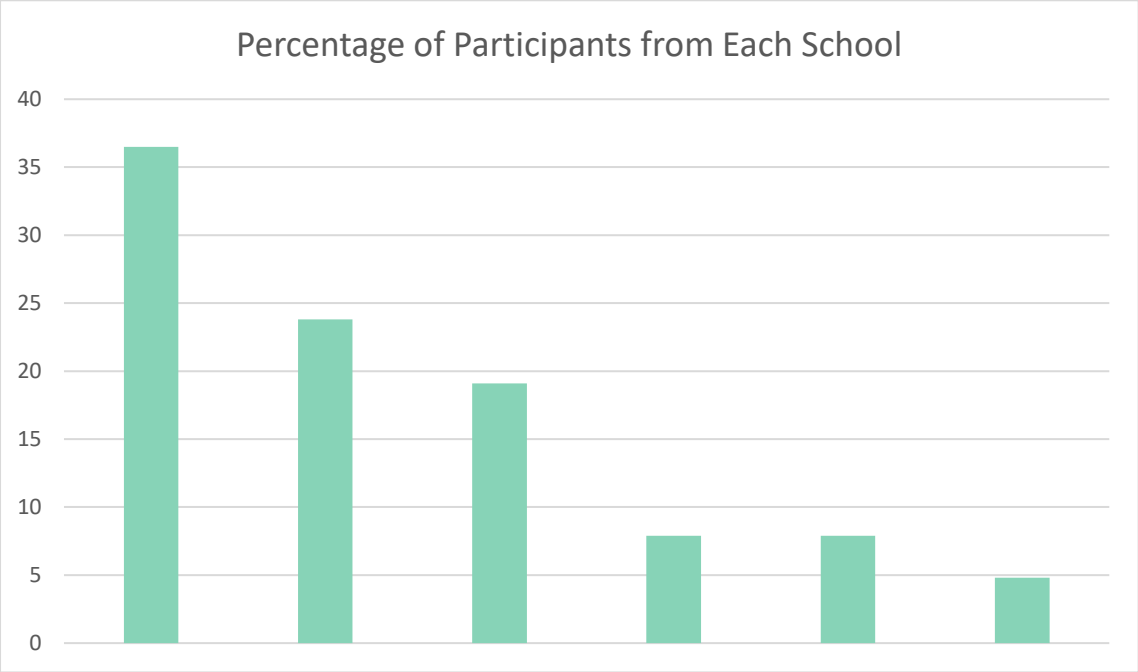
Table 4.1

Percentage of Participants from Each School

School	Frequency (F)	Percentage (%)
School A	23	36,5
School B	15	23,8
School C	12	19,1
School D	5	7,9
School E	5	7,9
School F	3	4,8
Total	63	100

Figure 4.1

Percentage of Participants from Each School



4.1.2 Language of instruction of participants

The language in which participants received their educational instruction, was used to determine the language used during the intervention sessions. As illustrated by Table 4.2 and Figure 4.2, Afrikaans was the language of instruction for 35 (55.6%) of the research participants, while 28 (44.4%) of the research participants were instructed in English, therefore, the intervention sessions were provided in the same language ratio.

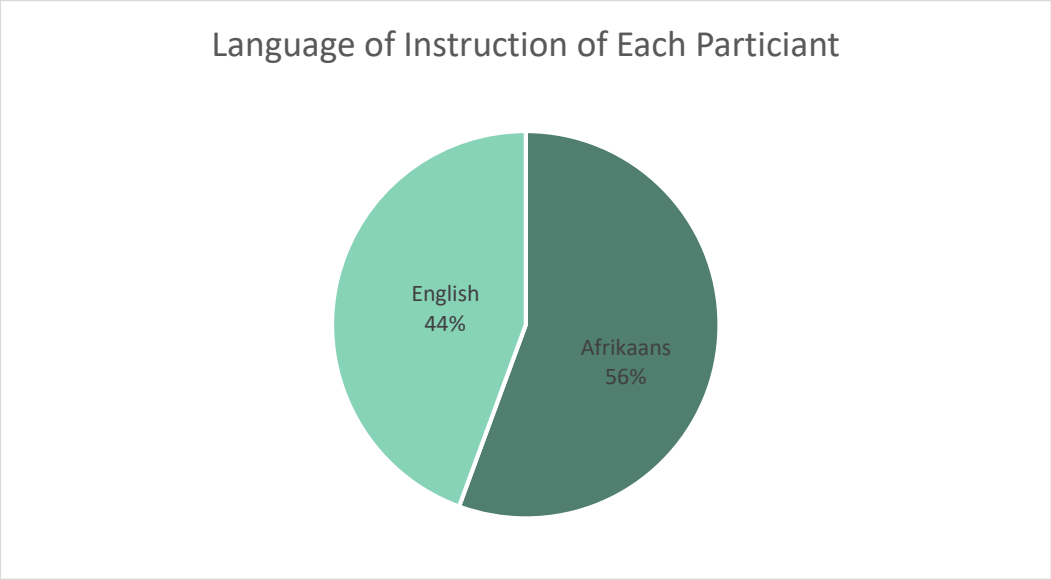
Table 4.2

Language of Instruction

Language of Instruction	Frequency (F)	Percentage (%)
Afrikaans	35	55.6
English	28	44.4
	63	100

Figure 4.2

Language of Instruction



4.1.3 Gender of participants

The DSM 5 (APA, 2013) reports a ratio of 2:1 male to female for children with ADHD symptoms in the general population. The sample used in this study consisted of 45 (71.4%) males and 18 (28.6%) females, with a ratio of 2.5:1 male to female. This indicates that the sample obtained a similar gender ratio than that reported in the DSM 5 (APA, 2013), and in the South African population (Meyer, 2005). Table 4.3 and Figure 4.3 below demonstrate the gender split of participants.

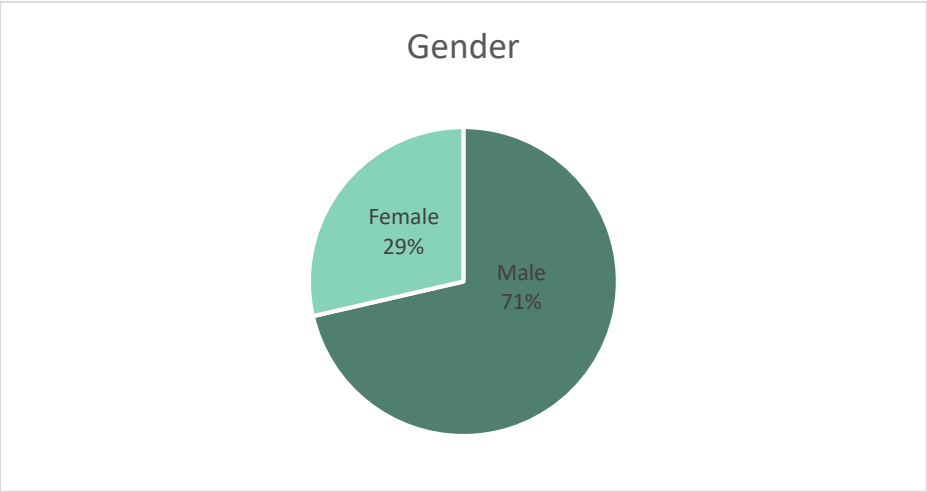
Table 4.3

Gender of Participants

Gender	Frequency (F)	Percentage (%)
Male	45	71.4
Female	18	28.6
	63	100

Figure 4.3

Gender of Participants



Further, all the participants in the study were between the ages of six and eight years old, and in Grade 1 at the time of data collection. Parents were asked to determine whether their children exhibited at least six of the following symptoms, and if so, they were asked to volunteer to participate in this study.

Required symptoms:

1. Making careless mistakes in schoolwork or failing to pay attention to details;
2. Often struggling to keep attention focused on a task (e.g. getting distracted during long conversations);

3. Often seeming to not listen to instructions (e.g. being in their own world);
4. Often starting something, but failing to complete it;
5. Difficulty doing a list of tasks (e.g. difficulty doing one thing before another);
6. Often trying to avoid tasks that require sustained attention (e.g. avoids schoolwork);
7. Often losing the things necessary to complete tasks (e.g. loses schoolbooks);
8. Easily distracted by other things (e.g. sounds outside);
9. Often forgetting to do the things that they were told to do;
10. Struggling to sit still when it is necessary (e.g. in church);
11. Is permanently “on the go”;
12. Always running and climbing on things when they shouldn’t;
13. Struggling to play quietly;
14. Blurting out answers;
15. Talking too much;
16. Cannot wait for their turn;
17. Often interrupting others.

4.2 Descriptive statistics

4.2.1 Mean, mode, median and standard deviation

As indicated by Table 4.4 below, the teaching through play group had 20 participants, with a mean pre-test score of 75.0%. The peer-teaching group had 23 participants, with a mean pre-test score of 75.4%. The control group had 20 participants with a mean pre-test score of 76.4%. The mean post-test score of the teaching through play group was 88.5%, the mean of the peer-teaching group was 90.2%, and the mean score for the control group was 81.5%.

Table 4.4

Mean, Mode, Median and Standard Deviation

Group	*Number of Participants*	*Mean (%)*	*Mode (%)*	*Median (%)*	*Standard Deviation (SD)*
Play – Pre-test	20	75	75	75	14,04
Play – Post-test	20	88,5	85	87,5	8,29
Peer – Pre-test	23	75,43	95	75	16,92
Peer – Post-test	23	90,9	95	92,5	8,68
Control – Pre-test	20	76,4	75	77,5	15,16
Control – Post-test	20	81,5	85	85	12,89

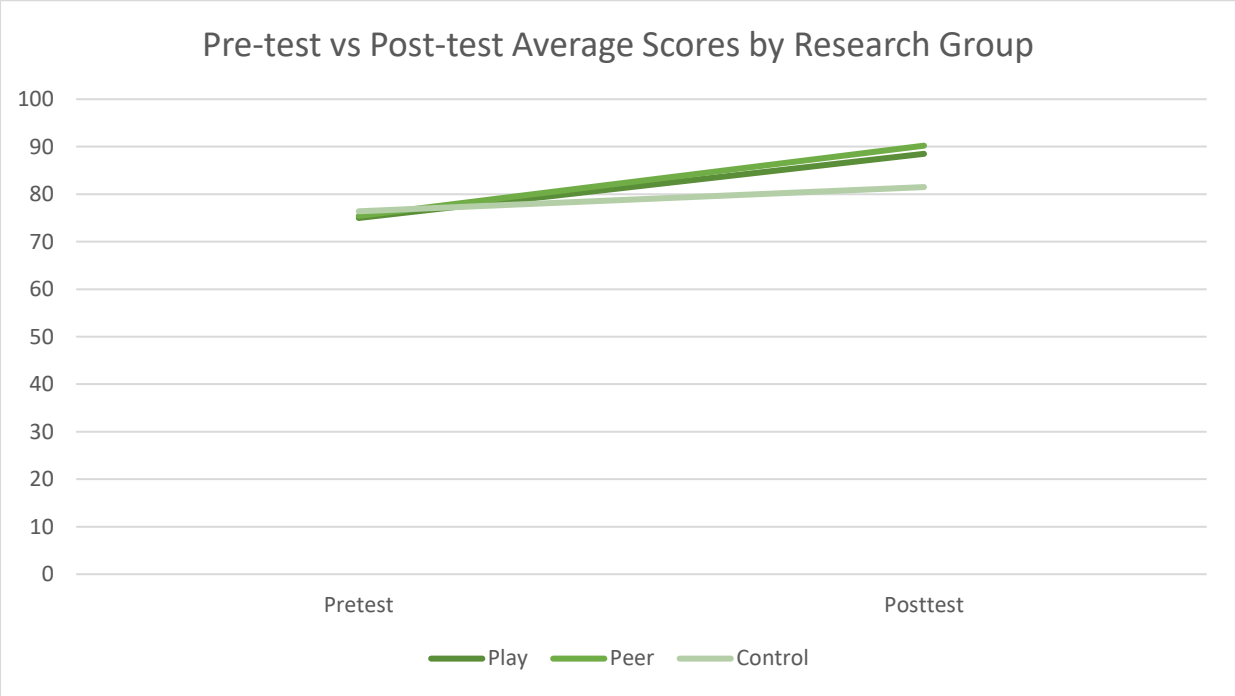
Table 4.5

Difference Between Pre-Test and Post-Test Means

Group	Mean Pre-Test score (%)	Mean Post-Test Score (%)	Mean Improvement (Post-Test - Pre-Test) (%)
Play	75.0	88.5	13.5
Peer	75.4	90.2	14.8
Control	76.4	81.5	5.1

Figure 4.4

Pre-Test vs Post-Test Average Scores by Research Group



The mean improvement (Table 4.5 and Figure 4.4) was calculated by subtracting the mean pre-test score from the mean post-test score for each group. The teaching through play group showed 13.5% mean improvement, the peer-teaching group showed 14.8%, and the control group showed 5.1%. Further statistical analysis was required to determine whether any of these improvements were statistically significant.

4.3 Dependent t-tests

The dependent t-test was used to determine statistically significant differences between the pre-test mean score and the post-test mean score, for each of the three groups (teaching through play, peer-teaching and control). Before the dependent t-test could be conducted the data had to satisfy the assumptions of the t-test.

4.3.1 Satisfying the assumptions of the t-test

The first assumption of the dependent t-test is normality, measured by the skewness value. To satisfy the assumption the skewness value of the mean score of each condition, should lie between 1 and -1.

Table 4.6

Skewness Values of Each Condition

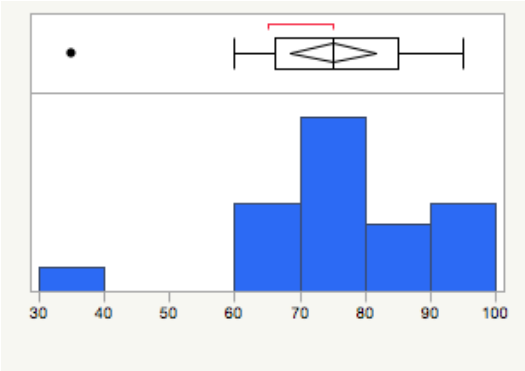
Condition	*Skewness Value*
Play pre-test	-1,01
Play post-test	-0,01
Peer pre-test	-0,85
Peer post-test	-1,21
Control pre-test	-0,88
Control post-test	-0,35

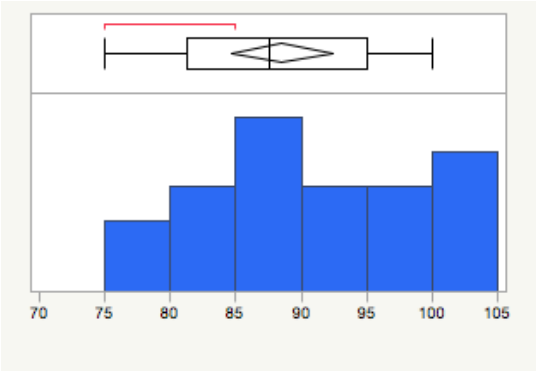
Figure 4.5

Skewness of Each Condition

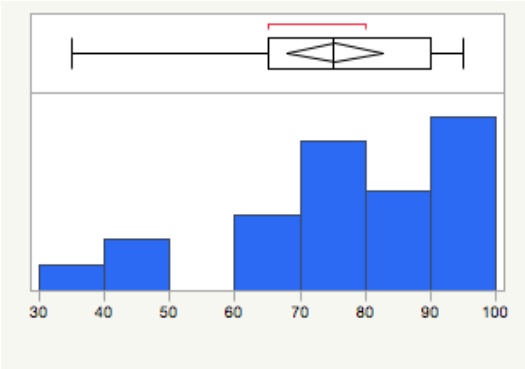
Pre-test Post-test

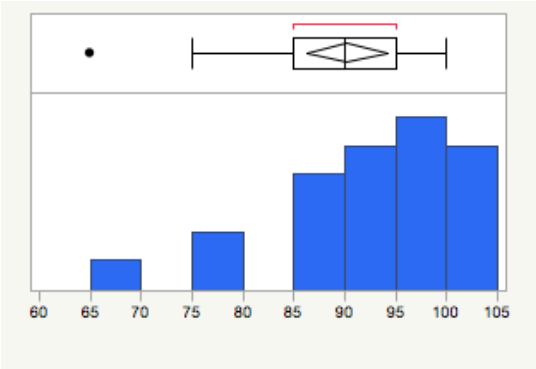
Play



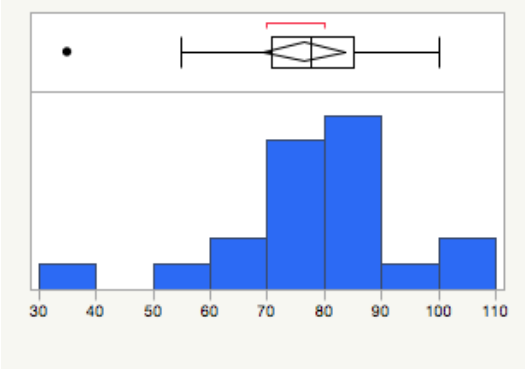


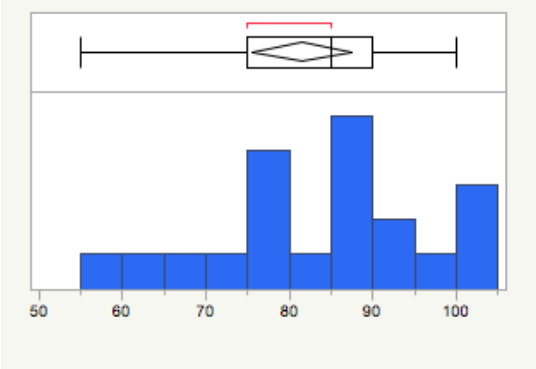
Peer





Control





The skewness values reported in Table 4.6 and illustrated by Figure 4.5 above, indicated that each condition's skewness value fell within the required range of -1 to 1,

except the post-test scores for the peer-teaching group. Therefore, the assumption of normality had been met for all but the post-test scores for the peer-teaching group.

The second assumption was that an adequate number of participants have been used to conduct a t-test. The recommended sample size for t-tests at a power level of 0.8 and an alpha level of 0.05, was 26 participants for a large effect size (Cohen, 1992). The current study had an average of 21 participants per group. Although this was not exactly the 26 participants required, it is close enough to conduct a t-test.

The final assumption of the t-test was that the variance in the two conditions being tested, were equal. Homoscedasticity (equality of variances) was determined by making use of Levene's test, then comparing this test result (F value) to the alpha level (0.05) for statistically significant differences.

Table 4.7

Difference Between Pre- and Post-Test Variances

Group	*F Value*	*Difference Between Pre- and Post-Test Variances*
Play	0,01	Statistically significant
Peer	0,01	Statistically significant
Control	0,24	Non-significant

The results displayed in Table 4.7 above indicated that the teaching through play and peer-teaching groups did not meet the assumption of homoscedasticity, requiring the use of a non-parametric statistical test. In this case, Wilcoxon Signed Rank test was used to compare the pre-test and post-test means for the teaching through play and peer-teaching groups, once

the assumptions of the Wilcoxon Signed Rank test were met. The control group data met all of the assumptions for the t-test and a dependent t-test was conducted for this group.

4.3.2 Satisfying the assumptions of the Wilcoxon Signed Rank test

The first assumption of the Wilcoxon Signed Rank test is that the dependent variable has to be measured as a continuous variable. The pre-test and post-test scores were all measured in percentage as a continuous variable. Therefore, the teaching through play and peer-teaching data has met this assumption (Laerd Statistics, 2020).

The second assumption is that the independent variable must be two categories that are a matched pair. The pre-test and post-test scores for the teaching through play group are matched as each set of pre-test scores and post-test scores are from an individual participant. This is true of the peer-teaching group as well. Therefore, the second assumption of the Wilcoxon Signed Rank test have been met by the teaching through play and peer-teaching data sets. This indicates that the Wilcoxon Signed Rank test can be used to test for statistically significant differences between the pre-test and post-test scores for the teaching through play group and the peer-teaching group (Laerd Statistics, 2020).

4.3.3 Dependent t-test and Wilcoxon Signed Rank test results

The tables and discussion below elucidate the results of the dependent t-test and Wilcoxon Signed Rank tests used to determine whether significant improvements were made in mathematical performance within each of the research groups (teaching through play, peer-teaching, and control). A statistically significant result within the teaching through play and peer-teaching groups respectively, indicated that a significant improvement had been made, and this outcome was desirable. In contrast to this, a non-significant result was expected within the control group.

Table 4.8

Teaching Through Play Wilcoxon Signed Rank Test Descriptive Statistics

	Descriptive Statistics							
	N	Mean	Std. Deviation	Min	Max	Percentiles		
						25th	50th (Median)	75th
Play_pre	20	75.00	14.049	35	95	66.25	75.00	85.00
Play_post	20	88.50	8.288	75	100	81.25	87.50	95.00

Table 4.9

Teaching Through Play Wilcoxon Signed Rank Test

Related-Samples Wilcoxon Signed Rank Test Summary	
Total N	20
Test Statistic	184.000
Standard Error	26.629
Standardized Test Statistic (z)	2.967
Asymptotic Sig. (2-sided test)	.003*

*Statistically significant

The results for the teaching through play group were analysed using a Wilcoxon Signed Rank test. The Wilcoxon Signed Rank test makes use of a two tailed test, although an improvement was expected from the pre-test to the post-test scores. This analysis revealed a

significant difference between mean scores observed in the two conditions (pre-test vs post-test) for the teaching through play group, with a z-score of 2.967, the p value (0,003) < 0.05 (alpha value). The observed difference between these scores at the 95% confidence level indicated that the teaching through play intervention statistically improved the mathematical performance of participants. Thus, the research rejected the $H_{0(1)}$ and assumed that H_1 is accurate. The effect size calculated manually as $r = \frac{z}{\sqrt{(n*2}}$, r = 0.468, indicated that the intervention had a medium effect on mathematical improvement.

Table 4.10

Peer-Teaching Wilcoxon Signed Rank Test Descriptive Statistics

	Descriptive Statistics							
	N	Mean	Std. Deviation	Min	Max	Percentiles		
						25th	50th (Median)	75th
Peer_pre	23	75.43	16.916	35	95	65.00	75.00	90.00
Peer_post	23	90.22	9.105	65	100	85.00	90.00	95.00

Table 4.11

Peer-Teaching Wilcoxon Signed Rank Test

Related-Samples Wilcoxon Signed Rank Test Summary	
Total N	23
Test Statistic	184.000
Standard Error	24.759
Standardized Test Statistic (z)	3.595
Asymptotic Sig. (2-sided test)	.000*

*Statistically significant

The results for the peer-teaching group were analysed using a Wilcoxon Signed Rank test. The Wilcoxon Signed Rank test made use of a two tailed test, although an improvement was expected from the pre-test to the post-test scores. This analysis revealed a significant difference between mean scores observed in the two condition means (pre-test vs. post-test) for the peer-teaching, with a z-score of 3.595, the p value (0,000) < 0.05 (alpha value). The observed difference between these scores at the 95% confidence level indicated that the peer-teaching intervention statistically improved the mathematical performance of participants. Thus, the research rejects the $H_{0(2)}$ and assumes that H_2 is accurate. The effect size calculated manually as $r = \frac{z}{\sqrt{(n*2}}$, r = 0.530, indicates that the intervention had a medium effect on mathematical improvement.

Table 4.12

Control Group Dependent T-Test

Control T-Test: Paired Two Sample for Means		
	Variable 1	Variable 2
Mean	76,4	81,5
Variance	229,726316	166,052632
Observations	20	20
Pearson Correlation	0,55592649	
Hypothesized Mean Difference	0	
df	19	
t Stat	-1,7065494	
P(T<=t) two-tail	0,1041979	
t Critical two-tail	2,09302405	

A dependent t-test was conducted using the control group pre- and post-test scores, to ensure that no statistically significant improvements were made during the normal course of schooling, for participants in the study. A two tailed dependent t-test was used, as the directionality of the results were unclear. The results of the dependent t-test indicated that the p value (0.104) > alpha value (0.05). The t statistic (1,71) did not fall beyond the critical value of (±2,09), indicating a no statistically significant result. Thus, there were no statistically significant improvements from the pre-test to the post-test for participants in the control group.

4.4 Analysis of variance (ANOVA)

The one-way ANOVA is typically used to test for differences between more than two groups. The dependent variable was continuous, in this case test scores, while the independent variables were categorical and independent, in this case the different intervention groups (Gerber & Hall, 2013). Before this statistical technique could be used to analyse the pre- and post-test scores, the assumptions of the specific technique need to be met, in this case the assumptions of the one-way ANOVA. If the assumptions of the ANOVA are not met the nonparametric Kruskal-Wallis test is used as an equivalent.

4.4.1 Satisfying the assumptions of the ANOVA

Normality is the first assumption of the ANOVA, which is determined by the use of the skewness value calculated by the use of the Shapiro-Wilk test. In order to meet this assumption, the significance values must be non-significant. In other words, the Shapiro-Wilk significance values should be greater than the alpha value ($\alpha = 0{,}05$). Histograms are included in Figure 4.6 as a visual representation of the distribution of the scores of each group in Table 4.11 (Gerber & Hall, 2013).

Table 4.13

Post-Test Skewness Value of Each Group

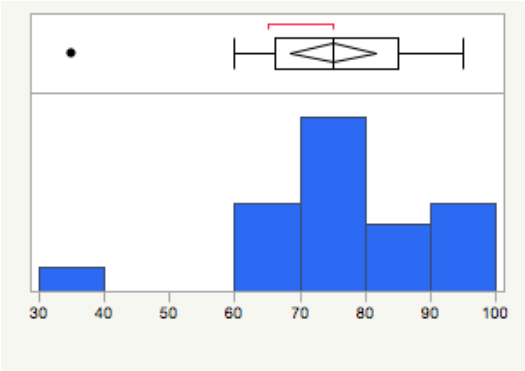
	Shapiro-Wilk		
	Statistic	df	Sig.
Play_post	.921	20	.105
Peer_post	.864	20	.009
Control_post	.954	20	.433

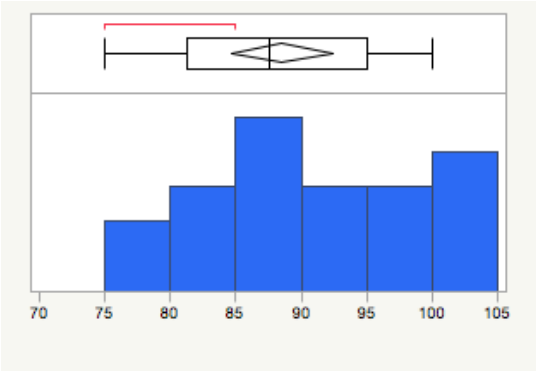
Figure 4.6

Post-Test Skewness Value of Each Group

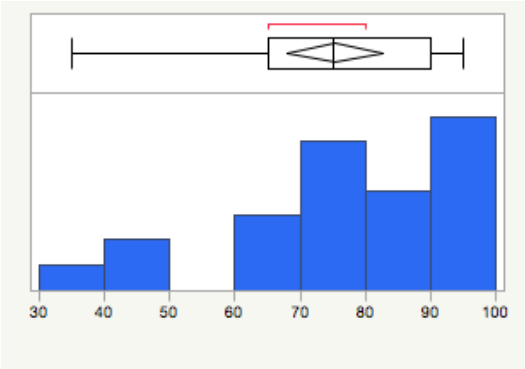
Pre-test Post-test

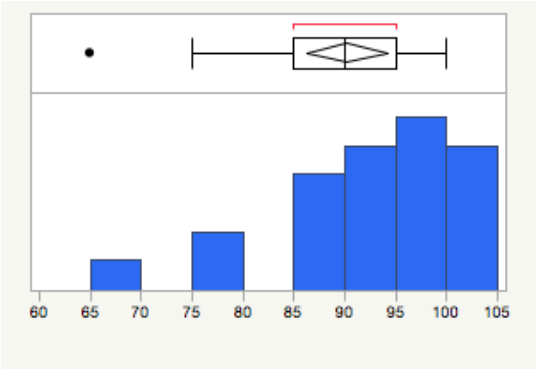
Play



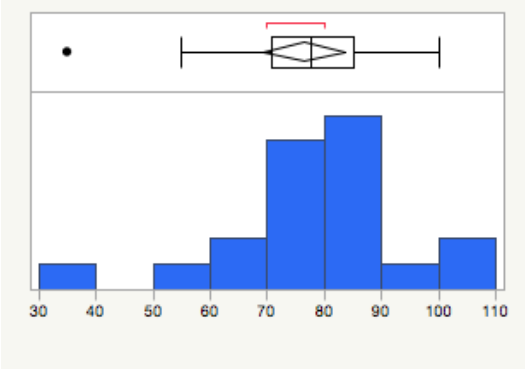


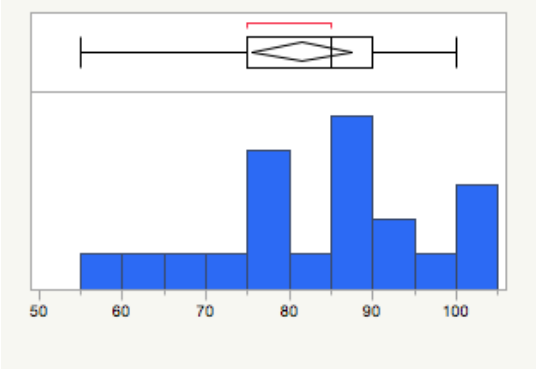
Peer





Control





As the Shapiro-Wilk significance values of all the teaching through play and control groups were non-significant (Table 4.11), we assumed that the data in these two groups were

normally distributed. The Shapiro-Wilk significance value for the peer-teaching group was significant indicating that the assumption of normality was not met.

Homogeneity of variances was the second assumption of the ANOVA, which was determined by the use of Levene's test. The p-value must be larger than 0.05 for the assumption to be met. As seen in Table 4.14 below, the p-value of the data set is 0.6054, which is larger than 0.05, thus the assumption of homogeneity of variances has been met.

Table 4.14

Levene's Test

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.3736	2	60	0.6898
Brown-Forsythe	0.2029	2	60	0.8169
Levene	0.5060	2	60	0.6054
Bartlett	0.2987	2	.	0.7418

The final assumption of ANOVA, independence of the groups, has been met, as the scores of each group were not influenced in any way by the scores of the other groups. Thus, the assumptions for the use of the statistical technique, in this case ANOVA, were tested and satisfied (Laerd Statistics, 2020).

Two out of the three assumptions for the ANOVA have been met, indicating that a nonparametric equivalent was required. The Kruskal-Wallis test was used after confirming that the assumptions for this test had been met.

4.4.2 Meeting the assumptions of the Kruskal-Wallis test

The first assumption of the Kruskal-Wallis test is that the dependent variable is measured as a continuous variable. In the current study pre-test and post-test scores were

measured on as continuous variables, ranging from 1-100%. Therefore, the first assumption has been met.

The second assumption is that the independent variables are more than two categorical variables. The independent variable, intervention group, were teaching through play, peer-teaching, and control group. Therefore, the second assumption has been met.

The third assumption is independent observations. All the pre-test and post-test scores were measured independently, any cross-contamination between groups was avoided. Therefore, the data has met the assumptions of the Kruskal-Wallis test (Laerd Statistics, 2020).

4.4.3 Kruskal-Wallis test results

The tables and discussion below establish the results of the Kruskal-Wallis test, to determine whether significant improvements were made in mathematical performance between the research groups (teaching through play, peer-teaching, and control). A statistically significant result indicated that the teaching through play and/or the peer-teaching group improved mathematical performance, of children with symptoms of ADHD, appreciably more than the normal development of children in the control group. Table 4.15 reiterated the mean pre-test and post-test scores for each group of participants.

Table 4.15

Pre-Test Scores of Each Group

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Play	20	75.0000	3.4654	68.068	81.932
Peer	23	75.4348	3.2315	68.971	81.899
Control	20	76.4000	3.4654	69.468	83.332

Table 4.15 provides a summary of the pre-test descriptive statistics of the teaching through play, peer-teaching, and control groups

Figure 4.7

Independent-Samples Kruskal-Wallis Test (Pre-Test)

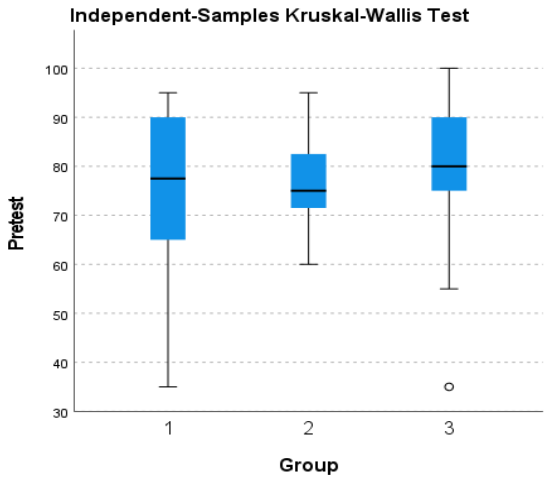


Figure 4.7 and Table 4.15 illustrate that there were no meaningful differences between the means of the various groups (teaching through play, peer-teaching, and control) during the pre-test at the 95% confidence level (alpha=0.05).

Table 4.16

Independent-Samples Kruskal-Wallis Test Results (Pre-Test)

Independent-Samples Kruskal-Wallis Test Summary	
Total N	54
Test Statistic	.409[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	.815

a. The test statistic is adjusted for ties.

With the confidence level set at 95% (alpha = 0.05), Table 4.16 illustrates the significance value of the Kruskal-Wallis test of the pre-test means is 0.815. The significance value is larger than the alpha value (0.815 > 0.05), thus there were no statistically significant differences between the means of the pre-test scores of the various intervention groups (teaching through play, peer-teaching, and control). Therefore, there were no differences between the research groups, initially.

Table 4.17

Post-Test Scores of Each Group

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Play	20	88.5000	2.2884	83.923	93.077
Peer	23	90.2174	2.1339	85.949	94.486
Control	20	81.5000	2.2884	76.923	86.077

Table 4.16 provides a summary of the post-test descriptive statistics of the teaching through play, peer-teaching, and control groups.

Figure 4.8

Independent-Samples Kruskal-Wallis Test Results (Post-Test)

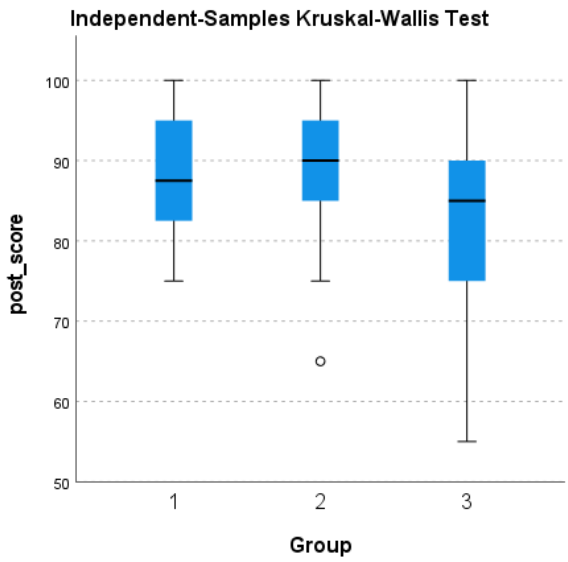


Figure 4.8 illustrates that there were meaningful differences between the means of the various groups (teaching through play, peer-teaching, and control) during the post-test at the 95% confidence level (alpha = 0.05).

Table 4.18

Post-Test Independent-Samples Kruskal-Wallis Test Results

Independent-Samples Kruskal-Wallis Test Summary	
Total N	63
Test Statistic (X^2)	6.428[a]
Degree Of Freedom	2
Asymptotic Sig. (2-sided test)	.040*
a. The test statistic is adjusted for ties.	

*Statistically significant

With the confidence level set at 95% (alpha=0.05), Table 4.18 illustrates the significance value of the Kruskal-Wallis test of the post-test means is 0.040, ($\chi^2(2) = 6{,}428$). The significance value is smaller than the alpha value ($0.040 < 0.05$), thus there were statistically significant differences between the means of the post-test scores of the various intervention groups (teaching through play, peer-teaching, and control).

Although the Kruskal-Wallis indicates that there were statistically significant differences between the various intervention groups (teaching through play, peer-teaching, and control), it does not indicate between which of the research groups these differences exist.

In order to determine this a post-hoc multi-comparison test is used to do the between groups comparison, using the Bonferroni correction. The Bonferroni correction is used to compensate for the risk of error introduced when multiple comparisons are made (Gravetter et al., 2015).

Table 4.19

Post-Hoc Tests for Kruskal-Wallis

Pairwise Comparisons of Group					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic (z)	Sig.	Adj. Sig.[a]
Play vs Control	9.375	5.715	1.640	.101	.303
Peer vs Control	13.829	5.525	2.503	.012*	.037*
Play vs Peer	-4.454	5.525	-.806	.420	1.000

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

*Statistically significant

With the confidence level set at 95% (alpha = 0.05), the values in Table 4.19 show the pairs of means that were statistically significantly different from one another. The significance value for the comparison of the peer-teaching post-test scores and the control group post-test scores were statistically significant. The pairwise comparison, 0.037 (significance value) < 0.05 (alpha value), indicating that there was a significant difference between the post-test score of the peer-teaching and control groups. The effect size calculated manually as $r = \frac{z}{\sqrt{(n}}$, r = 0.315, indicated a medium effect.

The post-test scores of the teaching through play group and the control group were not statistically significant. The pairwise comparison, 0.303 (significance value) > 0.05 (alpha value), indicating no statistically significant differences were found between the teaching through play and control groups' post-test scores.

However, the statistically non-significant values between the post-test scores of the teaching through play and peer-teaching groups demonstrated important results. The pairwise

comparison, 1.000 (significance value) < 0.05 (alpha value), indicated that there was no statistically significant difference between the two teaching interventions used.

It is important to note that the alpha level selected for all of the statistical analysis reported here was 0.05, allowing a probability of 5% that a type I error has occurred (Gravetter et al., 2018). Calculating the exact probability of a type II error is not possible (Gravetter et al., 2018). It remains a possibility that a small effect caused by the intervention was mistakenly concluded as no effect.

4.5 Answering the research questions

1) Does teaching through play improve the mathematical performance of children with symptoms of ADHD?

The results for the teaching through play group were analysed using a dependent t-test. The analysis discovered a significant difference between mean scores observed in the two conditions (pre-test vs. post-test), p value (0,003) < 0.05 (alpha value). The observed difference between these scores at the 95% confidence level indicated that the teaching through play intervention statistically improved the mathematical performance of participants. Thus, the research rejects the $H_{0(1)}$, concluding that teaching through play improved the mathematical performance of children with symptoms of ADHD.

2) Does peer-teaching improve the mathematical performance of children with symptoms of ADHD?

The results for the peer-teaching group were analysed using a dependent t-test. This analysis indicated a significant difference between mean scores observed in the two conditions (pre-test vs. post-test), the p value (0,000) < 0.05 (alpha value). The observed difference between these scores at the 95% confidence level indicates that the peer-teaching intervention statistically improved the mathematical performance of participants. Thus, the

research rejects the $H_{0(2)}$, reaching the conclusion that peer-teaching improved the mathematical performance of children with symptoms of ADHD.

3) Is either teaching through play or peer-teaching more effective in improving the mathematical performance of children with symptoms of ADHD?

With the confidence level set at 95% (alpha=0.05), the significance value of the Kruskal-Wallis test of the post-test means is 0.040. The significance value is smaller than the alpha value ($0.040 < 0.05$), thus there were statistically significant differences between the means of the post-test scores of the various intervention groups (teaching through play, peer-teaching, and control). The results of the post-hoc tests: the pairwise comparison and Bonferroni's correction, indicated that the only statistically significant difference existed between the peer-teaching and control group. Although, some research design changes would likely have resulted in a statistically significant difference between the teaching through play and peer-teaching groups' post-test scores, such as an increased sample size or a longer duration of the intervention. An increased sample size could have added to the robustness of the data or allowed for the use of parametric analysis. Similarly, an increase in the duration of the intervention could have allowed differences in the results of the post-test scores to become more apparent. The results allow the inference to be made that there was no statistically significant difference between the teaching through play and peer-teaching groups, with regard to the ability to improve the mathematical performance of children with symptoms of ADHD. Therefore, the research failed to reject the final $H_{0(3)}$, assuming that there is no difference between teaching through play and peer-teaching as interventions to improve the mathematical performance of children with symptoms of ADHD.

4.6 Conclusion

In this chapter descriptive and inferential statistics were detailed as used in the

study, with some discussion as to their interpretation. In the next chapter these results will be discussed more broadly and will be followed by specific recommendations for further research.

Chapter 5 Discussion, Limitations, Recommendations and Conclusion

The final chapter of this research study begins with a discussion of the results found in Chapter 4. This discussion reiterates the major findings of this study and the implications of these findings. This is followed by a discussion of the limitations of the study and recommendations for practice and further research on the topic of alternative teaching methods for children with symptoms of ADHD. This chapter is completed with the conclusion of this research study.

5.1 Discussion of results

The aim of this study was to establish whether changing the teaching approach used in the traditional classroom to include teaching through play and/or peer-teaching would improve the mathematical performance of Grade 1 children with symptoms of ADHD. Three research questions were identified to respond to the aim of the research. The results will be discussed in terms of these research questions.

The first question, does teaching through play improve the mathematical performance of children with symptoms of ADHD, was answered using a Wilcoxon Signed Rank test. The results of the Wilcoxon Signed Rank test indicated that there was a statistically significant improvement between the pre-test and post-test scores of participants that were exposed to the teaching through play intervention. In other words, the 10-week intervention based on teaching through play improved the mathematical performance of participants. These results underpin the notions of Moser (2018), Tucker (2014), and Riley and Jones (2010) regarding the role of play in learning. Play is considered to be a built-in mechanism that forms an integral part of learning and cognitive development (Moser, 2018; Riley & Jones, 2010; Tucker, 2014). The theories of the seminal researchers of cognitive development discussed earlier, can all be applied to underpin these results. Teaching through play makes use of an

experimental research approach which allows children to discover new information (Piaget, 1964). Complex modelling is used in the play of children as they act out what they believe is expected of someone in their position (Bandura, 1977). Furthermore, learning happens in an interactive environment where children can help each other to perform activities and reach set goals (Vygotsky, 1978).

The use of teaching through play as an intervention to improving mathematical performance was also found in the studies by McFeetors and Ireland (2016) and Riley and Jones (2010). McFeetors and Ireland (2016) made use of the game SET in teaching mathematics. Participants demonstrated improved communication, visualisation, and reasoning skills in terms of mathematics after playing the game SET. Riley and Jones (2010) found that through play with different shape blocks participants were able to improve their understanding of geometric shapes. Furthermore, the study conducted by Bulunuz (2013) demonstrated the effectiveness of teaching through play in teaching science to young children. Children in a teaching through play classroom obtained a better understanding of science concepts through interactive play scenarios that encouraged further exploration (Bulunuz, 2013). Other gaming aspects, such as grade reversal has shown to improve academic performance (Mishra & Kotecha, 2017). Teaching through play is also used as an element of the Finnish education system (Kager, 2011).

Additionally, these results provide evidence for the immaturity hypothesis, which states that the symptoms of ADHD presented by some children are the result of immaturity of the brain functions in comparison to their peers. Sheridan et al. (2007) suggest that the prefrontal cortex of children with symptoms of ADHD is not only less developed but demonstrates less activation than that of their peers. Vadiya (2012) and Kumar et al. (2017) found that the brain develops slower in those individuals affected by symptoms of ADHD.

Similarly, the DSM 5 states that children with symptoms of ADHD have a decreased overall brain volume (APA, 2013).

However, the results of the Kruskal-Wallis test did not show a statistically significant difference between the post-test scores of the teaching through play and control groups. This may be because the teaching through play intervention was not more effective than the control in improving mathematical performance. Alternatively, the intervention may need to be conducted on a larger sample or for a longer period, before statistically significant differences are seen.

The second research question, does peer-teaching improve the mathematical performance of children with symptoms of ADHD, was answered using a Wilcoxon Signed Rank test. The results of the Wilcoxon Signed Rank test indicated that there was a statistically significant improvement between the pre-test and post-test scores of participants that were exposed to the peer-teaching intervention. In other words, the 10-week intervention based on peer-teaching improved the mathematical performance of participants. Although none of the previous studies on peer-teaching made use of it as an intervention for children with symptoms of ADHD, several studies have reported similar results. Schuetz et al. (2017) found that peer-teaching improved the academic performance of university students to an average of 20%. Burton (2012) reported that the use of peer-teaching increased student engagement in the subject of “bullying”, while Mulrine and Flores-Marti (2014) suggested the use of peer-teaching as a way to teach children with symptoms of ADHD in a physical education classroom. Cloward (1967) maintained that peer-teaching is beneficial as the teacher also learns during the process. Teaching a peer enriches the experience of learning (Duran, 2016). Teaching involves mental processes related to the improvement of working memory. In order to teach another, the information needs to be entered into sensory memory, followed by working memory where it is temporarily stored before it is encoded into long-

term memory. This information then needs to be retrieved, manipulated, and reproduced, resulting in retrieval practice (Duran, 2016; Goldstein, 2015). A deficit in working memory has been found to be the main cognitive deficit in children with symptoms of ADHD (Miller et al., 2013). Re et al. (2010) confirmed this through their comparison of working memory of a group of five-year-olds with and without symptoms of ADHD demonstrating the deficit of working memory in those with symptoms of ADHD. Similarly, a comparison of children with symptoms of ADHD to their peers in their ability to complete word mathematical problems, working memory was identified as a problem (Re et al., 2016). The retrieval practice used in the process of peer-teaching improves working memory by requiring the teacher to repeatedly recall and manipulate information (Goldstein, 2015; Karpicke, 2012).

Additionally, these results are supported by the social cognitive and social cultural cognitive theories of development. The first participant was required to observe the way in which the researcher presented new information, retain this information, and believe in their ability to reproduce the information in order to teach it to the second participant (Bandura, 1977). Likewise, the ZPD was used when the researcher assisted the first participant to comprehend the information before they teach the second participant (Vygotsky, 1978).

The third research question, is either teaching through play or peer-teaching more effective in improving the mathematical performance of children with symptoms of ADHD, was answered by using a Kruskal-Wallis test. The results of the post-hoc test were as follows: the multiple comparison and Bonferroni's correction, showed that there was no statistically significant difference between the teaching through play and peer-teaching groups' post-test scores. This indicates that either teaching through play or peer-teaching could be viable interventions for children with symptoms of ADHD. As this was the first research study comparing the two teaching methods as interventions to improve the mathematical performance of Grade 1 children with symptoms of ADHD, there are no other studies to

which these results can be compared. In terms of the underlying cause of the symptoms of ADHD, these results indicate that a combination of factors may play a role instead of a single factor. The results of this study provide evidence for the immaturity hypothesis, the slower or insufficient development of neuroanatomical aspects of the brain of children with ADHD. Likewise, evidence is provided in support of the deficit in working memory.

Although all possible measures were taken to ensure the reliability and validity of the results of this study, it is not possible to control all variables outside of a laboratory experiment. The results of this study may have been influenced by the additional exposure participants received to the content covered in the intervention sessions. The participants in the teaching through play and peer-teaching intervention groups were exposed to the mathematical content during the pre-test phase, as well as during the eight intervention sessions they received. Therefore, it is possible that the intervention sessions improved the recall from long-term memory.

The short- and long-term consequences of ADHD may influence all aspects of an individual's life, including academic, occupational, and social spheres. As ADHD is a childhood disorder that may continue to affect an individual into adulthood, earlier intervention would be ideal. This foundational learning provides an individual with the necessary pathways to continue effective development and learning throughout their life (Garvis, 2020; Kettle & Ross, 2018; Moser, 2018). The abovementioned illuminates the importance of effective early childhood development and learning, which is often impeded by the symptoms of ADHD.

The results of this study provide two alternative teaching approaches as interventions for improved early development of mathematical skills/mathematical learning. Both teaching through play and peer-teaching seem to improve the mathematical performance of Grade 1 children. This information may inform curriculum development and/or lesson planning for

foundational phase learning. Teaching through play and peer-teaching may be included in the classroom as an alternative to the traditional classroom, or in addition to the traditional classroom. This information may help teachers to support the learning of children with symptoms of ADHD more effectively, ultimately reducing the academic gap between these children and their peers or preventing this gap from becoming progressively larger. Although, several limitations existed within this study, it may provide the first step in changing the academic futures of children with symptoms of ADHD and consequently effecting their future outcomes.

5.2 Limitations

As with any research, this study had several limitations. Firstly, the participants for this research study were selected from a confined geographical area. All the participants were attending schools within the eastern and central areas of Pretoria, Gauteng. Despite all efforts, this may result in a sample that is not representative of children with symptoms of ADHD in South Africa. Additionally, the participating schools were all located in urban neighbourhoods. Secondly, the sample size used in this research study, although large enough for statistical analysis, was small in terms of the population of all South African children with symptoms of ADHD. Thirdly, the quantitative nature of this research limited the results of the study, as it was not possible to understand why participants improved their mathematical ability beyond the teaching interventions used. Similarly, the opinions of teachers regarding the feasibility of integrating teaching through play or peer-teaching into their classrooms was not investigated. Furthermore, this study did not investigate the impact of teaching through play or peer-teaching children that do not show symptoms of ADHD. Fourthly, the scope of this study was narrow in that the focus was placed only on Grade 1 children. The symptoms of ADHD are likely to continue affecting effective learning as formal schooling continues

and/or may become problematic before the Grade 1. Fifthly, this study spanned 10 weeks without any follow-up measurement. Therefore, the long-term impact of teaching through play and peer-teaching could not be determined. Similarly, there is not enough information available on the future outcomes of these approaches. Sixthly, this research focused solely on the mathematical performance of children with symptoms of ADHD. Any other form of learning, for instance language, was not considered and the impact of teaching through play and peer-teaching could therefore not be evaluated. Seventhly, this research study did not consider the effect of medication on the symptoms of participants. Eighthly, the research did not separate the different subtypes of ADHD in the process of intervention. Ninthly, although the research instrument was based on the CAPS workbook set out for term 1 for Grade 1 learners, it was not scientifically tested for reliability and validity. Lastly, in general working with a large group of young research participants is no easy task. This is even more so the case when all the participants show symptoms of ADHD and intervention occurs at the end of the school day. This complicated task was initially underestimated, however, after some adjustment it became a rewarding experience for all those involved.

Despite the limitations of this study, some recommendations can be made for practise and further research.

5.3 Recommendations

The results and limitations of the current study illuminated several recommendations for practice and further research. Teaching through play and peer-teaching demonstrated the potential of alternative teaching methods to improve the mathematical performance of children with symptoms of ADHD. Adjusting the classroom setting to include aspects of these alternative teaching methods may improve overall learning potential of children with symptoms of ADHD. The practicality of adjusting the approach to teaching used in the

classroom will, however, depend on the resources available and number of children in the class. Neither of these alternative approaches to teaching should be implemented without the consideration of all children in the classroom, as well as their learning styles. For instance, what may be a great way to teach a learner with symptoms of ADHD may not be challenging enough for an academically strong student. The biggest difficulty of implementing any adjustments to teaching, is the uniquely diverse set of children in each classroom. This is exceptionally important in a country such as South Africa, with a diverse population originating from various backgrounds.

However, further research on the topic and teaching methods is necessary. The long-term impact and future outcome of children with symptoms of ADHD exposed to teaching through play and peer-teaching remain unexamined. These intervention methods should be tested in a larger scale study, including children from a larger geographical area. Furthermore, participants of different ages and levels of formal schooling should be included. Similarly, the impact of teaching through play and peer-teaching should be investigated on children with no symptoms of ADHD and/or other learning difficulties. Further research is required to determine the feasibility and impact of teaching through play and peer-teaching in other subjects, such as language or musical performance. The use of smaller intervention groups is recommended for increased experimental control.

A qualitative approach for further research is recommended so as to gain a deeper understanding of the perceived feasibility and the experience of teaching using alternative methods. Additionally, a qualitative approach may provide more insight into the improvement seen in the experimental groups' mathematical performance.

5.4 Reflection

Although reflection is not usually considered an element of quantitative research, some reflection of the ethics of working with children as research participants seems important. As a young ambitious researcher following the principles of ethical conduct seems simple, applying these principles in the field is much more complicated. The first principle set out by the APA is to maintain beneficence and avoid all maleficence. This study set out on a mission to benefit all participants by improving their basic mathematical knowledge. There was never any intention of harm, in fact, no possibility of harm. Yet, as a researcher I did not consider the entire impact that my presence may have on the research participants. I did not consider how easily younger children become attached to others. By the end of the 10 weeks that I had spent with the participants, I was in essence, abandoning these children and the relationships that they had built with me. Regardless of every attempt to remain objective, I cannot help but fear that I caused more harm than expected. My sudden entrance and equally as sudden departure in the lives of my research participants may have caused confusion.

I believe that we should be more aware of the emotional impact our presence as researchers has on participants, especially when working with children. Special precautions and debriefing of participants should be necessary, particularly in longitudinal studies. I began to prepare participants for my departure from the penultimate intervention session by explaining that the research was almost complete. During the last intervention session, I reminded participants that the following week will be the last time they see me and attempted to address all their questions on the topic.

5.5 Conclusion

In conclusion, teaching through play and peer-teaching have the potential to address the learning difficulties children with symptoms of ADHD face within the traditional classroom setting. Replacing the traditional classroom setting with a teaching through play or peer-teaching environment or adding aspects of these interventions to the traditional classroom may improve the mathematical performance of Grade 1 children with symptoms of ADHD. Ultimately, this research demonstrated the potential of teaching through play and peer-teaching as alternative approaches to the traditional classroom.

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Appendix A

Information Letter to Parents

Dear Parent/Guardian

I am currently completing my Master's degree in Research Psychology. I am conducting research on the effect of different teaching methods on the academic performance of children with Attention-Deficit/Hyperactivity Disorder (ADHD). I am looking for volunteers between the ages of 6 and 8 years and in grade 1. Volunteers may already be diagnosed with ADHD, have a sibling diagnosed with ADHD, or exhibit at least six of the following behaviours:

- Making careless mistakes in schoolwork or failing to pay attention to details
- Often struggle to keep attention focused on a task (e.g. Getting distracted during long conversations)
- Often seem to not listen to instructions (e.g. Being in their own world)
- Often start something, but fail to complete it
- Difficulty doing a list of tasks (e.g. Difficulty doing one thing before another)
- Often tries to avoid tasks that require sustained attention (e.g. Avoids schoolwork)
- Often loses the things necessary to complete tasks (e.g. Loses school books)
- Easily distracted by other things (e.g. Sounds outside)
- Often forgets to do the things that they were told to do
- Struggles to sit still when it is necessary (e.g. In church)
- Is permanently "on the go"
- Always running and climbing on things when they shouldn't
- Struggles to play quietly
- Blurts out answers
- Talks too much
- Can't wait for their turn
- Interrupts others

If your child would like to volunteer for the study, please complete the information below and return it to the school.

.....

I, ..., parent of ....., in.....(name of school) give permission for my child to be a volunteer in the above mentioned research.

....

Signature of parent Date

Appendix B

Consent Form

Parental informed consent for participation in the study.

Comparison of peer-teaching and teaching through play for children with ADHD.

Investigator: Vanessa Stratford

Supervisor: Prof. Ilse Ferns

Purpose of study: Your child is being asked to take part in a one hour per week workshop. The workshop will be used to identify whether peer-teaching or teaching through play is more effective in teaching children that have ADHD. All the information given to your child will be in line with the CAPS system.

Description of study: The study will take ten weeks to complete. Your child will only be asked to attend one-hour session a week. During the session your child will take part in playful learning and complete a short worksheet.

Costs/Reimbursements: There are no costs or reimbursements for participation in the study.

Confidentiality: The information gathered from your child's worksheets will be combined with that of other children. The consent forms will be stored separately from all other information. No identifying information will be included in the results of the study. The data will be stored securely for five (5) years, as required by law. All results will be given as a group result; thus, no child's individual data will be presented. All information will be kept confidential and necessary steps will be taken to protected it from public disclosure.

Benefits: There are no direct benefits to you or your child. The workshops may however improve their academic performance. This is however yet to be established.

Potential risks: There are no risks involved in the study. If your child feels uncomfortable, they are more than welcome to approach the researcher.

All participation in this study is voluntary. If you do not want your child to participate, it will not involve any loss of benefits. You may withdraw your child from the study at any time, for any reason. If you have any questions, please contact Vanessa Stratford at 072 575 3300.

Statement of consent:

I have read the above description of the research study and I understand it. I have been informed about any potential risks or benefits. I voluntarily give permission for my child to participate in this study.

I, parent/guardian of ....., in Grade 1 ..... give permission for my child to be a volunteer in the above-mentioned research.

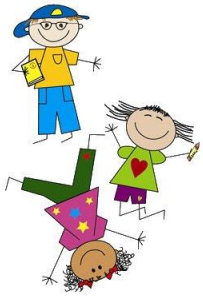
.....	.....	.....
Name of parent	Signature of parent	Date

Appendix C

Assent Form

CHILD ASSENT FORM FOR PARTICIPATION

What must I do?



Play along with us and learn while you do it.

How long will it take?

1 hour

If you feel sad, worried, scared please tell us.

You can choose to be in the study.

You can leave if you want to.

No one will know your name or what you wrote.

Statement of assent:

I am happy to be in this study Yes No

I agree to the activities Yes No

.....	.....	.....
Name of participant	Signature of participant	Date
.....	.....	.....
Name of researcher	Signature of researcher	Date

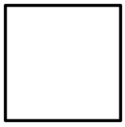
Appendix D

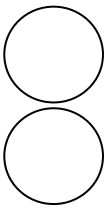
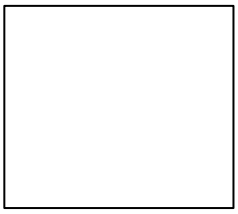
Pre-Test

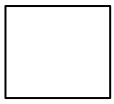
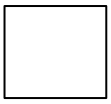
Pre-test

Circle the **shorter** object	Circle the **longer** object
	

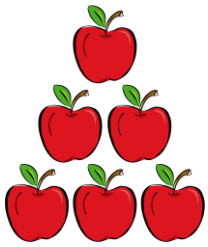
 and  make

 and  make 

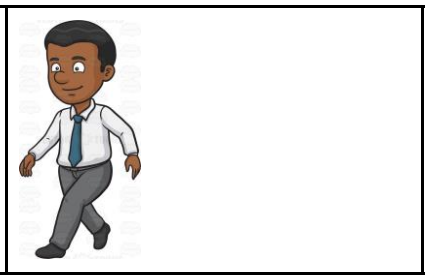
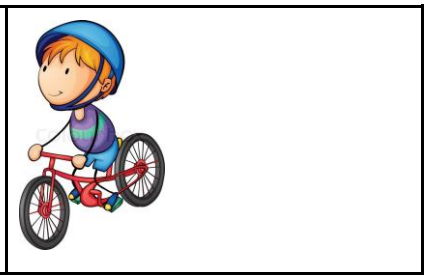
Double  is 

Double  is 

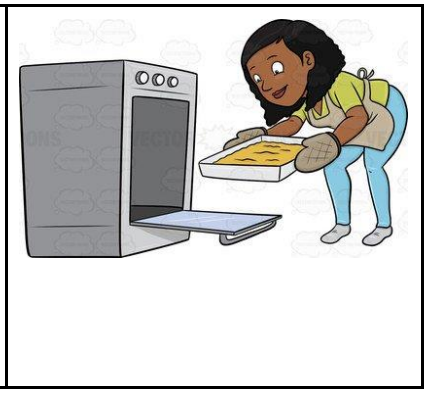
Share equally

What takes the longest?

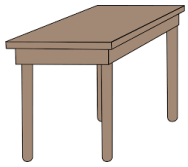
Sort the pictures in order

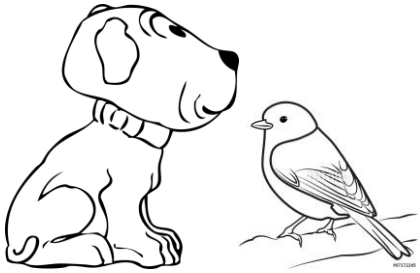



Which way is the arrow pointing?

 Left / Right

 Left / Right

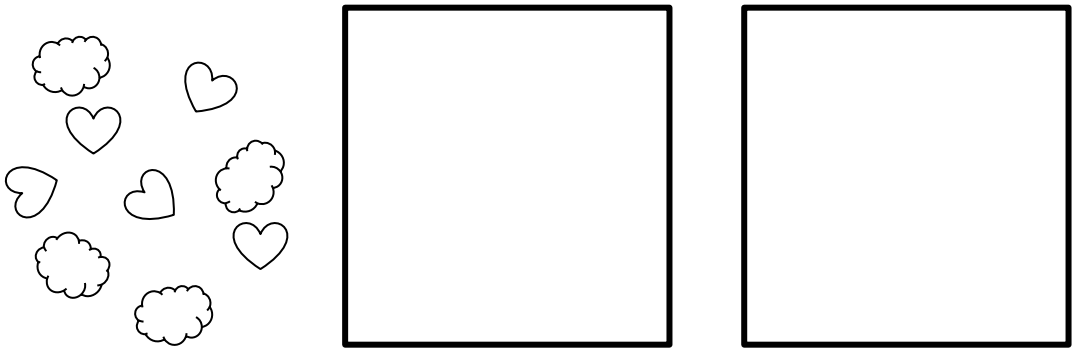
Draw a  under a 



Which one is **smaller**?

Draw a BIG △ next to a small ○

Sort the objects into the boxes



What day is it? Draw a picture of what you do on Mondays

Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

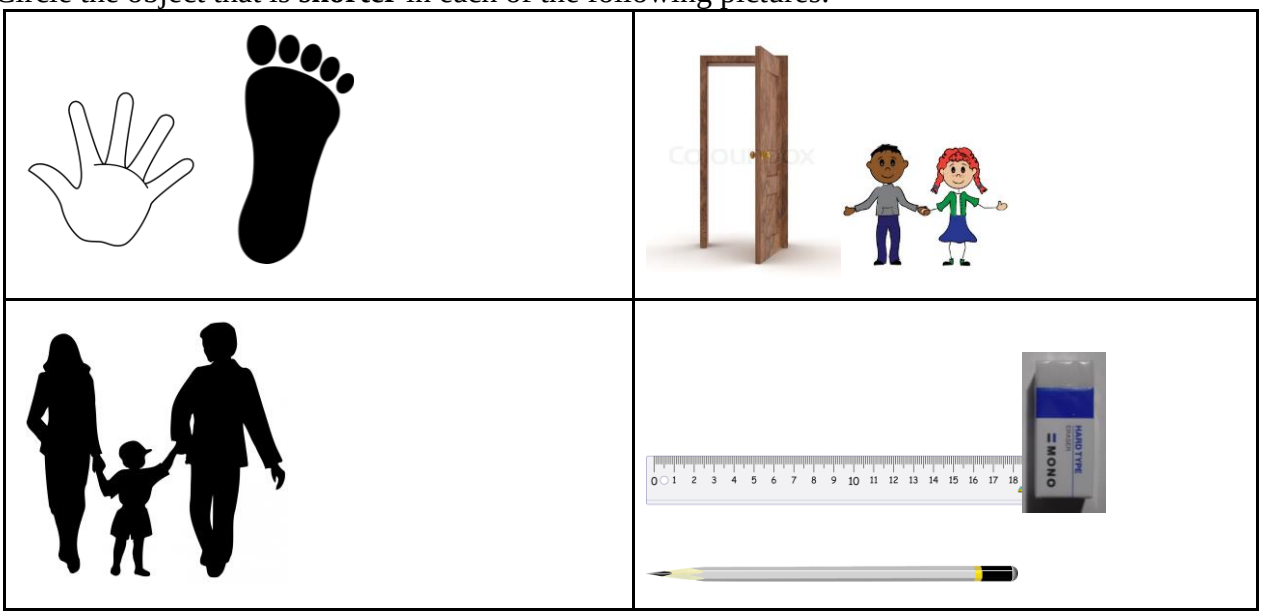
Appendix E

Weekly Worksheets

Worksheet 1: Shorter and Longer

Circle the object that is **longer** in each of the following pictures:

Circle the object that is **shorter** in each of the following pictures:



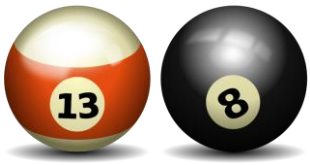
Worksheet 2: Add and Subtract


and

make

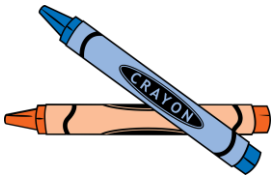

and

make


and

and

make


and
make



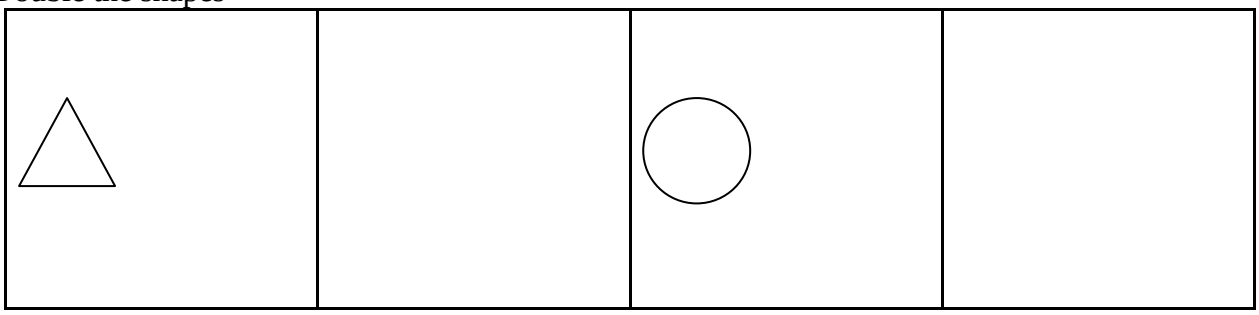
and
make



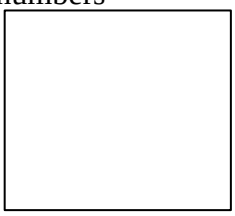
and
make

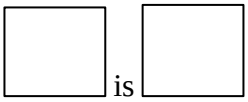

Worksheet 3: Double and Divide

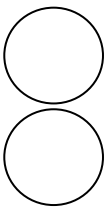
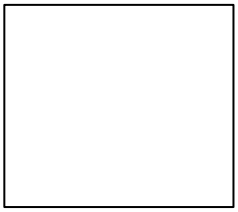
Double the shapes

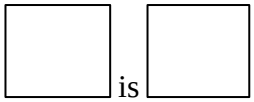


Draw and fill in the numbers

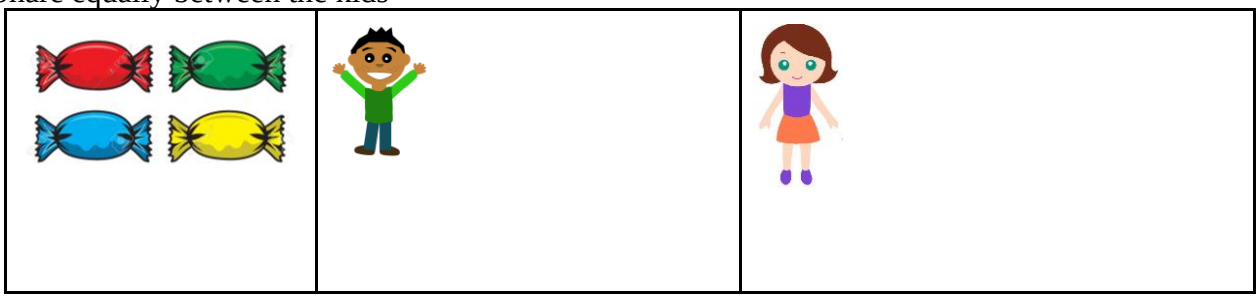
Double  is 

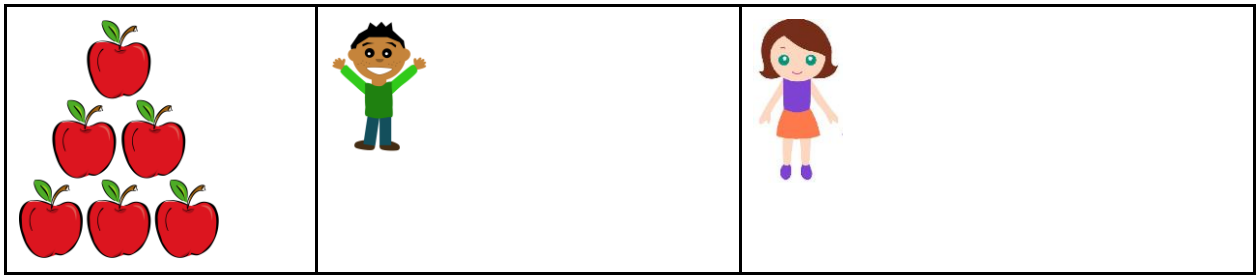
Double  is

Double  is 

Double  is

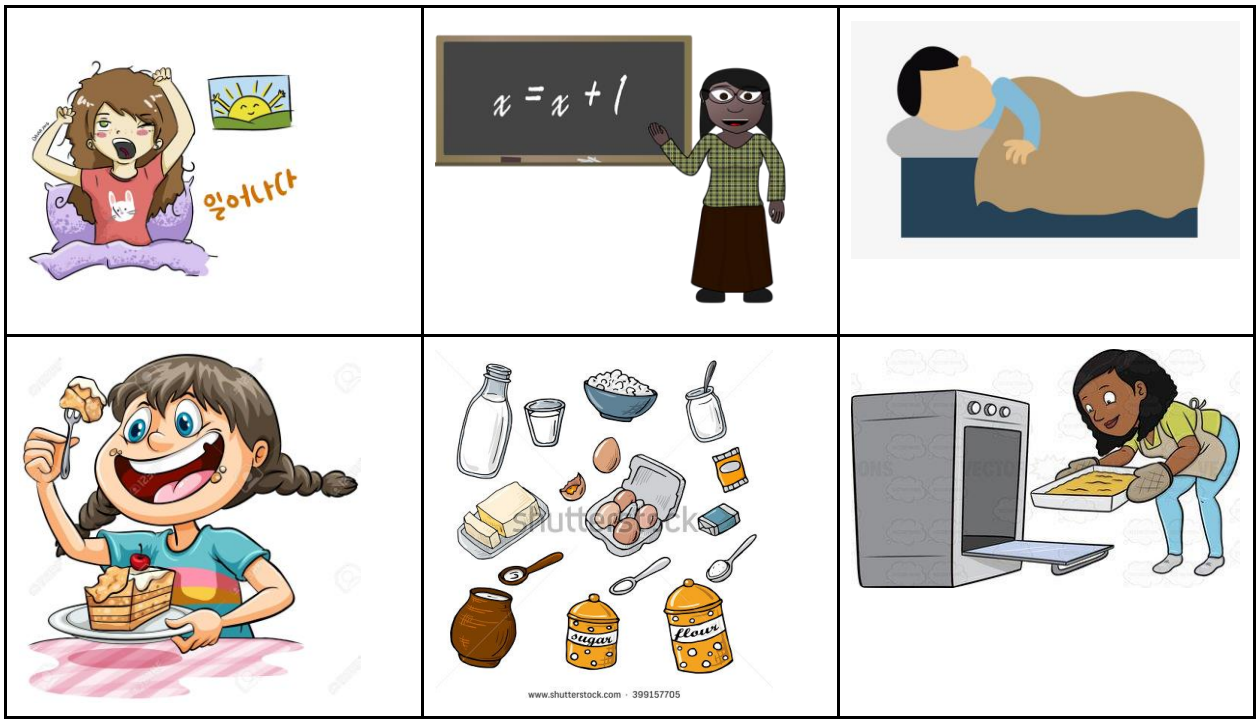
Share equally between the kids



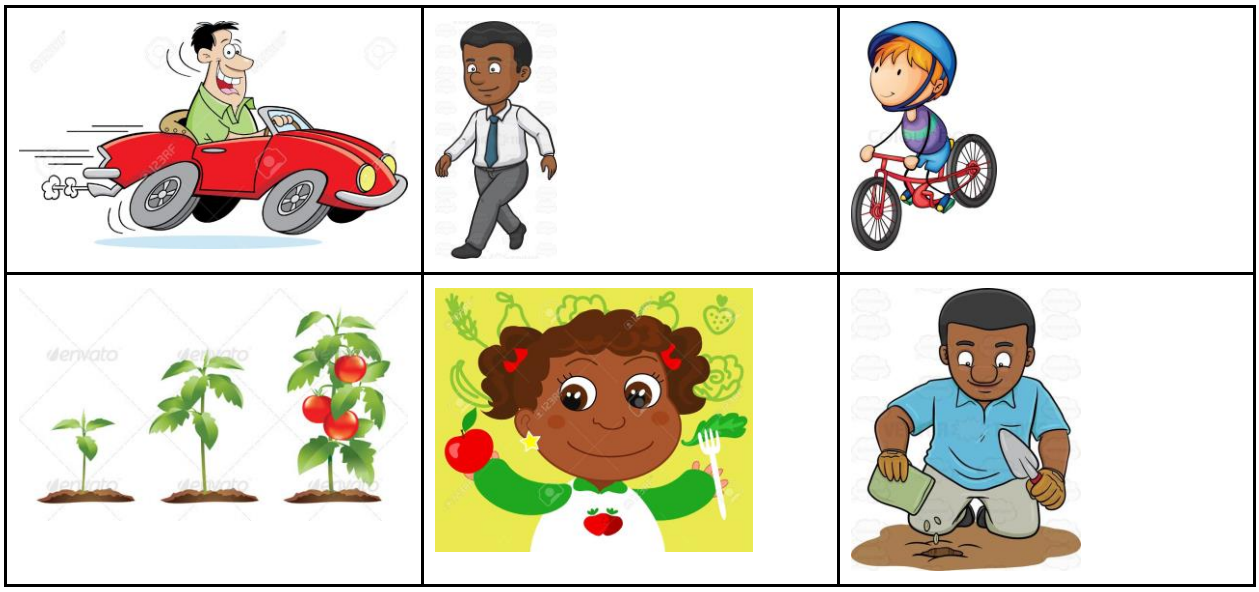


Worksheet 4: Time

Sort the following activities by numbering them in order:

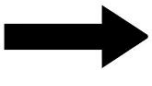


What takes the longest?



Worksheet 5: Direction

Circle which way the arrows are pointing?



Left / Right

Up / Down

Up / Down

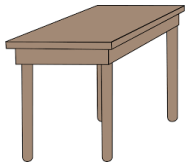
Left / Right

Where is the cat?

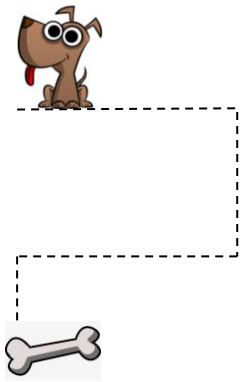
Inside / under

Where is the owl?

Behind / on top

Draw a  under a 

Help Spot find his bone by circling the direction he needs to go:

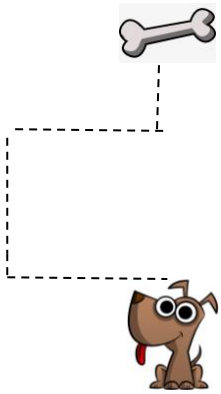


Left / Right

Up / Down

Left / Right

Up / Down



Up / Down

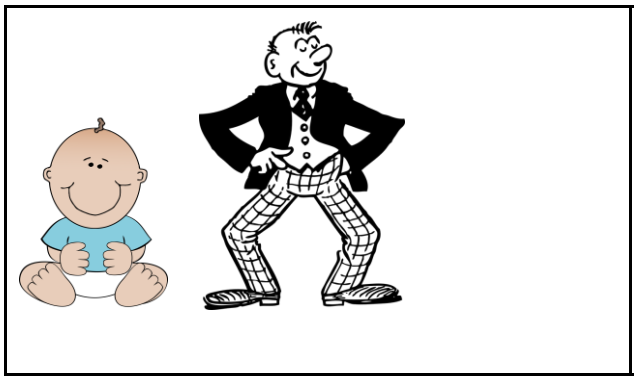
Left / Right

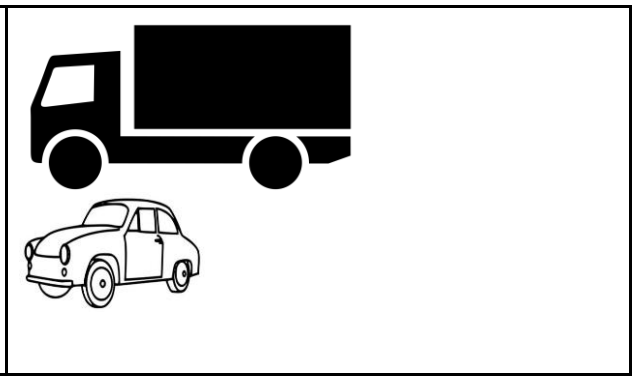
Up / Down

Left / Right

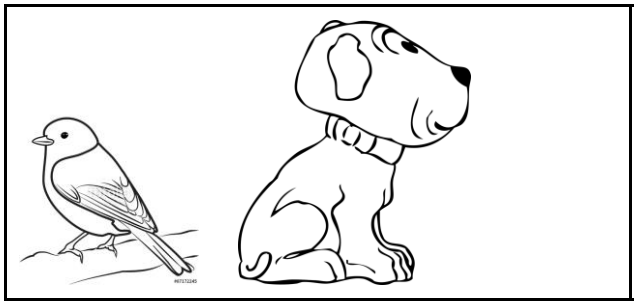
Worksheet 6: Bigger and smaller

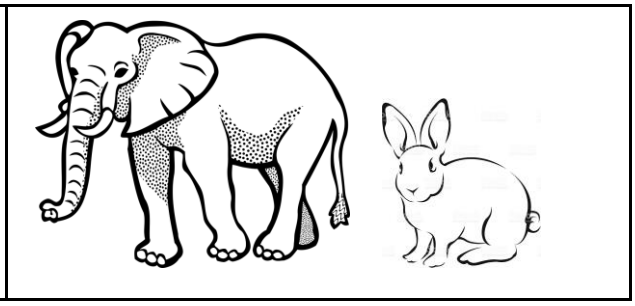
Circle the one that is bigger

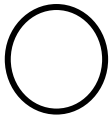




Circle the one that is smaller

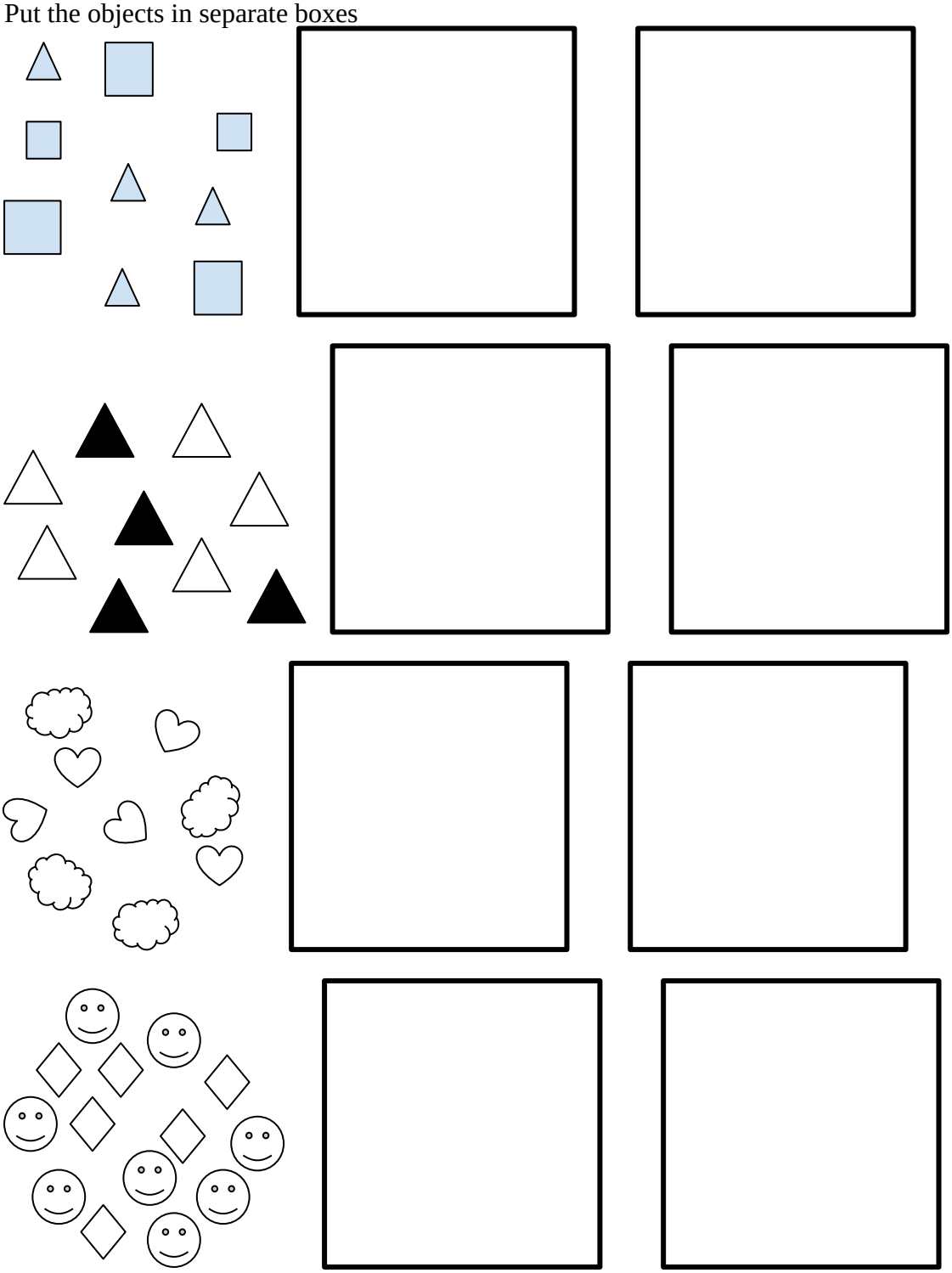




Draw a BIG  next to a small 

Worksheet 7: Sort objects

Put the objects in separate boxes



Worksheet 8: Days and Months

What month is it? Colour in the block. Draw yourself next to your birthday month.

	January	July	
	February	August	
	March	September	
	April	October	
	May	November	
	June	December	

What day is it? Draw a picture of what you like to do on Saturdays

Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

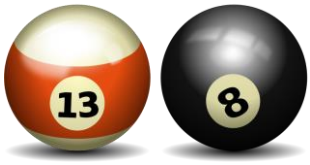
Appendix F

Post-Test

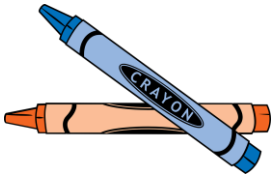
Post-test

Circle the **shorter** object

Circle the **longer** object

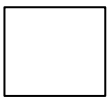
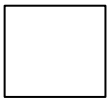


and  and  make

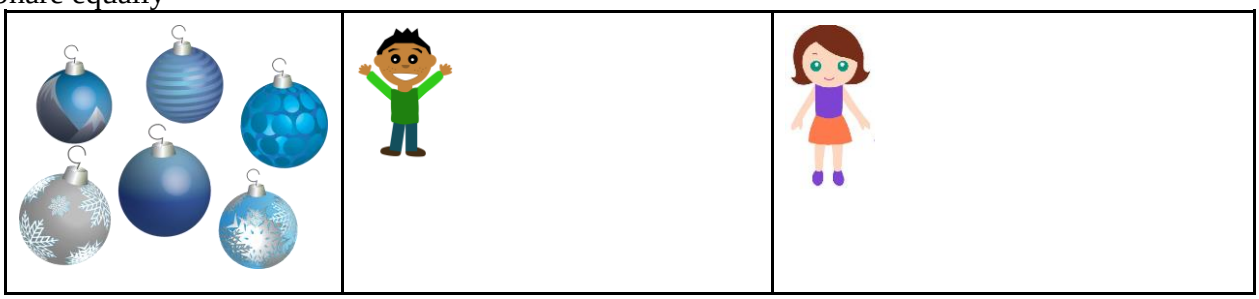


and make 

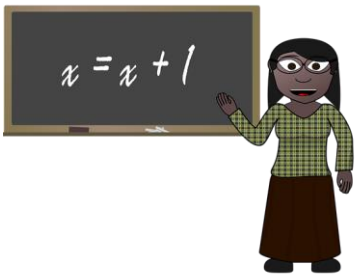
Double  is 

Double  is 

Share equally



Sort the activities in order

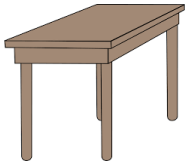


What takes the longest?

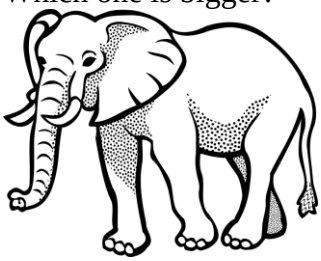
Which way is the arrow pointing?

Left / Right

Left / Right

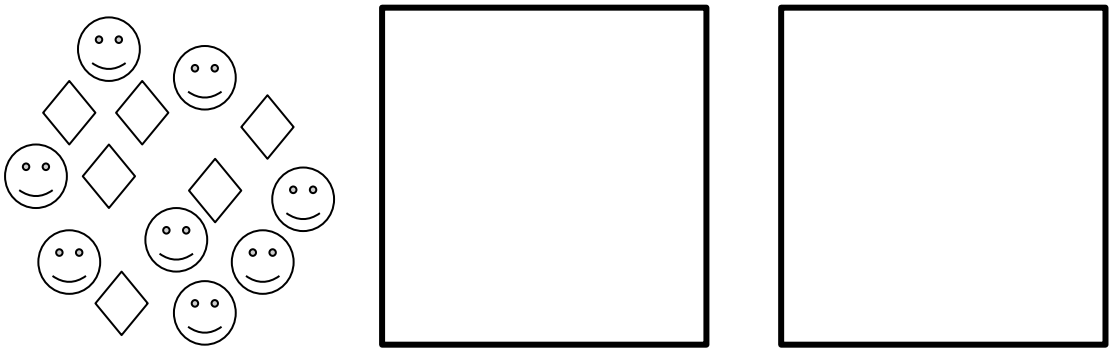
Draw a  left of a 

Which one is bigger?



Draw a BIG  next to a small 

Sort the objects into the boxes

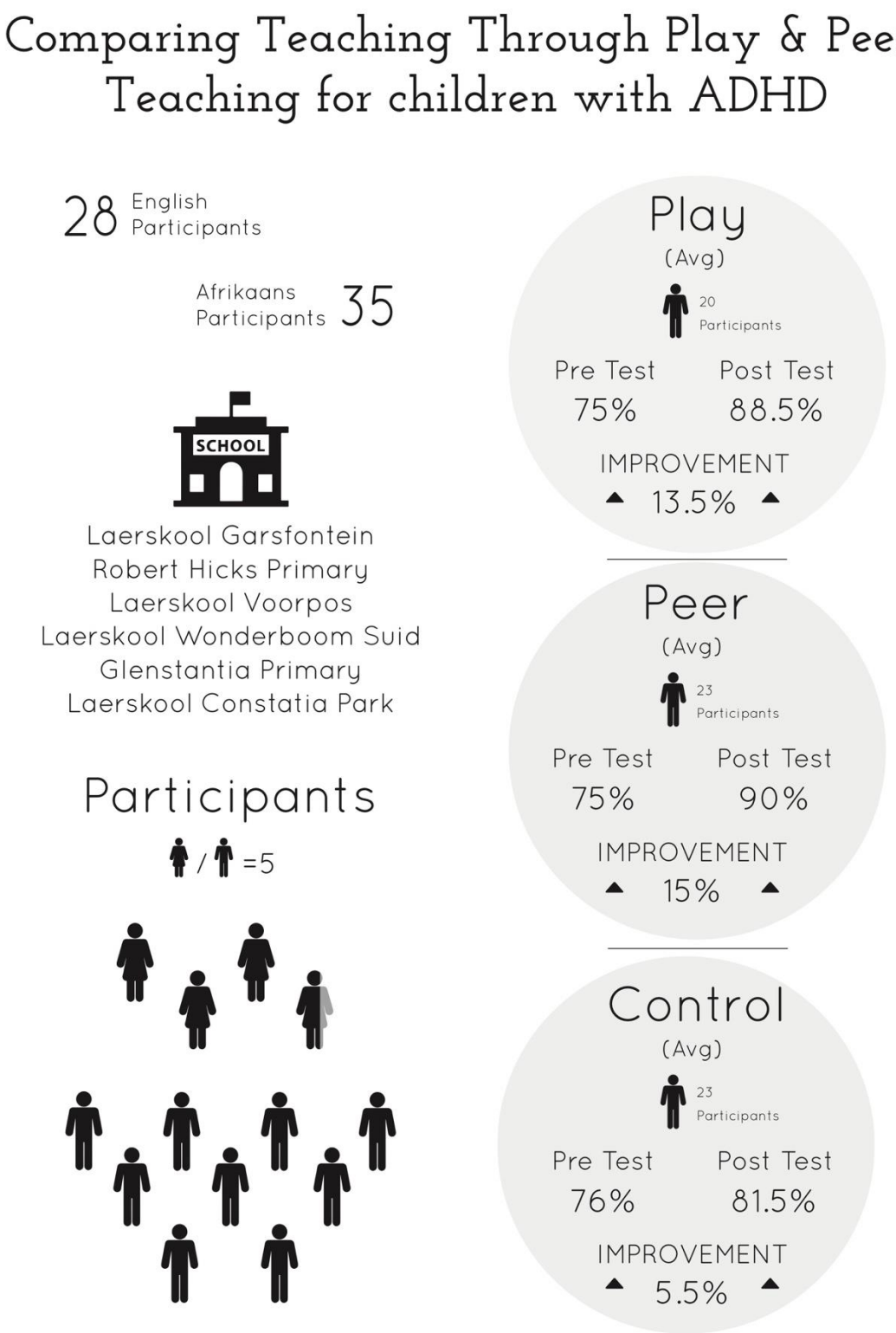


What day is it? Draw a picture of what you do on Fridays

Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

Appendix F

Results Sent to Parents



Appendix G

Procedures for Teaching Through Play

The following procedures were used for the first intervention group, teaching through play:

Week 1: Shorter and Longer

1. The participants are divided into groups of two to three depending on the number of participants.
2. Each participant receives a box with different objects in.
3. The first member in the group picks any object from the box and shows it to the other members.
4. The first member then says “shorter” or “longer”
5. The other members of the group then attempt to find an object in their own boxes that is either bigger or smaller than that of the first member.
6. The group members then compare their objects to determine if the objective of bigger or smaller was met.
7. A point is awarded to the team members that were correct in picking their objects.
8. The next group member then picks the first object, and instructs the other members to find something “bigger” or “smaller”
9. At the end of the game the points are added and a winner is appointed.

Week 2: Addition and Subtraction

1. Three baskets are set out at three different distances away from the participants.

2. Each basket is labelled with a different sum (+1, +2 and +3)
3. The participants line up behind a line drawn on the floor.
4. Each participant is given five balls.
5. The aim is to throw the ball into a basket.
6. If a ball is thrown into the +1 basket, the participant is awarded one additional point, in the +2 basket, the participant is awarded two additional points and so forth.
7. If the ball misses all the baskets the participant has to subtract one point from their score.
8. The baskets are placed relatively close to participants, as the aim is to add and subtract, and not to determine the aim of the participant.
9. Each participant is responsible for the calculation of their own score.
10. Once the game is complete all the participants calculate their scores and a winner is appointed.

Week 3: Double and Divide

1. A wheel is created with several different sections indicating either a double (x2, x3, etc.) or a divide (÷2, ÷3, etc.) a spinning arm is added.
2. The participants are divided into groups of two or three, each group with their own "math spin the wheel"
3. Each participant receives a container with a set amount of counters (marbles, beans, etc.)
4. Each participant takes a turn to spin the wheel and then performs the actions indicated by the spinning arm.
5. The other group members check that the actions have been done correctly.

6. If done correctly the participant is awarded a point, and the next participant has a turn.
7. The participants calculate their own scores and a winner is appointed.

Week 4: Time

1. Different pictures depicting various activities are printed onto small squares of paper, folded in half and placed in a box.
2. Two participants each select a paper from the box without showing the picture to anyone.
3. Each of the two participants is given the opportunity to act out the activity they selected from the box.
4. The other participants guess what activity is being performed.
5. Once the correct activities have been identified by the participants, they are asked to indicate which activity will take the most/least amount of time to complete.
6. Each participant is given the opportunity to pick an activity from the box and act it out.
7. Points are awarded to those that correctly identified each activity according to the time it takes to complete.
8. The participants calculate their own scores and a winner is appointed.

Week 5: Direction

1. The participants are divided into groups of two to three depending on the number of participants.

2. A “prize” is placed at one end of the room, the participants are at the other end of the room, and various obstacles like tables and chairs are placed in between the them prize and the participants.
3. Only a few obstacles are placed in the room, and moved around after each round, as the aim is to improve direction, and not to hurt any participants.
4. One participant from each group is blindfolded, while another is named the director.
5. The director attempts to direct the blindfolded participant to the prize by using commands such as left, right, back and forward.
6. The first group to reach the prize is awarded a point.
7. All participants are given the opportunity to direct as well as to be blindfolded.
8. Once everyone has had a chance, the group members calculate their scores and a winner is appointed.

Week 6: Bigger and Smaller

1. The participants are divided into groups of two to three depending on the number of participants.
2. Differently sized objects are placed into boxes. For example, various sized blocks, or balls.
3. The aim is for the participants to arrange the objects in the boxes from biggest to smallest or smallest to biggest.
4. Each group is given the same objects in their box.
5. The groups compete against each other to see who will complete the activity first.
6. The exercise is repeated with different objects.

7. Each team member is given the opportunity to be the leader of the group, to ensure equal participation from all group members.
8. Once everyone has had a chance, the group members calculate their scores and a winner is appointed.

Week 7: Sorting Objects

1. The participants are divided into groups of two to three depending on the number of participants.
2. Two different kinds of objects are placed into a box. For example, red and blue balls.
3. The aim is for participants to separate the objects into two separate boxes in the fastest possible way.
4. One member of each group competes against a member from the other groups at a time.
5. The group that sorts the objects correctly first, is awarded a point.
6. The activity is repeated until each participant has had the opportunity to compete against a member of another group.
7. Once everyone has had a chance, the group members calculate their scores and a winner is appointed.

Week 8: Months and Days

1. The participants are divided into groups of two to three depending on the number of participants.
2. Each group is given a set of cards containing the words Monday-Sunday.
3. The research has a set of cards, and then asks the groups questions, such as what day comes after Tuesday? Or what day is between Friday and Sunday?
4. Each group member goes head to head with a member from a different group, to ensure equal participation in the activities.
5. Each correct answer is awarded a point.
6. Each group is then given a set of cards with the words January-December printed on them.
7. The researcher then conducts another round of questions based on the months of the year.
8. Each group member goes head to head with a member from a different group, to ensure equal participation in the activities.
9. Each correct answer is awarded a point.
10. Once the questions have been completed the groups calculate their scores and the winner is appointed.

Appendix H

Procedures for Peer-Teaching

1. The participants are divided into groups of two or three, becoming study partners to one another.
2. Each week these groups are rearranged to ensure that the partners do not become overly comfortable with each other.
3. The researcher informs participants on the topic for the session.
4. The researcher discusses the information with one partner ensuring that the participant understands the topic and is able to use examples.
5. The first partner is then expected to relay this information to the other partner/s in whichever way they feel comfortable.
6. The process is then repeated with the other partner/s using the same topic but different examples.
7. Each additional class allowed both partners the opportunity to be the “teacher” as well as to be the “student”.
8. Throughout the session, the researcher controls the class to ensure that what they are teaching each other is accurate and in line with the theme.
9. Once all the partners have been given the chance to teach, the participants complete a worksheet on the topic.
10. During the completion of the worksheet, participants are encouraged to work with their partner/s and explain the answers to each other.

Appendix I

Ethical Clearance Certificate

Ref. No: PERC-17035

UNISA university of south africa
Department of Psychology

Ethical Clearance for M/D students: Research on human participants

The Ethics Committee of the Department of Psychology at Unisa has evaluated this research proposal for a Higher Degree in Psychology in light of appropriate ethical requirements, with special reference to the requirements of the Code of Conduct for Psychologists of the HPCSA and the Unisa Policy on Research Ethics.

Student Name: Vanessa Stratford **Student no.:** 61430390

Supervisor: Prof. Ilse Ferns **Affiliation:** Department of Psychology, Unisa

Title of project:

Comparison of teaching through play and peer teaching for children with ADHD

The proposal was evaluated for adherence to appropriate ethical standards as required by the Psychology Department of Unisa.

The application was approved by the departmental Ethics Committee on the understanding that –

- All ethical conditions related to voluntary participation, informed consent, anonymity, confidentiality of the information and the right to withdraw from the research must be explained to parents/guardians of the participants in a way that will be clearly understood;
- Any and all formal procedures that need to be followed to gain access to the participants and to obtain information for the purposes of research, as required by the relevant education authorities, will be adhered to;
- Signed letters of informed consent is to be obtained from the schools from which the participants are drawn, and from the parents/guardians of each of the pupils participating in the study.

Signed:

Prof P Kruger
[For the Ethics Committee]
[Department of Psychology, Unisa]

Date: 5 October 2017

Appendix J

Gauteng Department of Education Research Approval Letter

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE AMENDED RESEARCH APPROVAL LETTER

Date:	**17 April 2018**
Validity of Research Approval:	**05 February 2018 – 28 September 2018** **2017/272AA**
Name of Researcher:	**Startford V.**
Address of Researcher:	**181 Lisdogan Avenue**
	Arcadia
	Pretoria 0083
Telephone Number:	**072 575 3300**
Email address:	**Startford.nessa@gmail.com**
Research Topic:	**Comparison of teaching through play and peer-teaching for children with ADHD**
Type of Degree:	**MA Psychology (Research Consultation)**
Number and type of schools:	**Six Primary Schools**
District/s/HO	**Tshwane East and Tshwane Central**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

23/04/2018

1

Making education a societal priority

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

1. *The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
4. *A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
5. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
6. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
7. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
8. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
9. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
10. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
11. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
12. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
13. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
14. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

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Ms Faith Tshabalala
CES: Education Research and Knowledge Management

DATE: 23/04/2018

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